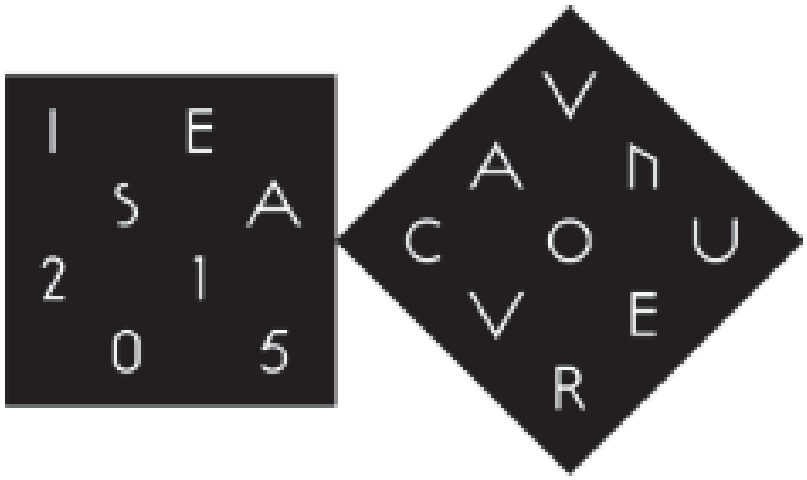

ISEA2015
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PROCEEDINGS

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INTERNATIONAL

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Introduction to the ISEA2015 Proceedings

Thecla Schiphorst & Philippe Pasquier

Computerization of society is ongoing, and digital media are the main communication and expression vehicles of our times. We live in a world saturated with electronic devices, that we literally spend a third of our awaken life on.

– Where does this lead us when it comes to culture, art, and their making?

– How does that influence the ways we make art?

– What is electronic art and how can it change the world?

Since its first edition in 1988, the International Symposium on Electronic Art has been focussing on the impact of technology on art making, and the impact of art on technology, techno-science and society at large.

ISEA2015 proceedings are no exception, and gather 184 contributions: 29 extended abstracts (2 pages) 79 short papers (4 pages) and 76 long ones (8 pages) grouped in 43 sessions. These sessions are the answers from the community to our call for papers under the overarching theme of disruption. Sessions span topics ranging from global warming, geopolitics, bio-art, generative systems and computer-brain interfaces. All these critical aspects of our societies are looked at through the lens of electronic art, and its disruptive potential.

ISEA2015 Symposium Directors

Thecla Schiphorst & Philippe Pasquier

[Session 1]

Climate Change

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Hyperdressing: Wearable Technology in the Time of Global Warming

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Abstract

"Hyperdressing" is inspired by the writings of Timothy Morton and his concepts hyperobjects and ecological thought. This paper views the evolution of wearable technologies in terms of both dressing and environmental awareness. Historically, dressing has always been bound up with technology. Ideas, behaviors, and materials come together on our bodies so as to administer to our human condition. Since the rise of capitalism, the dominant paradigm for dressing has been fashion. And fashion is one of the premises driving current wearable technology trends. The others are ubiquitous computing, affective computing, our innate yearning for perfection, and the Quantified Self. Sleek products like Google Glass offer both style and enhancement: a framing of reality as expanding information brought under our control and tailored to our wants. But the paper describes an alternative view of wearable technology that presumes a world increasingly beyond our control. As technology changes, dressing now undergoes a slow, steady disruption—a transformation from the fashion paradigm that serves individual self or self-identity, to a next phase. Will future dressing accessorize a Quantified Self based in biometric devices that accelerate environmental waste? Or might we dress for greater intimacy and openness amid overpowering natural forces and hyperobjects?

Keywords

Biometrics, Body, Dressing, Environment, Fashion, Hyperobjects, Quantified Self, Wearable Technology, Ubiquitous Computing

Introduction

My title is inspired by the philosophical/ecological writings of Timothy Morton. In several books, including his 2010 *The Ecological Thought* and his 2013 *Hyperobjects*, Morton writes that hyperobjects are giant physical and social systems that engulf us but cannot be completely perceived—like global warming or capitalism. We (humans) are objects among countless numbers of objects, some material and some not, comprising a mesh of phenomena and relations that impinge upon us. [1] My use of the term "hyperdressing," in light of Morton's ideas, is (admittedly) hyperbole—somewhat metaphorical, but based on the fact that dressing in any era comprises beliefs, behaviors, and a vast range of objects and technologies arrayed on our bodies that express our awareness of our condition. Since the rise of capitalism, the dominant paradigm for dressing has been fashion. I hope to show that our behavior of dressing now is undergoing a slow but steady disruption—a transformation from the paradigm of fashion expressing individual self or self identity, to a next phase: clothing and equipping a "no-self," a condition of far greater intimacy with a vast array of objects (including what we archaically call beings). This state of intimacy within interobjectivity is illustrated for Morton by the photographer Judy Natal's *Future Perfect: Steam Portrait #28*, about which he says: "The uncanny nothingness of the cloud forces the viewer into a disturbing intimacy with the clothed figure" (Fig 1). The role of technologies that are worn on the body, amid our emerging awareness of such disturbing intimacies, is a subject of this paper.

Figure 1. Judy Natal, *Future Perfect: Steam Portrait #28*. © Judy Natal 2012, as illustrated in Morton, *Hyperobjects*, p. 96.

Although the total *gestalt* of hyperobjects is by definition not perceptible, usually due to their expansiveness and pervasiveness, they evidence themselves through traumatic events and measurable changes that take place over time. In the case of dressing (behavior that responds to the relations or perceived relations between our bodies and other "objects" in our environment) there are two drivers of accelerating change: (1) dressing's historical ability to absorb and embody technologies including its role in the current race toward wearable technologies; and (2) the counterforce of ecological and environmental realities.

Dress and Technology

In my recent study of dress and technology, *Garments of Paradise: Wearable Discourse in the Digital Age*, I argue that historians and archeologists have always considered garments to be among the technological advancements of civilizations since ancient times. [2] Dress is a technology, something that absorbs the latest discoveries and incorporates ever better solutions for our physical and psychological needs. Part of the technological boundupedness of dress is its ability to manifest our cravings for physical enhancement, to launch abilities beyond our bodies.

Historically, from providing warmth and advantages in battle to facilitating sexual reproduction and social selection, technologies have adapted to the body to allow us to become (or imagine becoming) more agile and powerful, more sexual and desirable (e.g., the attention to sleekness was aided by the development of synthetic fibers in the early twentieth century), or more or less noticeable—I have written elsewhere about our ancient and ongoing wish for invisibility, something I will come back to in a moment. During the first half of the previous century, driven by two world wars and the rhetoric of eugenics, our popular imaginations were filled with powerfully dressed superheroes, often with garments or gadgets enabling enhanced strength, vision, speed, even the ability to fly (early super clothes or adornments appear from Batman to Green Lantern). The actual technologies to bring about such fantasies would be generated by the electronic devices developed only after World War II, with strides in computing power and miniaturization. For example, the notorious SONY Walkman, introduced in 1979, spawned generations of mobile (wearable) entertainment products. By the end of the last century we explored the fantasy of merging with machines: bionic superheroes, fictional cyborgs, and finally the first actual wearable computers.

Those began to be developed in the 1990s at centers like the MIT Media Lab, Carnegie Mellon, and Georgia Tech in the U.S. The early, geeky, hard-box wearable computers were complicated and expensive, and start-up companies like Charmed Technologies, that tried to forge a market for them, by presenting them as fashion, had an uphill climb. As Maggie Orth, wearable technology designer and founder of International Fashion Machines observed, clothing lines in the nineties were interested in garments that lit up or responded to the wearer with functioning electronics. Once an electronic module was tooled, hundreds of thousands had to be sold to create a profit, whereas clothing producers projected on a scale of tens of thousands of units because of the scope and rapid turnover of the fashion industry. One popular wearable tech (henceforth WT) item in the nineties was LA Gear's Lights sneakers. With LEDs in the heels that flashed with the pressure of heal strikes, the Lights sold over five million pairs and became iconic, if isolated, evidence of industry's aspirations for WT. But aspirations outraced abilities. Breakthroughs for marketable WT came slowly and were rarely adopted by mainstream dressing. Despite many campaigns for WT products, only illuminated garments received much attention. 2008-10 were banner years for LED couture, a short-lived red carpet trend in the midst of the economic downturn. But with the rise of social media accessed through mobile phones, in the past few years it has been devices rather than garments that have evolved to display sophisticated design and are marketed in tune with digital capitalism. Watches and other wearables, most notably Google's Glass, have leveraged the accomplishments of hand-held phones and their systems to mete out the enhancements we crave—instantaneous memory access, communication, and security (albeit in the form of surveillance). Through it all has been the steady growth in health monitoring systems, long strapped onto bodies in the medical environment, but now walking the streets. In the 2010s, Fitbits and related devices have become accessories of choice, by which we constantly measure our personal progress or decline.

Our sleek new devices now take on the very issue of dress itself. If, as Orth points out, wearable electronics are far more instrumentalized than fashionable dress, then they support a more computational and socially monitored perception of ourselves than does traditional fashion that changes season-by-season. So is dress itself changing in concert with the evolving manner in which we relate to the world and each other? Is dress gravitating toward something akin to the literary and social utopian dress posited by early modernism? Vladimir Tatlin's unisex worker's clothing, or the uniforms in nearly all modernist wonderlands, from Thomas More's *Utopia* (1516), to Alexsander Bogdanov's sci fi novel *Red Star* (1908, about a socialist utopia on Mars), George Orwell's *1984* (1934), and even Mao Zedong's Chinese Cultural Revolution (beginning in 1966) all advocated functional universal dress, often blocky suits or overalls with little or no difference between individuals. In support of this, some point to the recent rise of "normcore"—bland, anti-fashion attire—the latest trend for plain traditional clothes that fade to black as we focus on our devices. In the Google-Apple version of future dress, our sleekly designed enhancements signal that individuality is inside, or invisible, or dispersed across a wider net. Our bodies and social lives are endlessly attended to, but will our reliance on walk-in

closets fade away? As early as 1964 Marshall McLuhan (like other modernists before him) suggested that societies developing electronic media would adopt nudity—might he be right after all? [3]

Dress, Technology, and Environmental Impact

So far there is no sign that the fashion industry is in jeopardy; it adapts. In the twenty-first century, under accelerated post-industrial capitalism and aided by markets' increasing ability to exploit dress's psychological potential through brand imaging and social media (YouTube and blog posts of "beauty gurus"), we have fast fashion—cheap outsourced gobs of garments with incredibly rapid obsolescence. The term "landfill fashion" has been used for the trendy, low-cost garments of certain fashion chains serving consumers with shrinking attention spans facing an increasing vastness of choices, and sourced from expanding factories turning out fast fashion in China and Viet Nam—and Bangladesh, until the appalling factory collapse in 2013. [4] Mountains of cast-off clothes pass to thrift stores and are carted to postconsumer sorting facilities where about 30% of it is recycled, and the rest baled for export to developing nations. Most of it becomes garbage, contributing to escalating dumpsites, and trash islands in nearly every ocean. The presence of toxic chemicals, fire retardants, dyes made of heavy metals, and petroleum and other toxic processing agents in synthetic fibers make this trash lethal.

By the same token, the amount of electronic devices and components, increasing exponentially in accordance with Moore's Law, is also creating vast piles of garbage. According to the U.S. EPA, in 2000 4.6 million tons of e-waste—discarded electronics and components that include toxic chemicals that leach into land over time or are released into the atmosphere—ended up in landfills in the U.S. CBS News reported in 2013 that 50 million tons of e-waste per year were sent to dumps. A 2013 United Nations study estimated that e-waste would grow from 48.9 million metric tons worldwide in 2012 to 65.4 million metric tons in 2017. The numbers do not all coordinate precisely, but by all accounts they are astronomical. [5]

As we consider the potential expansion of WT as mobile devices, based on the heated market in the past few years, we might imagine two enormous flows of toxic trash converging. E-textiles, including nanoparticle-coated fibers, present upwardly scaling challenges that we have barely begun to study. As fashion-based WT grows, we can project a situation that compares figuratively with Walter Benjamin's image of the "Angel of History" (based on Paul Klee's 1920 painting, *Angelus Novus*):

> [The angel's] eyes are staring, his mouth is open, his wings are spread. This is how one pictures the angel of history. His face is turned towards the past. Where we perceive a chain of events, he sees one single catastrophe which keeps piling wreckage upon wreckage . . . A storm is blowing from Paradise . . . The storm irresistibly propels him into the future to which his back is turned, while the pile of debris before him grows skyward. This storm is what we call progress. [6]

But now the piles of debris are real, not imagery—they are toxic, and the angel is us.

Invisible Computing and WT

The backward vision presented by Benjamin also portrays our fundamentally flawed perception of a situation beyond our reach. Timothy Morton describes this as the ontological asymmetry between humans and nonhumans in a time of hyperobjects. Global warming (Morton rejects the polite term, climate change) already engulfs us—we cannot recycle our way out it: "we discover that the space we inhabit is not open and neutral, but is the interior of a gigantic iceberg whose seeming transparency was simply a matter of our less than adequate eyes. Flying through the universe in the space shuttle of modernity, . . . we have woken up inside an object, like a movie about being buried alive." [7] Our eyes are already asymmetrical with our bodies, which are entangled with the world of objects.

As an iconic example of WT (at least a great creator of buzz), Google's Glass forms a case study of how we seek to control and manipulate our vision (Fig. 2). A culmination of techno dreams of physical and mental enhancements, Glass offers us immediacy of information access and communication, and power over our physical contexts via its camera and GPS, all packaged in a heads-up, hands-free accessory that can imitate glasses or accommodate the most stylish frames. Of course, power works both ways, and alongside the privacy concerns that were raised are possible health and environmental hazards from Glass's micro-wave emissions, and impacts on vision such as binocular rivalry, visual interference, and phoria, a latent deviation or misalignment occurring when both eyes are not looking at the same thing. [8] But Glass also fictionalizes reality by asserting that we are in control of all that we see. The chaos of the world is reorganized

Figure 2. Google Glass, simulated view of data "timeline" overlaid on normal view. Google photo.

through the data overlay. Why fear climate change when we can call up statistical forecasts and chart a safe course? As Morton says, it is not as easy as that. "The more data we have about hyperobjects the less we know." [9]

Like almost all the prototypes for industrially produced WT today, Glass was built on the assumptions of ubiquitous computing, a term coined by Mark Weiser in 1980s. Weiser's fundamental principle was technology's drive to disappear. In a talk given at Xerox PARC in 1994 he said, "Good technology is invisible . . . ubiquitous computing is about 'invisible' computing." [10] Weiser envisioned ubiquitous technology (ubicomp) as augmentation, a way of being in the world, and the opposite of virtual reality, which involved withdrawal from the world. He imagined ubiquitous technology would become the natural and empowered way to deal with the overwhelming realities around us, release us from the stresses of information overload. It would calm us down.

Weiser was a thoughtful techno-scientist, but his untimely death in 1999 prevented the evolution of his ideas and any reassessments he might have made as technologies advanced. Instead of being improved or re-evaluated, Weiser's calm world of augmented reality became the norm for developers. In 1997 Rosalind Picard presented the concept of affective computing whereby devices that read our biometrics activate on our behalf, allowing computers to become more invisible still, operating on their own around us. Most technology that interfaces with our bodies, developed since that time, has sought this holy grail of "intuitiveness" by making the computational interface seem like it is a seamless part of us, that we are invisibly enhanced and at the center of our world. The model of invisible control trades on our age-old desire to leap beyond the limitations of our bodies and effortlessly navigate our complex environments free of stress. And so the market for these devices has accelerated like a runaway train.

But as Morton points out, the very notion of our "world" is itself a concept that we create and believe in. Our belief is "a token, a mental object that you grip as hard as possible, like your wallet or your keys." Nothing is more manufactured than the smooth, controllable data flows that Glass or even our smart phones offer as part of our personal vision. Nevertheless, the very scale of what we experience at this time—extreme weather, Big Data, and violent social upheavals—means that cracks in our world-view, no matter how enhanced, arise with increasing frequency. Morton writes, "*World* is a fragile aesthetic effect whose corners we are beginning to see." [11]

Asymmetrical WT

On the other side, there are artists and designers who work with electronics and garments in order to dramatize our smallness and our potential for intimacy amid the uncontrollable objects around us. Take Ricardo O'Nascimento, Ebru Kurbak, and Fabiana Shizue's *Taiknam Hat* (2007), with feathers that levitate in the presence of EMF waves. The hat materializes the invisible and dramatizes our engulfment in electromagnetic radiation in our environment emitted by our physical devices. This unseen electrosmog is an object with biological effects on humans and animals.

The WT created by Canadian designer Joanna Berzowska provides us with more examples. Rather than perpetuating modernist fictions of enhancement and control, her one-of-a-kind wired-up wearables display the "otherness" of technology, an effect rendered uncanny when worn on the body. Her work deploys not merely representation or metaphor, but reveals our asymmetrical relationship with an object world that impinges upon and, indeed, infuses us.

At Concordia University in Montreal, Berzowska collaborated with Di Mainstone on *Skorpions* (2007), five electronic garments that integrate Nitinol (a shape memory alloy or SMA), mechanical actuators such as magnets, soft electronic circuits, and traditional textile construction techniques such as sculptural folds and drapes of fabric (Figs. 3-4). *Skorpions* move and change on the body, controlled by their own internal programming.

Figures 3-4. Joanna Berzowska and Di Mainstone, *Skwrath* and *Luttergill* from Skorpions, 2007. Photo Nico Stinghe. ©XS Labs

The series was intended to explore an adversarial relationship with technology, how we sometimes fear it, and how, in opposition to the perfection technology is supposed to represent, it is ultimately unpredictable. The *Skorpion* garments do not create sound or light up, nor do they augment the wearer's abilities—rather the opposite. They slide around the wearer's body on their own like live skins or animals, opening pulsating gashes like breathing gills. Rather than embodying function, they malfunction—as if as clothes they are not just consumed, but "possessed," and threaten to possess us. *Skorpions* exploit characteristics such as anticipation, anxiety, and surprise.

The *Skorpions* have a feral nature and the series pays homage to their formidable namesake arthropod and its elegant but deadly tail. The dress called *Skwrath* ("Skorpion wrath") has an abdomen made up of three insectile, interlocking leather segments, embroidered with threads of SMA, which are activated through a custom electronic board to curl back, revealing slashes of red silk. *Skwrath* warns people to stand back. When they get too close, its plates crawl and retract, and red silk suggests blood. In contrast, *Luttergill* is a soft, quilted cotton cocoon. Its seams roll open and closed, controlled through SMA and custom electronics, revealing serene blue silk inside. As garments, *Skorpions* revisit Donna Haraway's notions about "companion species" by animating digital technology and wrapping us in its uncontrollable interface. Berzowska refers to such pieces as "reactive garments": rather than responding to us and administering to some perceived need, as with affective computing, we, as wearers, react to what we are wearing. She says, "My work . . . undermines our expectations about technology. These works are not meant to solve problems but pose questions about how design might operate." [12]

Berzowska's *Sticky* (from the group, *Captain Electric and Battery Boy*) revives the 1930s superhero, whose garments performed futuristic powers, and responds to the modernist eugenics fantasy with a human enhancement farce about electricity generated by the human body. *Sticky* is a hooded leather dress with sleeves tethered to shells on the abdomen such that the wearer must strain to move (Figs. 5-6). "*Sticky* binds the arms, restricting their motion, keeping them close to the body. It coerces the body into a state of isolation. Attempts to free oneself from the

Figures 5-6. Joanna Berzowska, *Sticky*, from *Captain Electric and Battery Boy*, 2007-10. Photo Guillaume Pelletier. © XS Labs.

restraints, by reaching away from the body, generate energy to soft luminescent blue pebbles in the pockets . . . concealed silicone forms [which offer] a comforting glow" that persists after the wearer has stopped struggling. [13] The "pocket pebbles" are warm, tactile objects similar to "calming stones," providing an unexpected spoof on Mark Weiser's notion of "calm technology."

In the above designs, the goal of augmentation or enhancement sought by builders of wearable computers and personal area network systems is entirely overthrown and replaced by non-product-based, experimental or ironic design that is highly coded but references the world of dress and culture as well as technology. These wearables are not only commercially unfeasible, but preposterous, even comic.

Some designers of ironic technological clothes focus on the external relationships between wearers and their environment (Figs. 7-8). Diffus Design's *Climate Dress* (Michel Guglielmi and Hanne Louise Johannesen), uses conductive thread embroidery, LilyPad Arduino, sensor, and LEDs. It illuminates in accordance with CO2 concentrations in the ambient air, so the dress is a platform for environmental awareness, pitting beauty against health or against the environment: the more carbon emissions, the more the radiant the dress becomes. What better reminder that beauty resides alongside immanent danger in hyperobjects?

Figures 7-8. Diffuse Design (Hanne-Louise Johannsen and Michel Guglielmi), Climate Dress, 2009. Courtesy Diffus Design.

Capitalism and the "Empire of Fashion"

Turning back to the evolution of industrially produced wearables, it is clear that the dynamics between bodies and environments are changing. Environments include the larger context of dressing, too, and that includes fashion, the dominant dressing paradigm since the industrial revolution. Fashion is the essential expression of modern, democratic societies. What French social philosopher Gilles Lipovetsky called *The Empire of Fashion* (1987) operated at the level of civic behavior. He argued that mass-produced fashion offers nuances of choice and

symbolism, which in turn enable consumers to behave as complex individuals within democratic societies: "Fashion is one of the faces of modern artifice, of the effort of human beings to make themselves masters of the conditions of their own existence." [14] Moreover, Lipovetsky writes that modern democracies are structured by fashion, meaning that taste in dress (among other things) navigates media and information and nurtures an essential skill set for individuals.

In the 1990s Lipovetsky updated the text, adding that the "logic of appearances" had moved from dress to the body, and prestige based on distinctions of dress was ebbing in favor of skin-based display involving tattoos, body-building regimens, and plastic surgery. Today, body-based enhancements coordinate with the growing interest in health monitoring systems and in the self as a physical project—monitoring will improve our exercise, weight loss, and sleep habits in a never-ending process of perpetual training, what Gilles Deleuze placed at the heart of "Societies of Control." [15] In fact, we acquiesce to the never-ending programming and retraining regimens in continuous cycles of self-improvement that are never complete but must be constantly maintained.

Quantified Self Vs. "No-Self"

The WT industry has leveraged itself on our intense fixation with ourselves as bundles of flesh and functions that are increasingly monitored and measured, a movement termed the Quantified Self (QS) by Gary Wolf in 2007. [16] The proliferation of health monitoring devices drives expectations for WT. In 2013 *Forbes* predicted 2014 as the "Year of the Wearable" and a year later Gartner Market Research reported that personal health and fitness devices would be a five billion dollar market by 2016. [17] The problem is, the more data we generate about ourselves, the more data we encounter, and the larger the task of maintaining systems, training plans, and upgrades, all seeming to manifest control society beyond even Deleuze's wildest dreams.

If this is a trend it seems likely that devices will eventually challenge our notion of dress as based in the practices of making choices (Lipovetsky), and move toward a different paradigm based on analyzing biometrics. And the possibilities are expanding. Already, a macabre chronometer watch called Tikker, from a start-up company crowdfunded in 2013, calculates its wearer's life expectancy and proceeds to count down to her projected time of death.

Some, like Dawn Nafus and Jamie Sherman, view the emergence of the QS-as-driver-of-wearable-devices as a dialectical response to universal corporate control represented by Big Data. They write that self-monitoring via wearable biometric devices, while still a part of the reach of Big Data, constitutes a "soft resistance" by which individuals retain the possibility to evaluate the data they receive and choose how they deploy it. While the devices' algorithms programmatically analyze data according to corporate categories and the marketing goals behind them, users work through "the constant unfolding of meaning to critically question what constitutes relevant information, whether individual datapoints or entire categories of information." But in the end the independence of the user is limited, and Nafus and Sherman concede that "self-trackers are making a lateral move," working both beyond and within received categories. [18] Even a wearable like Glass, that attempts to control the intersection between biometrics and Big Data, offers a framed experience that is always pointed toward us. That is what customizing algorithms do. Glass "fits" Big Data to us, just as fitness bands and health devices also put us at the center of data and "tailor" it to us. It is sartorial, fitted to our desires—the ultimate custom couture.

Morton talks about our frequent encounters with massive amounts of data as an indicator that we—humans—are becoming more aware of hyperobjects and our inability to truly measure them due to their vastness in time and space and their ability to both "stick to" us and, at the same time, withdraw. Global warming is like that and so is Big Data. Data sticks to us through our wearable devices yet we can never finally grasp it all. We deal with greater and greater scales of things. For Morton what is occurring is "the gradual realization by humans that they are not running the show, at the very moment of their most powerful technical mastery on a planetary scale." [19] Morton points to possibilities other than mastery. He references the philosopher Derek Parfit's idea of "no-self,": "a liberating abandonment of dominating self-interest." Parfit writes, "[Before,] I seemed imprisoned in myself . . . I now live in the open air. There is still a difference between my life and the lives of other people, but that difference is less. Other people are closer. I am less concerned about the rest of my own life and more concerned about the lives of others." [20] This "no-self" is not self-obliteration and not dehumanization (as the Quantified Self appears to be) but a "radical encounter with intimacy." Unlike Tikker, that tracks our progress toward death, hyperobjects force a closeness with mortality, with other beings and objects, and with the unknowable. And according to Morton, "Intimacy and the no-self view come together in ecological awareness." [21]

One means of becoming open to the reality of our condition might be by accessing cognition via aesthetics—actually a particular aesthetic Morton characterizes as demonic or uncanny, that incorporates the "terrifying glimpse" of, say, ghosts, "a glimpse that makes one's physicality resonate"—and he references Adorno's comment that the primordial aesthetic experience is goose bumps. [22] This physical glimpse supports a sense of intimacy, even of being "too close" to other life and other objects—and the life in other objects.

I will always remember an early childhood nightmare from which I awoke in a sweat. In the dream, a familiar floor lamp with a bare electrical bulb moved toward me in my bedroom. It reminds me of some early artistic uses of wearable technology, like Atsuko Tanaka's *Electric Dress*

(1956), which appeared as a giant pile of light bulbs, replete with tangled wiring, moving toward the audience in the performance space (Fig. 9). The bizarreness of the experience was felt even more by the artist who wore the "dress" and contemplated electrocution. Tanaka told an interviewer "I had a fleeting thought, is this how a death-row inmate would feel?" [23]

Feeling unsafe around technology is a feature of our imbrication in a world of forces that we try to push into the background. The "uncanny" brings about both an aesthetic closeness (not aesthetic distance) and an openness that Morton calls rest. Rest is an aesthetic event reflected in Tanaka's work. Rest-as-aesthetic includes (according to Morton) shock, stunned silence, and an attunement to the not human. If we compare Morton's concept of "rest" to Mark Weiser's notion of "calm" (as in calm technology) that has been the driving conceptual premise behind capitalist technological evolution, we find the two notions, linguistically so close (synonyms for Roget), are opposites. Weiser's calm technology, as he wrote about it in the 1990s, involved the fact that when we focus on anything—

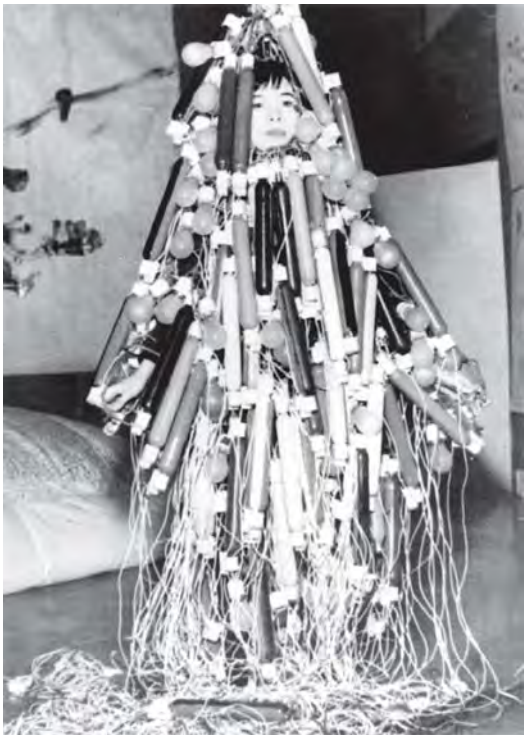

Figure 9. Atsuko Tanaka, *Electric Dress*, performed at the 2nd Gutai Art Exhibition, 1956. © Ryoki Ito. Photos © The former members of the Gutai Art Association.

driving a car is the example he used—we also notice things that happen on the periphery, like a child playing in the passenger seat. True calmness involves effective mastery of the movement between focus and periphery to achieve a sense of our locatedness. For Weiser, the job for a technology is master center/periphery such that users remain aware, but can focus on what they want: "As we learn to design calm technology, we will enrich not only our space of artifacts, but also our opportunities for being with other people. Thus may design of calm technology come to play a central role in a more humanly empowered twenty-first century." [24]

Since Weiser wrote that in 1995 technology design has changed. First, interaction is increasingly treated not as something to be eradicated but rather as a sensually appealing experience that attracts us. [25] Second, this experience has expanded opportunities for brandedness and more sophisticated tools that direct users' actions more effectively, rather than (as Weiser envisioned) enhancing user awareness. Simon Penny notes the recent development of ubiquitous computing on two fronts: (1) the still invisible: "clandestine, faceless technologies that involve distributed units in a larger control array . . ," and (2) "garrulous, clingy technologies close to the body"—encompassing WT that has commercially come of age. Penny finds neither of these trends particularly calming: "how far have we come . . . is the automated processing of logical operations necessarily applicable and an asset in every aspect of life?" [26]

On the other hand, rest or restfulness within the context of hyperobjects is not about human empowerment, but the opposite. Hyperobjects is of course not a technical term, but for Morton it is applicable to the technological age, which is also the age of global warming and events and objects that overwhelm us. The kind of rest he refers to is not safe and does not provide the illusion of security, but rather the acceptance of coexistence. He cites John Keats, who wrote about the poet as a spirit that has no self, but absorbs everything around him—Keats called himself a "Camelion Poet" [*sic*]. [28] If we happen one day to be overcome by environmental trauma, or, for whatever reason, we find ourselves catapulted beyond our capitalist behavior and reliance on technologies of control, then perhaps our future dressing might become hyperdressing. It would involve accepting our asymmetrical existence and, chameleon-like, becoming intimate in the time of hyperobjects.

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Turbulent World: An Artwork Indicating the Impact of Climate Change

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Abstract

This paper describes an artwork created in response to a question about the role of the artist in communicating climate change issues. The artwork, titled *Turbulent World*, incorporates turbulence and surprise as a means to visualize the potential instability of our culture and the environment due to climatic changes indicated by increased worldwide temperatures. The artwork makes use of a custom fluid engine that can represent any amount of turbulence and energy. A dataset encoding a simulation of rising surface-air temperatures over the next century is mapped to the turbulence system; and the visualization is updated as the months and years flow by, based on the projected temperatures at different areas of the world. That is, the increased turbulence of the system causes a representation of a map of the world to become distorted in different ways. A secondary view is overlaid, showing numerical data and providing a more dispassionate display of the inexorable increase in world temperature.

Keywords

Climate change, art-science, software art.

Introduction

Turbulent World is a time-based artwork that displays an animated atlas that changes in response to the increased deviation in world temperature over the next century. The changes are represented by visual eddies, vortices, and quakes that distort the original map. Additionally, the projected temperatures are themselves shown across the world, increasing or decreasing in size to indicate the severity of the change. The data used in the artwork was generated by a sophisticated climate model that predicts the monthly variation in surface air temperature across different regions of the world through the end of the century (Delworth et al. 2006). The various datasets that are output from this model are available at the National Climatic Data Center (NCDC), run by the National Oceanic and Atmospheric Administration (NOAA).

Motivation

Turbulent World was first created in response to a call for entries by curators Emmanuelle Namont Kouznetsov and Kathrine Worel of OFF Space for an exhibition titled "Brave New World." In their call for entries, they asked artists to think about creative responses to climate change: "What is the role of the artist as citizen in this climate? How might we reclaim our choice, our connection, our social power when immersed in a deteriorating environment?"[1] *Turbulent World* was originally featured in this show, presented within the Spare Change Artist Space in downtown San Francisco. It was installed for the duration of the exhibition, which ran from late 2013 through early 2014.

The goal of *Turbulent World* is to provide insight into a data model that represents current thinking by leading scientists about climate change. Scientific visualization often focuses on individual data samples; visualizations that effectively capture large-scale systems are more difficult to represent (Johnson 2004). Additionally, climate change represents multiple, intertwined systems and necessitates new thinking about economics, policy-making, urban development, and other activities (Folke et al. 2010). An additional issue in representing climate change is that it exists at a scale that is hard to reason about (Opdam and Wascher 2004). Despite the major implications of climate change for civilization, due to these issues in scale and complexity, people do not take the time to reflect upon climate change very often (Chia 1998). Since modeling, representing, and explaining climate change is so challenging, *Turbulent World* does not attempt to include a comprehensive information visualization of the relevant data, but rather presents one aspect (the projected surface-air temperature) in order to provide a window into this complex system.

The piece was motivated in part by scientific visualizations that were developed by the geoscientists Jeremy Weiss and Jonathan Overpeck, both affiliated with the Institute of the Environment at University of Arizona. Their research includes simulations of the coastal regions that will be affected by a rising sea level (Overpeck and Weiss 2009; Weiss, Overpeck, and Strauss 2011). Additionally, it was inspired by other artworks that explore ways to represent the impact of climate change, including Bruce Caron's *Light Blue Line* outdoor installation, which painted a blue line throughout the city of Santa Barbara at exactly seven meters above sea level, dramatically showing the potential effects of melting glaciers and sea ice decline due to climate

*http://evl.uic.edu/creativecoding

[1] http://www.off-space.org/bravenewworld

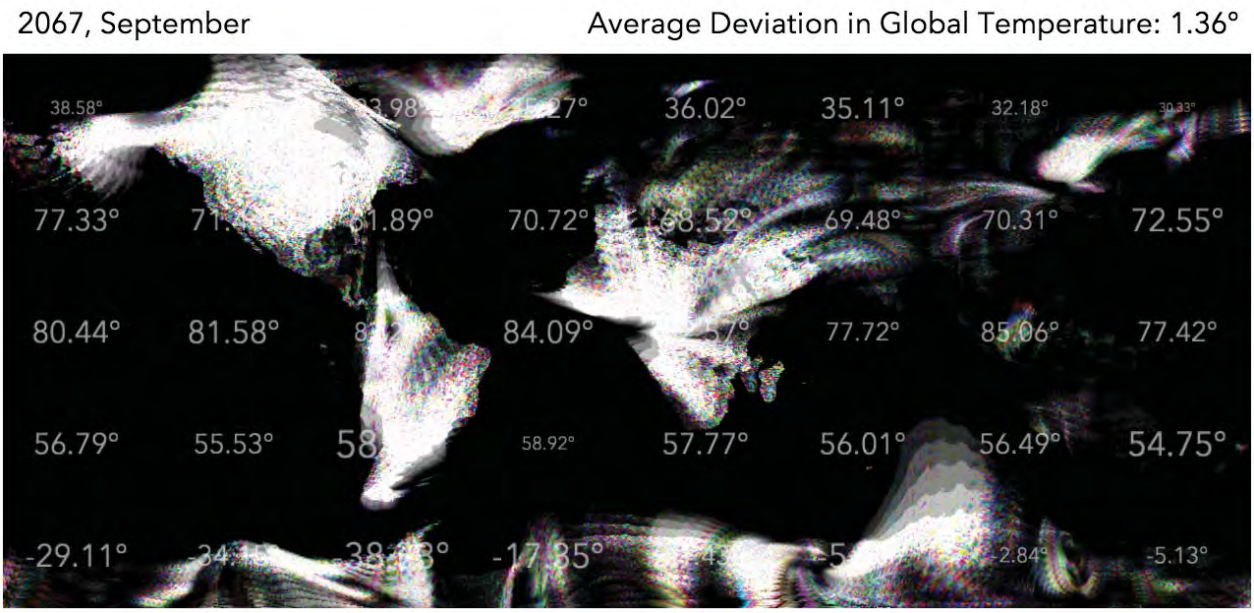

Figure 1: Screen capture from the artwork as it shows the average surface-air temperature across the world for September 2067, using the projected values generated by the CM2.1 model developed by the Geophysical Fluid Dynamics Laboratory. ©the author.

change.[2] Work by other artists and artist collectives that took part in the Brave New World show, including Amy Balkin, Gioj de Marco, Alicia Escott, Alan Hopkins, Andréanne Michon, Barbara Milman, Emmanuelle Namont Kouznetsov and Elyse Hochstadt, and Kathrine Worel, among others, also influenced the creation of *Turbulent World*.

Though a range of artists have produced works that in some way use data related to climate change as a material, or that explicitly comment on climate change, both artists and scholars can be uncertain of the cultural impact of these types of works. For example, a recent article by Adam Corner argues that through the invention of novel forms of representation artistic projects keep environmental issues "in the public eye."[3] Jonathan Rowson notes that public events, while briefly generating hope and inspiration, are also "tampered with a little sadness," since the false belief that simple awareness is useful is "part of what prevents us from facing up to the monstrous complexity and embarrassing urgency of the problem."[4]

Other commentators believe however that artworks, more than simply raising awareness, can make issues tangible and thus meaningful. An article jointly penned by the professors Elke Weber and Irena Bauman and the artist Olafur Eliasson makes the claim that art is precisely the appropriate vehicle for change. The article describes Olafur Eliasson and Minik Thorleif Rosing's 2014 work *Ice Watch*, which consists of 100 tons of ice transported from the Nuup Kangerlua fjord to Copenhagen and arranged in City Hall Square in a circle resembling a clock.[5] The spectacle of the installation literally melting away is presented as a means to permanently change perceptions about climate change. They write that the scientific community is failing because "[t]he information presented by the IPCC is overwhelming and [...] too complex to be able to translate into effective actions." Thus, they argue that "strategy plans, position papers, and limits for CO2 omissions" need to be accompanied by "art, architecture, storytelling, and other cultural activities."[6]

Description of Artwork

Unlike many other artworks that explore topics related to climate change, rather than staging a dramatic portrayal of the effects of climate change, *Turbulent World* includes a more direct representation of the data indicating a projected change in climate, as modeled by the Geophysical Fluid Dynamics Laboratory at the National Oceanic and Atmospheric Administration. The artwork begins in the current month of the current year by showing a still image of the world map using an equirectangular projection. The average surface-air temperature (SAT) for locations across the world for the current month are overlaid on top of the map in an eight-column by five-row grid containing cells of uniform size. As the animation begins, the deviations from the expected SATs (that is, if there were no increase in CO_2 into the atmosphere) are indicated by a change in size of the numbers representing the tem-

[2] http://tnms.org/lightblueline

[3] http://www.theguardian.com/sustainable-business/art-climate-change-communication

[4] http://www.rsablogs.org.uk/2014/socialbrain/

[5] http://olafureliasson.net/icewatch

[6] http://www.theguardian.com/sustainable-business/2014/oct/23/climate-change-ice-watch-installation-art-greenland-copenhagen-ipcc

peratures. The total deviation in temperature across the world (from the original baseline) in shown in the upper righthand corner. The artwork uses an interpolation of the values in the CM2.1 model (described below) in order to better fit them on the screen, but they are otherwise faithful to the model.

As the surface-air temperature deviates from the baseline values, the magnitude of the deviation within a particular cell distorts the map by either pulling the map toward the point where the number is centered, if the projected temperature rises, or pushing it away, if the temperature falls. The artwork uses the Fluid Automata system (Forbes, Höllerer, and Legrady 2013; Forbes and Odai 2012) for creating turbulent fluid effects. The overall turbulence of the fluid system becomes more chaotic as the deviation to the temperature increases. Additionally, a series of image processing techniques are used to augment the turbulence in the fluid system by changing the saturation and brightness of the map. Figure 1 shows a screenshot of the installation when displaying projected data for Septmeber 2067.

Climate Change Data

The dataset for the artwork consists of the projected average surface-air temperatures across the world through December, 2099. The data was retrieved from a repository hosted by Geophysical Fluid Dynamics Laboratory at NOAA,[7] where the model was developed. Specifically, the CM2.1 model was used, which is a coupled ocean-atmosphere general circulation model using an idealized 1% increase in carbon dioxide emissions per year. That is, it models the climate as an interconnected system composed of atmosphere, land, ocean, and sea ice systems. The CM2.1 model was used to "conduct a suite of climate change simulations for the 2007 Intergovernmental Panel on Climate Change (IPCC) assessment report" (Pachauri and Reisinger 2007). A 2013 report reiterates that scientists have a "very high confidence that models reproduce the general features of the global-scale annual mean surface temperature increase over the historical period" (Flato and Marotzke 2013). That is, the CM2 model has been effective at simulating "the main features of the observed warming of the twentieth century," and is thus seen as a reasonable, though potentially conservative, model for predicting probable changes in the climate (Delworth et al. 2006). More detailed information about CM2 Global Coupled Climate Models (and the data itself) can be found at the Geophysical Fluid Dynamics Laboratory (GFDL) website.[8]

Discussion

Turbulent World was discussed during a panel interview led by the environmental poet Eric Magrane, which was partially summarized in the online magazine *Proximities*.[9] The discussion focused on the use of visual representations, whether artistic or scientific, and how they function as a tool to *communicate* the meaning of data, rather than simply to represent it. The artwork was used a means to think about the tension between telling a story from a biased perspective and presenting neutral data. Specifically, we discussed the use of scientific data as a material for data-centric artworks and artistic techniques for representing scientific data.

Participants on the panel, which also included the geoscientist Jeremy Weiss and the graphic designer Kim Daly, had differing perspectives about how visual representations should emphasis climate change data. However, the panelists agreed that, since climate change is a complicated topic involving researchers from many different fields, it is simply too big an issue to be summarized by any one visual representation. Artists and designers can only capture and illustrate pieces that can provide a window into this complex system. Providing users with a chance to see the data unfold through a artistic visualization allows them to reach their own conclusions about the data, even as the piece presents a clear provocation about the impact of the data. At the minimum, it communicates the data in a clearer way that might encourage a viewer to do further research into these types of climate change models, and, ideally, if we agree with Weber, Bauman, and Eliasson, it widens cultural space to include interconnected and interdependent experiences.

[7] http://nomads.gfdl.noaa.gov/CM2.X/

[8] http://nomads.gfdl.noaa.gov

[9] http://environment.arizona.edu/proximities/envisioning-climate-change

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World-Wide-Walks: Glaciers in the age of global warming

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Walk: Perito Glacier © 2012 Peter d'Agostino

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Abstract

World-Wide-Walks have been performed by Peter d'Agostino on six continents over the past four decades to explore elements of natural, cultural & virtual identities: mixed realities of walking through physical environments and virtually surfing the web. Initiated as video "documentation/performances" in 1973, the Walk Series evolved into video/web projects during the 1990s, and mobile/locative media installations in the 2000s. During the past decade, the World-Wide-Walks / between earth & water projects have considered the dire crisis of climate change and its ominous threat to impact on human civilization by operating as part of a long tradition of walking practice as exploration, meditation, political activism, community engagement.

This paper focuses on Walks that explore the immediate peril of global warming. Melting ice has the capacity to raise sea levels and change the configuration of civilization in heavily populated coastal regions. These Walks record the real time deterioration of glaciers, while noting their historic loss. Recent books by Elizabeth Kolbert and Naomi Klein contextualize the challenges of climate change. Kolbert talks about the precariousness of species, exacerbated by human environmental abuse. Klein discusses how wealth, worldwide economics, and the negotiation of geo-political differences challenge the mobilization to enact timely change.

The arts have a role to play on the cutting edge of these issues through the production of works of significant cultural resonance and art the transmission of urgent concerns about a world at risk.

Keywords

World-Wide-Walks, art, walking, climate change, global warming, glaciers, ecology, Anthropocene

Walk: Vatnajokull © 2012 pdA

Walk: Columbia Ice Fields 1965 marker
© 1992 peter d'Agostino

Walking in Changing Environments

Humanity, upright, went into the caves, made markings by leaving imprints of hands, painted bison, and created great ritualistic spaces. Young Aboriginal men came of age by walking to learn about country, history, politics, time and space, geography, horticulture, fauna, natural boundaries, language. In the virtual age, walkabout has diminished. Losing that profound contact with the environment, losing the stories shared, the Law, the community suffers. Identity disappears. Environmental memory disappears. Humanity stamps the landscape with an economically driven, utilitarian, self-engaged framework that distances other operative systems that offer insight, meaning, and an alternative.

The act of walking, literally and metaphorically, from first steps to daily routines, still holds a key to individual and collective human identity. Walking positions the individual within a world of empirical awareness, statistical knowledge, expectation and surprise - anticipation of unknown encounters around the bend.

In mediating the frontiers of human knowledge, walking and other forms of exploration remain a critical means of engaging global challenges. Walking also constitutes a political act, most notably now when traversing environmental boundaries undergoing radical and potential cataclysmic change.

In *The Sixth Extinction: An Unnatural History* (2014), Elisabeth Kolbert discusses predictions that almost half of all living species on earth might vanish within this century.

> One of the defining features of the Anthropocene is that the world is changing in ways that compel species to move, and another is that it's changing in ways that create barriers roads, clear-cuts, cities - that prevent them from doing so.
>
> Thomas Lovejoy has written that "in the face of climatic change, even natural climatic change, human activity has created an obstacle course for the dispersal of biodiversity," the result of which could be "one of the greatest biotic crises of all time." [1]

In *This Changes Everything: Capitalism vs. The Climate*, Naomi Klein takes the issue head on-today and for a not too distant future. Klein's exploration covers the geo-political terrain.

Klein also explores the meaning of individual humanengagement with the environment. During a difficult pregnancy, she describes how walking became a meditative process enhancing political insight into traditional understanding, awakening consciousness.

> What helped most was hiking, and during the final anxious weeks before the birth, I would calm my nerves by walking for as long as my sore hips would let me on a well-groomed trail along a pristine creek. [2]

Klein bridges the individual's growing singularity on the technological age with that of the individual reconnecting with the surrounding environment. She expands the metaphor through her own reproductive narrative:

> If the earth is indeed our mother, then far from the bountiful goddess of mythology, she is a mother facing a great many fertility challenges of her own. Indeed, one of the most distressing impacts of the way in which our industrial activities affect the natural world is that they are interfering with systems at the heart of the earth's fertility cycles, from soil to precipitation. [3]

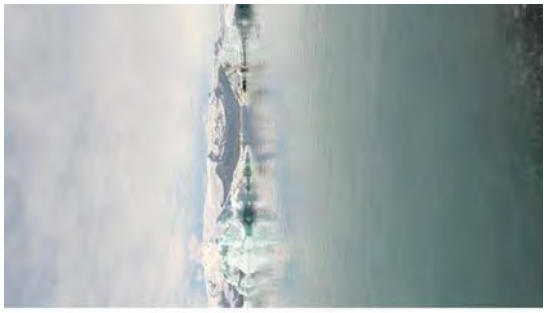
World-Wide-Walks

In their fragility, the World-Wide-Walks, over the past four decades, assemble a finite human figure's making of micro and macro meaning within natural and mediated cultural environments. Individual experience must continue to resonate to sustain a greater political awareness and mobilization.

> Many years later, as he faced the firing squad, General Aureliano Buendia was to remember that distant afternoon when his father took him to discover ice. [4]

The news of Gabriel García Márquez's passing in 2014 rekindles the memory of these opening lines to *One Hundred Years of Solitude,* the saga of a family in a village on "the bank of a river of clear water."

While walking in California's Sierra Nevada mountains during the summer months, there are experiences of drinking clear water flowing directly from the melting snow pack at the higher elevations. Other walks through the Canadian Rockies to the Columbia Ice Fields in 1972 set a baseline for witnessing glacial retreat. On revisiting the ice fields two decades later, a video walk records strategically placed signs at five year intervals - beginning in 1965 and proceeding to 1990 - marking the path toward rapidly receding glaciers.



Walk: Vatnajokull © 2012 pdA

World-Wide-Walks / between earth & water / ICE

Recent walks at the edge of glaciers at the top and bottom of the globe - in Iceland, Alaska, and Tierra del Fuego, Argentina - were performed to witness the consequences of man-made global warming.

Juxtaposed with the ICE Walks and a sound score of evolving glacial dynamics composed by Reese Williams, cautionary texts serve as a counterpoint to the sheer beauty of these places - reminders of the fragility of massive glaciers during this current era of accelerating climatic changes. Informed by scientific studies and local knowledge, this project focuses on direct physical experiences of dramatically receding glaciers to address 'glocal' - global / local ecological concerns for a sustainable future.

Iceland Walks

Iceland marks a place of coexisting 'fire and ice', where the European and North American continental shelves meet, characterized by factual and mythic histories, (notably the remarkable sagas.) Icelandic sagas (13th century) provide the first written documentation of geographic names of Iceland's glaciers although most of the glacier names originated after 1890. "During the last half of the 20th century, 6 named glaciers 'disappeared;' 3 mountain glaciers melted and 2 distributary outlet glaciers and 1 outlet glacier receded into the parent outlet glacier or ice-cap margin." [5]

Two of the most significant sites for the Walks are rapidly receding glaciers: Snaefellsjokull and Vatnajokull. Snaefellsjokull sits on top of an active volcano believed by some to be one of the 'seven primary energy centers' of the earth, and the setting for Jules Verne's novel *Journey to the Center of the Earth*. Vatnajokull, in southeast Iceland, is Europe's largest glacier. In 2009 a leading glaciologist at the University of Iceland explained the outcome of continued global warming. "The glacier ice will melt. The water that runs off will go to the sea. The sea level will rise about 7 metres, which means we'll have catastrophic effects on the highly populated areas all over the globe." [6]

Walk: Grand Pacific © 2013 pdA

Alaska Walks

Alaska harbors more than 100,000 glaciers. The Alaska Walks focus on Glacier Bay ranging from Bartlett Cove to the Grand Pacific Glacier (sites of walk performances). The Bay epitomizes the natural, cultural and virtual issues related to effects of climate change on the glaciers.

> Although a handful of Alaska's large glaciers are, surprisingly, advancing, more than 99 percent of them are retreating. In the past decade, Alaska's coastal glaciers have added as much (or more) melt water to the global ocean as the ice sheets of Greenland or

Antarctica, making these glaciers a significant factor in global sea-level rise. [7]

The Ecological Society of America argued that establishing Glacier Bay as a national park in 1923 would help with the study of the natural processes of glacial advance and retreat within the confines of the bay.

> Unlike many park service sites that commemorate a single event or significant features, Glacier Bay celebrates change and natural processes. However, no natural cycle can explain the current warming of our planet. [8]

The park recognized the history of the bay and its associations with British explorer George Vancouver (1791) and naturalist John Muir (1879). Before his research in Alaska, Muir's original studies of glacial trace history in Yosemite supported the designation of this California valley as a National Park in 1890. Two years later, Muir helped found the Sierra Club, which has perpetuated his legacy as a naturalist and ecologist well into the 21st century.

The cultural history of Glacier Bay, however, begins with the aboriginal peoples who populated the area well before the arrival of Muir, Vancouver or the Russian explorers, who first arrived in Southeast Alaska in 1741.

> Eskimos from the west initially pushed into lands bordering on the [Glacier Bay] park's northwest boundary. Athabascans later migrated from the interior headwaters of the Alsek River toward the river's mouth at Dry Bay. The Alsek eventually served as a transportation corridor, linking the Athabascans with their neighbors the Tlingit Chilkat tribe. [9]

In addition to these significant natural and cultural histories of Glacier Bay, the Walks explore important virtual issues related to the present state of global climate change. Beyond direct ground level experiences at Glacier Bay, mediated by the use of video/web and GPS systems, the walks reference the Satellite Image Atlas of Glaciers of the World, which forms the basis of glacial studies by the U.S. Geological Survey.

> The Atlas remotely sensed images, primarily from the Landsat 1, 2, and 3 series of spacecraft, are used to study the glacierized regions of our planet and to monitor glacier changes. [10]
>
> Changes in the volume of glacier ice on land produces changes in global (eustatic) sea level. Seasonal changes in sea ice and snow cover and decadal changes in glacier area can be monitored regionally and globally with image and other data from Earth-orbiting satellites. [11]

Walk: Martial Glacier © 2012 pdA

Argentina Walks

Walking glaciers at the top of the globe in Iceland and Alaska led to an interest in pursuing several parallel natural and cultural features in Tierra del Fuego, Argentina, at the southern tip of South America.

Framed by the Straits of Magellan and the Beagle Channel, this archipelago is referred to as the 'Uttermost Part of the Earth' by E. Lucas Bridges in his memoir of the same title (1947). He recounts his life as a European settler growing up with the indigenous Fuegian Indians.

L. Bergreen documents the first written account of glaciers in this region in *Over the Edge of the World*:

> Magellan pauses at Santa Cruz because of storms and comes upon the Strait of Magellan, Oct 21, 1520. He sees fires in the distance, and calls the land Tierra del Fuego (Land of Fire). They pass glaciers with deep blue ice, view the Southern Cross in the heavens. Consisting of packed snow and ice, the glaciers never rested; they cracked, they groaned, they roared, and they threatened to decompose and tumble onto the beaches and water below. [12]

The Walks were performed in Tierra del Fuego at the Martial Glacier and at the Perito Moreno Glacier, located in the Andes on the border with Chile. Perito Moreno is one of 48 glaciers in the Patagonian ice field, the world's third largest fresh water reserve.

> South America is perhaps most often associated with the Amazon jungle. But along its western edge, from Ecuador to southern Chile and Argentina, it also harbors huge glaciers, which are rapidly melting due to global warming. The melting of the glaciers

means the loss of vast reserves of fresh water for human consumption, and for the rivers that provide hydroelectric power. [13]

Argentine government agency researchers issued warnings that the Martial Glacier was rapidly disappearing. Jorge Rabassa, a geologist associated with the National Scientific and Technical Research Council (CONICET) proclaimed that "by 2050, 'nothing' will remain of it." [14]

Re-Discovering the meaning of ICE

The memory of "discovering ice," while facing a "firing squad," as portrayed in the Marquez tale, suggests an apt metaphor for the global climate situation.

Is this the kind of perceived threat necessary for a call to action as humanity stands on a precipice at the edge of an abyss - a tipping point of no return as a direct consequence of man-made global warming ?

Countries, individual citizens must now mobilize against complacency and economic expediency for the sake of the earth and its future inhabitants. Our survival depends upon it.

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Authors Biographies

Peter d'Agostino's pioneering photograhy, video and interactive projects have been exhibited internationally. Surveys of his work include: Interactivity and Intervention, 1978-99, Lehman College Art Gallery, New York; the World-Wide-Walks projects at the University Art Gallery, Bilbao, Spain (2012); and the University of Paris I Partheon-Sorbonne (2003), Major group exhibitions include: The Whitney Biennial, Sao Paulo Bienal, Brazil, and Kwangju Biennial, Korea. His works are in the collections of The Museum of Modern Art, New York, University Art Museum, Berkeley, and is distributed by Electronic Arts Intermix. D'Agostino has been awarded grants and fellowships and awards from: the NEA, Japan Foundation, Onassis Foundation, Pew Trusts, Fulbright Program, MIT's Center for Advanced Visual Studies, Banff Centre for the Arts, Rockefeller Foundation's Bellagio Center, Italy, the American Academy in Rome, the Art / Sci Center, University of California, Los Angeles. He is Professor of Film and Media Arts, Temple University.

David I. Tafler is Professor of Media and Communication at Muhlenberg College in Allentown, Pennsylvania. As a consultant for the Irish Red Cross Society (IRCS) in Banda Aceh (the ground zero site of the 2004 Tsunami) in 2009, he co-developed and authored a manual on communication and new communication technologies for the support of beneficiary populations in disaster prone regions. David Tafler has worked with the Pitjantjatjara, Yankunytjatjara, and Ngaanyatjarra people in central Australia since 1991 as a consultant, writer, and web designer/administrator. Tafler has authored and published many articles on interactive media, camcorder activism, avant-garde cinema, electronic art, and community media. His publications include journals such as Afterimage, Wide Angle, Media Information Australia, Continuum, Kunstforum, and a book that he co-edited with Peter d'Agostino, Transmission: Toward A Post-Television Culture.

[Session 2]

Environments + Ecology

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Audiovisual Installation as Ecological Performativity

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Abstract

This paper stems from my practice-based research as a composer of collaborative multimedia works. The majority of artifacts that result are audiovisual installations that explore new relationships from an ecological perspective—that is—the perspective that considers the world to be a network of interconnected and interdependent phenomena. In an attempt to contextualize my research and explore new possibilities for creative practice, I have become interested in a number of theories about the agency and performativity of living and non-living systems. I present several of these theories within a historical context, and describe the audiovisual installations *Aspects of Trees*, *Undercurrent*, and the work-in-progress, *Bridgings,* all of which illustrate my evolving practice and ontological notion of *Ecological Performativity*.

Keywords

Audiovisual Installation; Ecological Performativity; Agency; New Materialism; Systems Theory; Ontology; Autopoiesis; Cognition; Interconnectedness; Practice-based research.

Introduction

Over the past twenty years, my creative practice as a composer has increasingly become a multidisciplinary and collaborative endeavor. This work has been an enriching enterprise covering numerous perspectives that have expanded both my artistic practice and philosophical thoughts on creativity. In order to develop a supportive discourse for these creative activities, and explore new patterns of inquiry and networks of communication, I have recently been drawn to several scholarly discussions about the agency and performativity of living and non-living systems. In this paper I present several of these dialogues in their historical context, and give a descriptive account of the audiovisual installations, *Aspects of Trees, Undercurrent*, and the work-in-progress, *Bridgings*, which illustrate my evolving practice and ontological notion of *Ecological Performativity*.

Historical Background

The idea of agency and performativity in Western thought evolved from a variety of philosophical, scientific and artistic research, the majority of which took place over the last century and continues into the 21st century. [1] This work reflects a paradigmatic shift away from a mechanistic, representational model to one of an interrelated, performative network in which the "stuff of the world" is considered an operative agent. [2] From emergent properties, cybernetic theory, autopoiesis, and systems theory to the new paradigms of expression in creative practice, a shift in ontological thinking had begun—away from representational models to a more performative, time-based and non-linear practice. [3]

Advances in mechanical and computational technologies influenced this transformation and are well documented in Chris Salter's book, *Entangled: Technology and the Transformation of Performance*. He writes: "Technology does something in and to the world by modifying existing relations and constructing new ones between humans, tools, processes and the environment which are deeply entangled." [4] Within a few decades theatre, dance, literature and music responded to the shift in ontological thinking, fostering the convergence and synthesis of artistic forms. [5] Salter suggests that "…these new relationships and interactions of discrete aspects of experience [opened] deeper understandings of the nature of consciousness and the workings of the mind...the reorganization of human interaction and the reimagination of interrelatedness." [4]

To briefly summarize this shift, we need only look at a selection of fine art works throughout this time period. Picasso's *The Old Guitarist* of 1904 was completed just one year before Einstein published his "Special Theory of Relativity." This singular perspective painting is remarkably different from his *Guitar Player* of 1910; we can note the transformation of a static representational viewpoint to that of a "multipositional dialect of space and time." [5] Kandinsky's *Composition VIII* from 1928 was completed three years after C. D. Broad first proposed his idea of emergent properties, whereby properties of a system emerge at higher levels of complexity due to the relationship of all parts. The more common research approach at the time focused on the smaller parts of a system rather than the whole—that is, its dissection. Broad's theory encouraged an ecological perspective that later became known as systems thinking. [6] From this as well as from cybernetics theory, Roy Ascott's artistic efforts developed. [7] Ascott introduced cybernetics into art education during the 1960s and believed this theory "opened the door to understanding the nature of mind as a systems phenomenon and became the first successful attempt in science to overcome the Cartesian division between mind and body." [8]

It was from cybernetics theory that Humberto Maturana began to develop his theory of autopoiesis (*self-creation*).

He explored this notion while researching visual perception and the organization of living systems posing the question, "How do I do what I do as an observer in observing?" [10] In reply, he proposed a new concept of circular organization claiming that "living systems are cognitive systems, and living as a process is a process of cognition." [10] All of his subsequent research came from this basic epistemological and ontological shift of thinking, which eventuated into the Santiago Theory of Cognition. With this theory, Maturana, along with Francisco Varela, proposed that "to live is to know" and that cognition is a "continual bringing forth of a world through the process of living." [11] The particular world that is brought forth depends, first, on the structure of the organism, and, second, on its relationship to its environment. [12]

This theory was a profoundly new view of cognition that included all processes of life such as perception, emotion, action, and emergence. It involved the concept of mind as a process, not a thing, and extended the act of cognition to all living systems including organisms that do not have a brain, such as simple-celled organisms. [12] At the time of its introduction, the Santiago Theory of Cognition provided the comprehensive scientific framework necessary to challenge the Cartesian division between mind and body, and afforded a "new synthesis of mind, matter, and life." [9]

Maturana[1] and Varela, respectively, expanded on this theory of cognition that, in Varela's case, would evolve into what is now widely accepted in cognitive science as the "embodied mind." [14] Varela *et al.* introduced this term in the early 1990s with the central thesis that cognition, including knowledge, meaning, and emotion, is intrinsically linked to our body, to the active living of that body, and to the environment in which these activities, or "enactions" take place. [14] Since then, the concept has widened to include the very structure of human reason as arising from our bodies, brains and bodily experience evoking a quality of emergence and agency. The concepts "embodiment" and "enaction" are now part of the lexicon of contemporary creative researchers.

Recent Theoretical Discourse

Currently there is a rigorous discourse throughout the arts, humanities and sciences about the interconnected agency, or "performativity" of living and non-living systems, and between the human and non-human—so much so that "formerly fast held distinctions between the inert and the active, the human and the non-human and life and matter are cracking." [15]

Noted contributors to this discussion include Chris Salter, who, as previously mentioned, has written comprehensively on the trajectory and development of agency and performativity in the arts. His recent publication, *Alien Agency: Ethnographies of Nonhuman Performance,* continues this enquiry by describing works in which the materials of art—the "stuff of the world"—behave and perform in ways beyond the creator's intent. They each encourage "a radically different vision of the world—dynamic, temporally emergent, contingent, and performative." [2]

Andrew Pickering joins the discussion with his notion of the "dance of agency." This is Pickering's attempt to move away from the idea that agency is specific only to humans, or to what he refers to as "human exceptionalism." He suggests that the world, in all its heterogeneous multiplicity, is full of agency and processes of emergence. By exploring these processes and performative relationships between things, including those beyond the human realm, Pickering suggests that we invite the "possibility of a non-modern stance of revealing rather than enframing which, in turn, invites open-ended extensions." [16]

Karen Barad elaborates on the notion of performativity in her substantial book *Meeting the Universe Halfway*. Here, Barad introduces the term "intra-action" which refers to the idea that "existence is not an individual affair [where entities] pre-exist their interactions," but rather, an ongoing ebb and flow of agency where individuals and things emerge through and as part of their entangled intra-relating. [17]

Similarly, Jane Bennett's concept of "thing-power" gives voice to the energetic vitality intrinsic to matter and the active, earthy, and complex entanglements of humans and non-humans. [18] She fosters the notion of "greater recognition of the agential powers of natural and artifactual things, greater awareness of the dense web of their connections with each other and with human bodies, and, finally, a more cautious, intelligent approach to our interventions in that ecology." [19]

Timothy Morton expands the discussion to include his idea of the "hyperobject," meaning agents or objects "so massively distributed in time and space as to transcend localization, such as the biosphere, global warming, or the sum of all the whirring machinery of capitalism." [20] Morton argues that these objects are the result of "the mesh"[2] of human and non-human agency, particularly those which took place during and after the Industrial Revolution. He further suggests that art in the time of the hyperobject can function as an attunement to the reality of the coexistence of all things on Earth:

> Thus the art in the time of hyperobjects explores the uncanniness of beings, the uniqueness of beings, the irony and interrelationships between beings, and the ironic secondariness of the intermeshing between beings. [22]

[1] In the context of this conference, it is interesting to note Maturana's own reflections on technology and art: "As different technologies open and close different relational dimensions, they offer different possibilities for social and nonsocial coexistence, as well as different possibilities for the artist to create the relational experience that he or she may want to evoke. In all cases, though, whatever he or she does, the artist will be a participant creator of some virtual reality that may or not become a grounding reality in the course of human history." [13]

[2] In Morton's writing, "the mesh" substitutes words such as interdependence and interconnectedness. [21]

Fritjof Capra and Pier Luigi Luisi weigh in with their 2014 publication, *The Systems View of Life: A Unifying Vision*. The authors present a coherent systemic worldview that integrates the biological, cognitive, social, and ecological dimensions of life. They discuss the philosophical, social, political and spiritual implications of such a unifying vision, in an attempt to overcome, what they define as "a crisis of perception," or a human-centric use-value worldview. [23] The broader intention of this book is to provide an appropriate framework for discussing one of the "great challenges of our time—the building and nurturing of sustainable communities." [23]

While all of these concepts and discussions resonate at their own frequency, the fundamental ideas are similar: the world is a mesh of agency, and because of this, a host of ecological, social, cultural, and political observations and concerns are raised and challenged.

Ecological Performativity

The intention of my research, or, "mode of artist practice,"[3] is to contribute to this discourse in an artistic, experiential, and dynamic way. I do so in an attempt to develop a creative practice that I refer to as *Ecological Performativity*. I introduce this term to bridge my creative research with the ideas outlined above, that is, the ecological perspective of interconnectivity, the cognitive components that include all processes of life, the "dance of agency," the intra-action of living and non-living systems, and the complex systems and entanglements of humans, nonhumans, and hyperobjects. Beyond technical and aesthetic choices, my research attends to the performative substance of place and time. It stems from the premise that artistic practice can enable different perspectives of the world and become, in and of itself, an apparatus of change—promoting what I (and other practitioners) consider to be "a long overdue ontological shift in how we exist in the world." [25]

Ecological Performativity has resulted from a series of collaborative mixed-media audiovisual installations. Similar to other ecologically-grounded creative practices,[4] these installations explore the relationships of environment, material, and process, and are derived from an intensive data-gathering procedure and immersion within the respective environments. At the same time, by considering the interdependent performative agency of all components involved (the cognition, environment, and autopoietic units), *Ecological Performativity* attempts to explore new networks of communication and meaning from a systemic understanding; in other words, its pattern of organization (Figure 1).

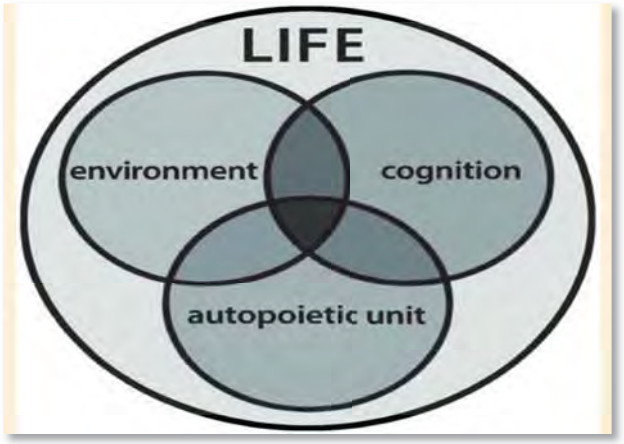

Figure 1. The Trilogy of Life. [31]

Studio Practice

For the purpose of my creative research, the generative audiovisual installations are understood then as "the embodiment of the shared meaning generated by the networks of communications." [32] These networks include multimedia collaboration as the creative field of activity, which nurtures an environment where the 'possibility of something to happen' is cultivated. From a philosophical perspective, this touches on Stuart Kauffman's notion of "the adjacent possible—" that within the components of any given moment, many untapped possibilities are available. [33]

> The strange and beautiful truth about the adjacent possible is that its boundaries grow as you explore those boundaries. Each new combination ushers new combinations into the adjacent possible. [34]

These possibilities emerge from the creative interactions of practices, processes and potentials activated by the visceral, in-person experiential engagement with the chosen environments. Immediacy, unpredictability and surprise register in this relational liveliness of matter and material, forming an open-ended experimentation process that embraces the unexpected. Salter suggests that experimentation, as process, "takes its materials or entities as active, dynamic, and changeable, rather than passive, inert, and immutable…[transforming them] into agents…that have actual effects in the world." [2]

In my research, the exploration of materials is done in part through the development of specifically designed computational systems. These systems vary in construction and are intrinsically linked to the collected location data that include audio field recordings, moving images and photos, as well as weather, meteorological, and environmental data. What emerges does so in an iterative, non-deterministic manner, which affords a holistic interaction

[3] I borrow this turn of phrase from Manning and Massumi in which they claim: "Every practice is a mode of thought, already in the act. To dance: a thinking in movement. To paint: a thinking through color. To perceive in the everyday: a thinking of the world's varied ways of affording itself." Each is a technique, or, springboard that sets in motions "a practice from within." [24]

[4] Terms used to denote other ecologically-grounded creative practices include *ecocomposition, sonic ecologies, EcoSon, ecosystems, and audible ecosystems*. [26, 27, 28, 29, 30]

Figure 2. *Aspects of Trees* - opening section. Photo: Andrew Denton

between material, practice and process. This interaction subsequently involves the recording of live musical improvisations in response to the developed system. Recordings have taken place in live multimedia concert improvisations, studio settings, and their respective environments. What this provides is a cumulative database that in turn folds back into the final installation system. The 'performativity of improvisation' becomes an active agent in the process and evolution of the artifact.

From the systems theory perspective, Capra and Luisi suggest that process is the link between organization and structure. Here, they speak to the emergent and agential qualities of living and non-living systems and to the interdependent and fundamental interconnectedness of all levels of life. They do so through a conceptual synthesis of what they consider to be the four perspectives of life: *form, matter, process, and meaning.* [32] In general, *form* corresponds to patterns of organization, or self-generating networks of communications, of which through *process* the material embodiment, or *matter* of the form emerges. *Meaning,* which relates to the inner world of reflective consciousness, is generated by extending *form, matter, and process* into the social dimension, including "rules of behavior, values, intentions, goals, strategies, designs, and power relations." [32] Human action, then, is understood to flow from the *meaning* we attribute to our surroundings. This meaning, in turn, gives rise to material structures in a process of continual embodiment.

In this context the initial engagement with the chosen environments, the creative experimentations, and the cognitive experience of the resulting artifact become part of the co-evolution of the process and meaning. Reflection, contemplation, and consciousness are then considered part of the network. This evokes a cyclical aliveness and an empathic discourse[5] that extends to include the larger biosphere, and contributes to the flow of internal and external networks of communication and meaning. In modern science this cyclical process of life is called metabolism, or the "breath of life." [36]

The following descriptive accounts of the audiovisual installations *Aspects of Trees, Undercurrent* and the work-in-progress *Bridgings* will illustrate the creative practice, informing the conceptual development of *Ecological Performativity.*

Aspects of Trees

Aspects of Trees (2013 installation version) is my sixth collaboration with filmmaker Andrew Denton, and is an extension of our previous artistic explorations of human impact on the Earth's landscapes and ecologies. The subject of this work is the escalating pine beetle epidemic that has decimated forests on the west coast of North America. Due to the increase of pine beetle activity in this location, this devastation has more of a human touch than global warming alone. Western Canadian reforestation practices during the latter half of the 20th century implemented a mono-species program, which has resulted in a pine-tree-only forest. The combination of these mono-species plantations and the increasing average winter temperatures have cultivated an environment for the beetle to flourish. Currently, over 16 million hectares of British Columbia forests alone have been destroyed.

Initiated by Denton, *Aspects of Trees* is the result of a two-year field recording process that comprises video footage and stills from the decimated forests, as well as audio captured inside and on the surface of affected pine trees.[6] Having both worked in BC reforestation before, during and after the epidemic, Denton and I have a visceral and multi-layered engagement with this landscape. Because of this, a contemplative practice emerged during the collection process of which Denton writes: "Once time is taken to absorb [the location], I attempt to record material that communicates my sensations and experiences of being there." [37] He reflects that by "letting go of a need to understand, comprehend, and categorize, … the intensity of the making–feeling–thinking [could] take over in the moment of capture, leave[ing] the reflection and reinterpretation for a

[5] Jeremy Rifkin suggests that empathy is the "invisible hand" that allows us to stretch our sensibility to all life. He proposes that more technologically advanced cultures have evolved into that of *homo empathicus*, which is ushering in a biosphere consciousness. This evolution has occurred due to the diversity of human interaction, creating a more complex system of communication and emergence [35].

6 David Dunn and Felix Wilson provided additional field recordings of internal and external tree sounds.

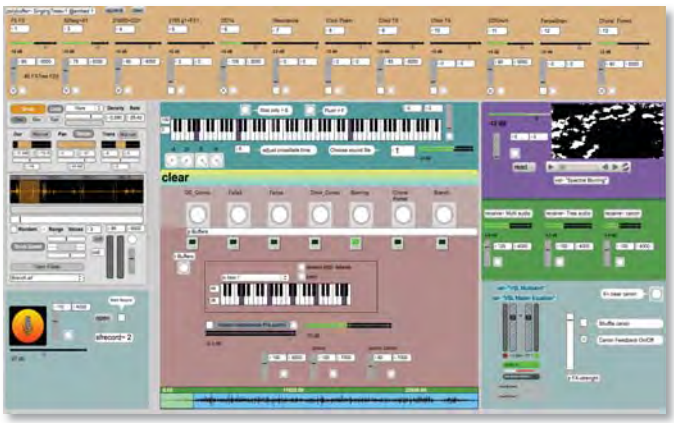

Figure 4. The 'tree instrument' Max6 patch.

later distanced encounter with the material during post-production." (Figure 2) [37]

From these field recordings, and coinciding with Denton's post-production visual experimentations, I began the development of the 'tree instrument.' Constructed in Max6, this portion of the research developed and amalgamated sonic material and computational processes for the purpose of live improvisation with cello, laptop performer (Max6 patch), and visual projections (Figure 3). Components of the 'tree instrument' include sonification of still and moving images, live convolution of cello with field recordings, an eight-part canonic system based on the numerical ratios taken from tree growth, and live granulation and transposition. [33] A series of improvisations took place in studio settings and live concerts, featuring myself, cellist Charlotte Ketel (New Zealand), and cellist Anna Bourne (Canada). Recorded and incorporated into the final installation, these improvisations fostered the relational potentials between subject, material and the cognitive agency of improvisation in which the performativity of components co-composed the resulting artifact: a system of engagement.

The final installation comprises multi-projections with composite images, surround sound and a 30-minute looping sequence, the trajectory of which moves, uncannily, from known to unknown, or rather, concrete to abstract. "It is melancholy and loss for an idea and a fantasy of nature that is no longer there…the invisible made visible, the unsayable now hearable. It is a eulogy." [37]

Observations made during this research focused on the need for open-ended exploration in the chosen environment, in the iterative interactions with the material, and in the methods, pathways, and techniques employed in the creative practice. [37] These observations underscored the conceptual, philosophical, and artistic notion of *Ecological Performativity*. The stimulus was equally informed by the questions that surfaced: If we broaden our understanding of agency and performativity, is it possible to explore different vocabularies and networks of communication? Can this encourage, as Morton suggests, an attunement to the reality of the coexistence of all things on Earth? If so, as a creative practitioner, what then is my response?

Undercurrent

As it was presented at the *Balanced/Unbalanced 2015 International Conference* in Tempe, Arizona, *Undercurrent* is a generative installation that features multi-channel video projections and surround sound. It is my third collaboration with media artist Shannon Harris, and is an interpretation of the ecological and personal landscape explored through moving image, video tracking, improvisation and data sonification.

Undercurrent emerged from what was initially a personal journey for Harris. Shot in the Yalakom River, British Columbia, her visit became a pilgrimage in memory of her recently deceased father, as they had camped often in this region. She writes: "I had no intention of filming on this pilgrimage but usually bring my cameras wherever I go. As I spent time by this quick river listening to the 'shrush and bubble' I was filled with a profound sense of completion: of cycles and patterns, beginnings and endings. I started shooting. Watching light." [38] Harris's still photography and moving images are known for their exquisite and evocative use of light and landscape. Her creative process is embedded in presence, place, and time in which the camera "becomes embodied, my eye/I, my experience." [38]

Through refined experimentation, and with breaks to warm her hands from the glacial freeze, the *Undercurrent* footage was eventually captured while "try[ing] to find the light under water." [38] It was the quality of light that prompted my decision to use video tracking as a generative tool. Imbued with a hypnotic play of light, these underwater shafts of sunlight become the triggering agents that afford an interaction between experience, material, and creative process. With no prior knowledge of Harris's intention of a "pilgrimage," my visceral response to the play of light was additionally influenced by a concurrent audiovisual

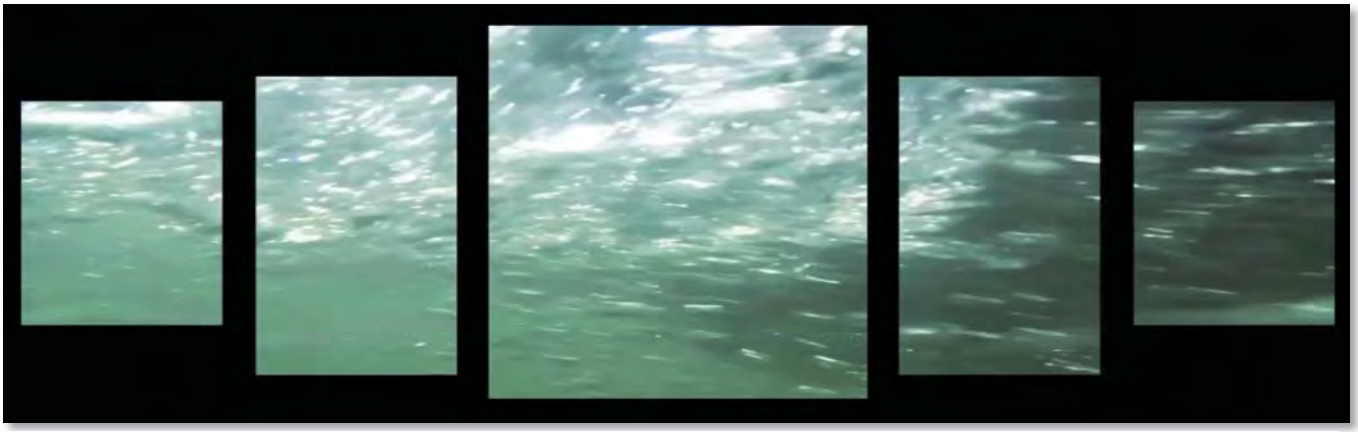

Figure 3. *Undercurrent.*

collection process throughout the Southwestern drought regions of the United States. This was a grueling three-week journey with collaborator Andrew Denton that brought us to many bleakly sunbaked landscapes found in this region. Water, or lack thereof, was at the forefront of our minds.

With this in mind, a single underwater video was selected and subsequently divided into five panels (Figure 4). Through the movement of light, each video panel randomly triggers a databank of sonic material: hydroponic recordings from the primary river location; sonification of Acoustic Doppler Current Profiler data[7] using piano samples; vocal snippets from on-line media in which global warming is debated; and, a catalogue of pre-recorded short improvisation using bassoon, cello, and Bb clarinet convoluted with underwater recordings. Constructed in Max7, these accumulated resources layer into a web of emergent realizations. With no beginnings, middles, or ends, this generative installation becomes more of a contemplation on time and place, process and meaning, or, a meditation in the time of crisis.

Bridgings

I include this descriptive account of the work-in-progress, *Bridgings,* as it occurs at a noteworthy place in the development of *Ecological Performativity*. Having benefitted from the observations made in the previous collaborations, and having absorbed the varied contemporary discourses on agency and performativity, *Bridgings,* is, I believe, a synthesis of different modes of thought: everyday perception, artistic practice, and philosophical thought—"creatively in the act." [24] As research is often reported on after the fact, describing this work-in-progress affords a view into the middle-of-the-making.

Bridgings is Stephanie Symns and my first collaboration, and is the result of data collection that took place on the Granville Street Bridge in Vancouver, BC, Canada between 2013 and 2014. This work-in-progress, in part, was conceptually inspired by the following quote found in *The Sketchbooks of Paolo Soleri*:

> Of all things that are man-made, bridges are, with dams, the most "structural," single-minded, and imposing. As connectors at a breaking point, they have a heroic force that is aided by a challenging structuralism. As a strand of continuity in a non-continuum, the bridge is full of implied meanings. It is the opposite of devisiveness[sic], separation, isolation, irretrievability, loss, segregation, abandonment. To bridge is as cogent in the psychic realm as it is in the physical world. The bridge is a symbol of confidence and trust. It is a communications medium as much as a connector. [39]

The initial research began with a series of weavings, designed by abstracting photo images of the Granville Street Bridge. The original image was taken underneath the bridge and manipulated in Photoshop. By posterizing the image to a certain number of layers that later corresponded to weave structures, the image was subsequently mirrored, both horizontally and vertically, to form a singular pattern unit. Of this process Symns writes: "I am inspired by minimalist architecture and the interrelationship of people, space, and structure. The intention with this series was to create compelling, graphic designs that would make a strong statement with the repetitive use of pattern and geometry." (Figure 5) [40]

Figure 5. Sample design and weaving. (photo/weaving Stephanie Symns)

These would eventually transform into a number of large-sized weavings realized with the use of copper thread (Figure 6). Coinciding with the developments of these weavings, a number of audio recordings were captured on the bridge with the use of contact microphones that were attached to the metal components of the bridge. These recordings took place at different times of day and in varying weather conditions, resulting in a folder of sonic materials influenced by the movement of traffic, the bridge vibrations, and the movement of air through the cylinder components of the bridge.

Figure 6. Copper weaving (photo/weaving Stephanie Symns)

[7] Provided by Stephens Scott of NIWA Taihoro Nukurangi.

Satisfied with the initial collaborative processes, Symns and I envision the final installation to include a series of similarly rendered copper weavings embedded with motion sensors that, once triggered, will randomly select from the following components: images generated from visual data captured from the Granville Street Bridge Webcam (Figures 7 and 8) and a databank of sonic materials developed from the initial field recording and subsequent vocal improvisations. The webcam images will be displayed on small monitors mounted throughout the installation space along with a multichannel surround sound system. One additional consideration is the development of a computational system based on the architectural design of the bridge that would become a performative agent during the vocal improvisations. As such, this would be similar to the 'tree instrument' developed for *Aspects of Trees*. In this case, the 'bridge instrument' would afford an interaction between the architectural matter of the bridge and the agency of improvisation.

With these combined components, then, the final installation might be considered an immersive space of "emergent collectivities," or, "an event-based ecology of experiences" [24] which co-evolves between object and collaborators, material and process, and structure and meaning: a "dance of agency." [16]

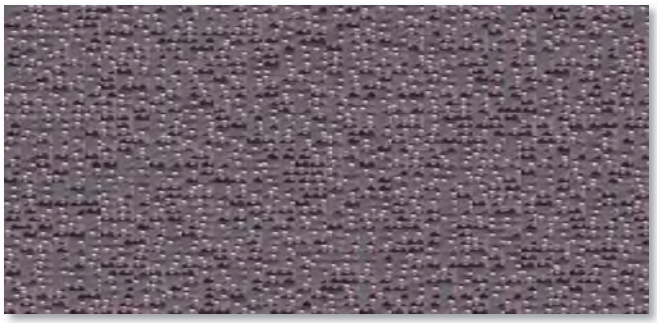

Figure 7. Generated from solo pedestrian image obtained from the Granville Street Bridge Webcam.

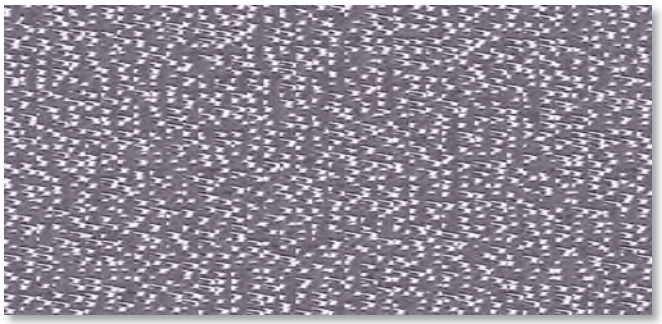

Figure 8. Generated from street marking image obtained from Granville Street Bridge Webcam.

Conclusion

Ultimately, my practice-based research is a multimodal endeavor deeply entangled in the mesh of the world: matter, material, and modes of thinking. In line with the discussions on agency and performativity, this research considers the complex, emergent, and dynamic encounters available through experience and experimentation. By considering the world as a network of phenomena that are fundamentally interconnected and interdependent, the result is a performative engagement and attunement with the world that can function as an aid to the imagination. Human activity is placed into a larger environmental context by intersecting with forces greater than those of human design, which provides a multi-layered point of creative enquiry. This, I believe, works towards an artistic philosophy that considers how we imagine the world and how we act in it reciprocally informs one another. [16] As such, the concept of *Ecological Performativity* has developed alongside the iterative creative practice, the trajectory of which will continue in two future collaborative installations: *Flight Variant* with Andrew Denton and *Signal to Noise* with Shannon Harris.

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Breaking Paradigms: Electronic Arts & Humanitarian Actions

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Abstract

The equilibrium between a healthy environment, the energy our society needs to maintain or improve this lifestyle and the interconnected economies could pass more quickly than expected from the current complex balance to a complete new reality where human beings would need to be as creative as never before to survive. Environmental problems, economic uncertainty and political complexity have been around for a long time. What was different before was the speed and depth of transformations compared with today's sudden changes. The frequent occurrence and severity that certain weather and climate-related events are having around us is increasing, and the ability of human beings on modifying adjacent surroundings as well as distant places have turn into a power capable of altering the planet. Have electronic art a role in all this? Have electronic artists a responsibility in this context? Aiming to use electronic art as a catalyst with the intent of engendering a deeper awareness and creating lasting intellectual working partnerships in solving our global environmental crisis, three initiatives were launched: *Balance-Unbalance*, '*art*! ⋈ *climate*' and EChO.

Keywords

Electronic arts, media arts, sound arts, humanitarian actions, climate change, environmental crisis.

Introduction

We are living in a world reaching a critical point where the equilibrium between a healthy environment, the energy our society needs to maintain or improve this lifestyle and the interconnected economies could pass more quickly than expected from the current complex balance to a complete new reality where unbalance would be the rule and human beings would need to be as creative as never before to survive. Environmental problems, economic uncertainty and political complexity have been around for a long time. What was different before was the speed and depth of transformations compared with today's sudden changes. The frequent occurrence and severity that certain weather and climate-related events are having around us - such as floods, twisters, etc. - is increasing, and the ability of human beings on modifying adjacent surroundings as well as very distant places have turn into a power capable of altering the whole planet.

The global climate is changing, and communities around the world are suffering the consequences. Traditional disaster management approaches are not enough to deal with rising risks, and new forms of collaboration are needed to inspire people and organizations to link knowledge with action. Have computer artists a responsibility in this context? Have computer art a role in all this?

Artists could inspire new explorations regarding how to actively participate in this major challenge of our environmental crisis. We need to develop innovative ways to facilitate a paradigm shift towards a sustainable future. We need to discuss proposals for the future from a diversity of cultural perspectives and socio-economic situations with open minds. Creative thinking, innovative tools and transdisciplinary actions could help to produce perceptual, intellectual and pragmatic changes. It is not about an indulgent utopia for the future nor about a desire, but a matter of survival.

Aiming to use digital art as a catalyst with the intent of engendering a deeper awareness and creating lasting intellectual working partnerships in helping to solve our environmental crisis, three initiatives were launched and have been well received by the international community of computer-based artists and by humanitarian and cultural organizations, policy makers, educators and experts from a variety of fields. Those initiatives are: the Balance-Unbalance program, the '*art*! ⋈ *climate*' contest, and the online EChO network.

Balance-Unbalance

The arts could play a major part in helping the global society to understand the magnitude of the crisis we are facing, and in promoting the awareness around environmental matters. And it could also be a very good vehicle to disseminate proposals that could produce changes in our behavior and decisions, influencing our chances for the future. Artists could promote inter and transdisciplinary actions focusing on the global environmental crisis and our responsibility regarding the turning point we are living in defining the future of life on Earth.

The *Balance-Unbalance* project was launched with an international conference in 2010, aiming to develop the role of the media arts and artists in dealing with environmental challenges. *Balance-Unbalance* explores intersections between nature, art, science, technology and society as we are moving into an era of unprecedented ecological threats. The first conference was held in Buenos Aires, Argentina and was named in Spanish "Equilibrio-Desequilibrio". It was organized by the Electronic Arts Research and Experimentation Centre (CEIArtE) from the National University of Tres de Febrero. Papers were delivered by a representative of the National Secretary of Environment and Sustainable Development of Argentina, experts and graduate students from different universities with chemical, agricultural and environmental engineering backgrounds (some of them specialists in pollution, renewable energies and food technologies), a lawyer, a sociologist and philosopher, artists coming from Argentina, Brazil and Canada, and an astrophysicist. [1]

Balance-Unbalance (a.k.a. BunB) was held again in 2011, this time at Concordia University, in the city of Montreal, Canada. Those were two days of reflection, debate, information exchange and promotion of projects and actions regarding the environment and our responsibility at this crucial moment in history. This conference was possible thanks to the direct involvement of faculty from Concordia University coming from very diverse backgrounds, like communication, political sciences, geography, management, music, digital arts and design. There was an amazing number of submissions received to participate in the conference with paper presentations, posters, films, electroacoustic and computer music, art installations and also a diversity of transdisciplinary sessions with open structures to accommodate all kind of innovative proposals, always considering digital art as the interconnecting hub and the environmental crisis as the umbrella covering us all. [2]

Once again in 2013, a third edition of *Balance-Unbalance* was showing the high potential of these actions. The expected catalyzer started to work and the digital arts were, step-by-step, leading the way. This time the conference was held at the Noosa biosphere, an ecological reserve recognized by UNESCO in Australia. The Noosa Biosphere is a dynamic learning laboratory for sustainability in one of the most pristine and diverse environments in Australia. The three-day conference took place at Central Queensland University, with satellite events in several other places, including Lake Cootharaba. [3]

An e-book with some of the papers presented at the 2013 *Balance-Unbalance* conference was published and it can be downloaded from the Internet for free. [4]

The conference theme: 'Future Nature, Future Culture[s]' aimed to challenge our expectations of Earth, provoke our understanding of nature and inspire our actions for a sustainable future. *Balance-Unbalance* was proposing to ask ourselves: "What we will be calling nature in 20, 50 or 100 years? How we will live in the future? How could creativity help us shape a society of understanding and interconnectedness? What role could transdisciplinary thought and action play in reimaging a sustainable future?" considering that: "All is interconnected. No person, no animal, no object or idea can exist independently. Our limited knowledge of life can be expanded, but to do so we need better ways to understand each other. This includes a deeper awareness of how different human societies can comprehend cultural differences and synergies. There is a dramatic need for a paradigm shift and we need to act now if we are going to survive as a species." (from the *Balance-Unbalance* 2013 website).

Like in previous editions, digital art was not only part of the papers in the form of theoretical analysis and proposals but a substantial component of the event. Works and papers by Nicolas Bullot, Krista Caballero, Frank Ekeberg, Hamilton Mestizo, Ian Clothier, Karola Obermueller, Sarah Pirrie, Roslyn Taplin, Peter Gilbert, Teresa Connors, Andrew Denton, Rene Burton, Damian Castaldi, Leah Barclay, Todd Ingalls, Mary Bates Neubauer, Suzon Fuks, Mónica Mendes, Pedro Ângelo, Nuno Correia, Jim Denley, Monika Brooks, Dale Gorfinkel, Garth Paine, Ben McMullen, Sabine Feisst, Andrea Polli, Julie Arrighi, Perdita Phillips, John Dahlsen, Michel van Dartel, Anne Nigten, Susan Davis, Tony Fry, Jodi Newcomb, Claudio Rivera-Seguel, John Coulter, Lisa Chandler, Ramón Guardans, Susan Frykberg, Daro Montag, Jordan Lacey, Paul James, Proyecto AbRiGo, Feral Arts and members of the Australian Forum for Acoustic Ecology, among others, were presented at Queensland Central University and the Noosa Regional Gallery, where also the Leweton Cultural Group was performing (traditional music and dance from Vanuatu's endangered islands). A number of artistic events were also held in partnership with the Floating Land festival and presented in Boreen Point and locations within the region. Fifteen short articles on research and creation projects presented during this conference have been published by The MIT Press on Leonardo, the Journal of the International Society for the Arts, Sciences and Technology, on a special section devoted to *Balance-Unbalance*. [5]

After the first *Balance-Unbalance* conference was held in Argentina in 2010, other associated initiatives were also produced: "Balance-Unbalance. Environmental Responsibility" ("Equilibrio-Desequilibrio. Responsabilidad medioambiental") was a digital arts exhibiton presented by CEIArtE at the National University of Lomas de Zamora, Buenos Aires province, in 2011. A second exhibition was presented at the same venue in 2012: "Balance-Unbalance. Sustainably economy, sustainable energy, habitable environment" ("Equilibrio-Desequilibrio. Economía sostenible, energía sustentable, medio ambiente habitable"). The third exhibition of the series was held in a central location of downtown Buenos Aires, the San Martin Cultural Centre, during the 2012 *Electronic November* large-scale festival of media arts: "Balance-Unbalance. Knowledge-Action in Times of Uncertainty" ("Equilibrio-Desequilibrio. Conocimiento-Acción en Tiempos de Incertidumbre"). In 2014, a new edition of this exhibition series was presented

at the original venue, the National University of Lomas de Zamora, under the name of "Balance-Unbalance. Posthumanity and Environment" ("Equilibrio-Desequilibrio. Posthumanidad y Medio Ambiente"). Always linking computer art with environmental issues, these exhibitions presented Internet works, electronic sculptures, video installations, telematic pieces, artistic interventions, site-specific interactive installations, electroacoustic and soundscape works as well as sound art installations by artists from Argentina, Austria, Brazil, Canada, Chile, Colombia, France, Italy, Mexico, The Netherlands, New Zealand, Portugal, South Korea, Spain, the United Kingdom, United States and Venezuela

The fourth edition of *Balance-Unbalance* was held in March, 2015. It was hosted by Arizona State University and its main focus was set on: "Water, Climate and Place. Reimagining Environments". The subject reflects some particularly relevant circumstances considering the location: the Southwestern desert of the United States.

Balance-Unbalance 2016 is being organized in Manizales, Colombia. This city is part of the coffee-growers axis and it is built in a mountain region with seismic instability. A rich, changing and challenging environment, with a subtropical highland variety of climate and an average of 1,500 millimeters (59 inches) of precipitation a year, that will allow participants to have a contrasting experience considering the places where previous editions of the conference where held.

'*art*! ⋈ *climate*'

Sometimes experiments take their own way, and an unexpected positive consequence in the form of a project - with an excellent potential- becomes a possibility. *Balance-Unbalance* had no resources to invite keynote speakers for the conference but still we were able to bring in Dr. Pablo Suarez, Associate Director of the Red Cross / Red Crescent Climate Centre to Montreal for the conference in 2011. As a direct result of Dr. Suarez participation in *Balance-Unbalance*, the '*art*! ⋈ *climate*' project was born shortly after. [6]

The Red Cross / Red Crescent Climate Centre and the Electronic Arts Research and Experimentation Centre (CEIArtE) joined forces to develop the *art*! ⋈ *climate* contest for the creation of digital sound-based art miniatures focusing on the environmental crisis and climate change related issues. The Climate Centre's mission is to help address the humanitarian consequences of climate change and extreme weather events. In its efforts to engage people at risk, government agencies, academic institutions and other stakeholders, it has become clear that information is rarely sufficient to trigger behavior change. As a result, the Climate Centre is designing and facilitating methods for learning and dialogue that involve not only the brainpower but also the emotions of participants (such as collaborative workshops, participatory games and short educational films, linking information, decisions and consequences on disaster management).

The *art*! ⋈ *climate* contest had two main objectives: a) Provide the Climate Centre with sound-based art material that can support their actions; and b) Improve knowledge about the human dimensions of the environmental crisis and promote awareness about the effects of climate change, both among creative artists and among those exposed to their work.

The first *art*! ⋈ *climate* contest has been co-sponsored by Hexagram, the Research-Creation Centre in Media Arts and Technologies of Concordia University, Canada, the Central Queensland University and the Noosa Biosphere Reserve in Australia, and Leonardo/ISAST.

For this contest, sound art miniatures implied short creations of sound art/music produced using new technologies and encompassing what is known as soundscapes, electroacoustic and computer compositions, sonorizations, and sonifications.

The categories available for the contest were two: 'Mosquitoes' and 'Open Theme'. The 'Mosquitoes' category aimed to support initiatives to raise awareness and better manage the growing risk of malaria, dengue and other mosquito-borne diseases that are showing new regional and seasonal patterns due to changes in rainfall and temperature - an issue highlighted in several Red Cross projects in Africa, Asia and the Americas. The 'Open Theme' category invited submissions about other dimensions of changing environmental conditions.

The works were selected by a jury of internationally recognized composers and new media artists: Marc Battier, Andrés Burbano, Joel Chadabe, Ricardo Dal Farra, Alireza Farhang, Rajmil Fischman, Arturo Gervasoni, Leigh Landy, Fabián Luna, Raúl Minsburg, Jaime Oliver, Julien Ottavi, Garth Paine, Andrea Polli, Paul Rudy, Suzanne Thorpe, Barry Truax, Michel van Dartel, and members of the Climate Centre as well, finding that was possible to have good artistic works that could also fulfill the specific needs of an humanitarian organization for its daily field actions. Selected works came from sound artists and electroacoustic composers from all over the world: Argentina, Australia, Austria, Brazil, Canada, Colombia, Czeck Republic, France, Germany, Greece, Israel, Italy, Mexico, New Zealand, Peru, Portugal, Romania, Spain, The Netherlands, South-Korea, United Kingdom, United States and Venezuela. [7]

All pieces are now available in SoundCloud both for listening online and for downloading, under a Creative Commons license. [8]

Composing digital sound art miniatures proved to be a great way for musicians to stop being spectators and start to contribute actively to humanitarian goals.

A second contest was launched on October of 2014. This time, several organizations are teaming up: the original two organizers, CEIArtE and the Red Cross / Red Crescent Climate Centre, are now working together also with the Climate and Development Knowledge Network (CDKN), the International Institute for Environment and

Development (IIED), and the Overseas Development Institute (ODI). [9]

There are also two categories on this second *art*! ⋈ *climate* contest but are not the same proposed on the first instance. The categories are always defined according to the needs specified by the humanitarian organizations, on this opportunity they were: 'Sea level rise' and 'Zero poverty. Zero Emissions. Within one generation'. [10]

This new contest had two deadlines, the first one targeted the Climate and Development Days that were held in the context of the UN Climate Change Conference (United Nations Framework Convention on Climate Change - UNFCCC COP) in Lima, Peru during December 6 and 7, 2014. [11]

Four sound-art miniatures were selected from this round and one from each category was then publicly announced and shared during the international event.

The second and final deadlline, in February of 2015, allowed sound artists and composer more time to research and create their miniatures. Worth mentioning that there is no limit to the number of works to be selected by the artistic jury and the humanitarian organizations jury.

This time the artistic jury was composed by: Alex Adriaansens, Leah Barclay, Marc Battier, Sandeep Bhagwati, Adriana Casas, Joel Chadabe, John Coulter, Ricardo Dal Farra, David de Gandarias, Orlando Jacinto García, Goh Lee Kwang, Amin Hammami, Fernando Iazzetta, Adina Izarra, Leigh Landy, Neil Leonard III, Fabián Luna, Andra McCartney, Raúl Minsburg, David Monacchi, Daniel Quaranta, Jaime Reis, David Rothenberg and Rodrigo Sigal. Then members of the Climate Centre and associated organizations were working on the last part of the selection process, aiming to find the works that best fit with their humanitarian needs. Pieces came from sound artists and composers living in: Argentina, Australia, Brazil, Canada, Italy, Kosovo, Mexico, Portugal, South Korea, The Netherlands, United Kingdom and the United States.

The selected pieces have been already presented during the *Balance-Unbalance* 2015 conference in Arizona and the Festival Internacional de la Imagen 2015 in Manizales, Colombia, among other events. Same as with the first edition of *art*! ⋈ *climate*, they will be made available in SoundCloud for listening online and for downloading, and the Red Cross / Red Crescent Climate Centre -and associated humanitarian organizations- will be using them according to their field actions needs.

EChO

EChO is a project focusing on how the media arts have responded to the challenging problems of the environmental crisis, looking forward towards an increased role for the media artists. It seeks to understand how art has served and can further serve as an essential link between science, social science, activism, and policy formation.

There are many projects by artists and artist-related organizations working in the media arts field and focusing on environmental problems. There are also many governmental, intergovernmental and non-governmental organizations, as well as private institutions, searching for solutions to the ecological danger for human life either at the local, regional or global level. EChO's goal is to connect, hence empower initiatives from around the world aiming to help in facing major ecological threats and finding solutions for a sustainable -and humanly livable- future.

EChO is proposing to match a public online database devoted to electronic art projects focusing on environmental issues with a virtual meeting point to facilitate communication. It has an openly proactive orientation as it seeks to produce knowledge that could be used for inspiring and enabling collective actions, connecting media art projects using science and digital technologies.

A transformational knowledge network to facilitate the generation of links among similar art-science-technology projects around the world, empowering and helping them also to connect with key players (research groups, humanitarian organizations, policy makers, artists associations, opinion formers, technology innovators, etc.) having interests alike.

This project proposes to facilitate the building of links to give power to otherwise unrelated initiatives and actions.

ECHO will be cataloguing and analyzing efforts by media artists to represent the causes, nature, extent, and possible solutions to environmental problems ranging from climate change-related issues to hazardous waste disposal, habitat destruction, the introduction of invasive species, and many others. The resulting database will: create links between artists' projects and actions, and between artists and other possible partners. The outcomes of EChO will have the potential of converting limited-reach projects with significant potential into something that could influence an international community, and eventually develop and increase its original scope.

The information will be organized according to different criteria, currently under analysis. Some examples could be: disaster type (e.g. biological, geophysical, hydrological, climatological); consequences (e.g. drought, flood, storm, mass earth move); artworks characteristics (e.g. focus, supporting concepts, potential applications, methodologies, technical requirements, possibilities for achieving the goal of solving a specific environmental problem: water scarcity, air pollution, etc).

The fundamental concept supporting EChO is to create a network to develop forces large enough to turn good will into actions. It could be a way to analyze, test and promote artistic projects considering solutions for environmental problems defying our existence and life in general.

Conclusions

In this context of global threats: Can the electronic arts and artists help? Yes, we can help. Everyone has a responsibility in the construction of the future, electronic artists too.

We can reflect, research and create. We can act and also invite others to reflect, engage, envision and act.

A large part of the population is living in uncertainty [regarding basic needs] and many barely surviving. When the *Balance-Unbalance* project started some years ago it probably appeared to be a naïve, good-will based, utopian initiative, trying to join intelligence and forces from a variety of fields in using e-art as a catalyst to face a problem we all share: the complex environmental crisis. Bringing people from very different sectors of society together, today *Balance-Unbalance* and its associated projects are not only proving it is feasible to connect artistic creation and realistic tools for change but to actually help in making that social changes could happen. The electronic arts as a driving force for…? Yes, the possibility to work on a project where artistic quality, knowledge building and humanitarian actions are all together in a balanced equation to confront the unbalance is feasible.

The '*art*! ⋈ *climate*' project became possible as a creation-knowledge-action proposal to reach those who are already affected or in imminent danger from the consequences of climate change, and also to those who are not directly touched by it yet. It can be seen as a tool but it is not less artistic for being that. On the contrary, the principal idea here grows from a cooperative effort, having powerful means based on artistic creations -with a value independently from its potential functionality- and simultaneously, a tangible application in humanitarian actions. The Red Cross / Red Crescent Climate Centre has found the '*art*! ⋈ *climate*' project helpful according to its goals and objectives. It seems to be a true collaboration that can have an effect on "real people" while preserving the significance and meaning of each contribution and action. [12]

EChO is still in an early stage of development but many people is convinced of its potential "benefits" in a variety of ways. EChO wants to help in building a network that should not duplicate other efforts and would extend our possibilities to learn from each other, empowering the significant actions that artists working with digital means could offer to face environmental challenges. Please, feel welcomed to share your thoughts and send your feedback about it.

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The Listen[n] Project: Acoustic Ecology as a Tool for Remediating Environmental Awareness

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Abstract

The Listen[n] project[1] is an interdisciplinary media arts project, investigating the pristine acoustic ecologies of Southwest deserts of America. Establishing the largest database of ambisonic and stereo field recordings of the Southwestern landscapes of the United States, the Listen[n] project is designed to not only archive sound, but to explore how virtual environmental engagement through media arts and sound can cultivate environmental awareness and community agency. It delivers community partnerships and capacity building with enthusiastic communities in four American Southwest desert communities: Joshua Tree, Sequoia & Kings Canyon and Organ Pipe Cactus National Parks and the Mojave Desert Trust. Aiming to empower and encourage communities to make creative contributions to and have agency in the development of the Listen[n] project, this paper outlines the fieldwork undertaken in 2014 and 2015 and discusses the substantial online listening database, virtual reality and web based tools deployed and currently in development. It will also provide information on the project's innovative application of ambisonic audio recording and playback to create 360-degree immersive experiences online and through the Oculus Rift VR headset (EcoRift).

Keywords

acoustic ecology, field recording, ambisonics, immersion, virtual reality, modes of listening.

Introduction

The Listen[n] project is an interdisciplinary media arts project, investigating the invaluable sonic ecologies of Southwest deserts of the United States. At its core, accessibility is actively designed into the digital platforms, community workshops and media artworks to support their creative use by as many different people as possible. The outcomes support engagement with rich natural environments for the broader public whilst also advocating for the proper recognition, respect and the active involvement of indigenous communities, elderly individuals and people with disabilities who would not traditionally have visitation access to these environments. The Listen[n] project aims to empower individuals of different abilities to collaborate and engage communities that do not traditionally have access to audio-visual technology. The project's collaborative media artworks and forthcoming touring exhibition will provide immersive environmental experiences for audiences all over the world.

Contested Spaces

The Listen[n] project focuses on the acoustic ecologies of pristine natural environments in the American Southwest. The term, "pristine natural environments" is of course problematic. It romanticizes and commodifies the land and our engagement with it. All landscapes are contested spaces, they are constructions of enculturation, be that perceptions of the energy and spirits within the land, and reflected by the land and the animals inhabiting it; a Western romanticized notion of settlement, belonging, entitlement, or an industrial view of the potential of wealth production, the gallons of oil, tons of ore, gold etc. and all the possible nuances between. Beyond these critical notions of land and place we can perceive an interplay of sharing commonalities, conflict and the transformation that occurs as the lobbyists and activists dance around each other over time.

The acoustic ecology of a space often tells a story of intervention and the relationship between the quality of the land surface, the vegetation, and the sounds of habitation, be they human or otherwise. Made up of two principal components, the acoustic ecology can be described as consisting of the substrate; the sonic properties of the land itself, the reverberation, the softness or harshness of the sound, the land's quietness. It also consists of a second principal component containing the sounds of activity of animals for whom the land is their habitat, the sounds of the critters, insects, birds, and larger animals [biophony], and non-sentient sound sources such as water, rocks, wind, weather [geophony] and above these naturally occurring sounds is a third dimension made up of human sounds [anthrophony], airplanes, motor vehicles, air-conditioning etc. - the sound of human presence, activity and intervention, sounds that often overlay the sounds of the natural habitat. These acoustic ecology dimensions indicate the rich and dynamic interplay between natural, cultural and industrial presence on any site.

This point is well illustrated by the experience of standing in the middle of the vast Soda Lake salt pan at 4:00 a.m., May 28, 2014. The terminus of the Mojave River in the Mojave Desert of California, contained within the Mojave Desert Preserve, one could hear the I15 freeway, some miles away, but reverberating across the flat surface of the

[1] See http://www.ecolisten.org , viewed 23 May 2015.

salt pan,the occasional air conditioner, maintaining comfort at the research station several miles in the opposite direction. Simultaneously one is aware of the soft enveloping acoustic of the site, established by a quietness, a fullness of air, characterized by the absorbent qualities of the salt lake surface, the reverberant qualities of the surrounding hillsides and the minimal bird and insect life active at that time of day. The sound of the freeway predominated the underlying acoustic of the site.

Soda Lake is part of the UNESCO Mojave and Colorado Deserts' Man in the Biosphere Reserve designated by UNESCO in 1984 to promote ecological conservation. The Mojave and Colorado Deserts Biosphere Reserve includes the Death Valley National Park (in the Mojave Desert), Joshua Tree National Park (in the Mojave/Colorado transition zone), the Santa Rosa Mountains Wildlife Management Area (in the Colorado Desert) and the Anza-Borrego Desert State Park (in the Colorado Desert). It is a vast land area which has a long history of human intervention and protection. What is now the Mojave Desert Preserve witnessed some of the first Spanish expeditions through eastern California in the late 18th century. In 1860, the U.S. Army maintained a fort at the site named Hannock's Redoubt, but a twentieth-century maverick gave it its lasting appellation, Zzyzx Mineral Springs and Health Resort which remained an active alternative community until 1974. In 1976, the California State University system negotiated with the U.S. Bureau of Land Management to establish The Desert Studies Center, a research facility that draws scientists and students year-round. Almost any site of human habitation could have as diverse a history. This evolution of occupation, intervention, and transformation is made explicit through the site's acoustic ecology in a unique manner. Listening deeply to the sonic environment makes one feel increasingly present – deeply present. Just listening for the delicate and intricate web of sounds that are there, but that one doesn't hear most of the time makes one aware that these spaces are neither silent nor empty. They reveal an ecology, made up of acoustic features - an acoustic ecology, that carries with it, even in the recorded medium, a sonic signature of the environment in which it was created, a sonic signature for the environment to which we have a somatic response – a bodily, phenomenological response. In this way, the I15 traffic noise, the distant sound of the air-conditioner at the research center, the quietness and softness of air, and the qualities of reverberation across the salt pan surface, all combine to provide an abstract, experiential history of the Soda Lake site. This experiential history is not a concrete, fact-based narrative but more a felt, somatic engagement with the qualities of the site through listening.

It should be noted that the terminology used in soundscape studies references sources – birds, wind, humans, etc. – but does not really address a notion of a baseline soundfield, a sonic a-priori.

R. Murray Schafer's key terms include:

- Keynote Sounds – sounds created by nature (geography and climate): wind, water, forests, plains … including birds, insects, animals.
- Sound Signals - foreground sounds, which are listened to consciously: bells, whistles, horns, sirens, etc.
- Soundmarks – "sounds that make the acoustic life of a community unique."[3]

A challenge that remains even with Stuart Gage and Bernie Krause's remaking of these terms into:

- Geophony - non-biological natural sources such as wind in the trees, water in a stream or waves at the ocean, and earth movement.
- Biophony - non-human, non-domestic biological soundscape sources of sound.
- Anthrophony - all of the sound signatures generated by humans.

Anthropologists have sought a more phenomenological approach. One approach being Steven Feld's phenomenological discussion of sensing place "as place is sensed, senses are placed; as places make senses, senses make place" and his term acoustemology: "one's sonic way of knowing and being in the world"; He talks about "how sounding and the sensual, bodily, experiencing of sound is a special kind of knowing."[2]

These responses are subtle, somatic and yet profound – one might reflect here on Richard Shusterman's proposal of Somaesthetics – which is said to "foreground the role of bodily experience in aesthetic appreciation." Shusterman says we must differentiate between representational foregrounding and experiential foregrounding. In the former, the body is seen and treated as an external object. In the latter, the body is a fundamental part or vehicle of lived experience. (n.b. also Dewey, *Art as Experience*,1934).

In an attempt to move away from citing sound sources (the excitation - representational foregrounding) and acknowledge a baseline sonic atmosphere (experiential foregrounding), we might consider extending the existing terminologies to focus on whole being, direct experience of sound rather than sound as an external object and in so doing, recall Gregory Bateson's (Bateson, 1972) proposition that the patterns of mind (consciousness) and the patterns of matter are reflections of one another and part of an unbroken dynamic whole, suggesting that the body, the space, and the resulting sense of place are inseparable.

During a keynote presentation at the Ecomusics & Ecomusicologies 2014: Dialogues conference in Asheville, Garth Paine proposed the term: *Somaphony* - *Soma* meaning the subtle body and *phon*, denoting sound.[3] Somaphony hints at a sense of being present – of being in a place that is defined as much by its baseline sonic signature as it is by

[2] Steven Feld, "From Ethnomusicology to Echo-Muse-Ecology" Reading R. Murray Schafer in the Papua New Guinea Rainforest," *Soundscapes Writings Essays 2001*, accessed 23 May 2015, http://www.acousticecology.org/writings/echomuseecology.html.

[3] See Ecomusics & Ecomusicologies 2014: Dialogues, accessed 23 May 2015 http://www.ecomusicologies.org/.

the presence of sound signals and keynote sounds, an inclusive experience of "knowing and being in the world," a "bodily, experiencing of sound [as] a special kind of knowing" whilst simultaneously acknowledging the sonic as an object as referenced by the standard acoustic ecology terminology. Paine is drawing attention to a whole-body mode of listening where perception is singular and cumulative and in line with Feld's "ways of knowing," rather than a concrete, separable and identifiable mode in the sense of traditional acoustic ecology concepts.

Embodied Interaction

Embodied interaction drives the technology development of the Listen[n] project which includes a large-scale online field recording database, an Oculus Rift VR experience (EcoRift) and a set of tools for mobile devices that allow the users to translate their current geolocation into one of the documented UNESCO Biospheres and National Parks and to immediately make recordings, take pictures or write stories for upload to the Listen[n] community portal. This strategy aims to engage users through embodied experiences in the rich potential of pristine natural environments.

Phase One

In 2014 two sets of field trips were undertaken and ambisonic and stereo field recordings were made in the early morning (dawn), early afternoon, and early evening (dusk) in each of the American Southwest desert Biospheres/National Parks named above. More than sixty hours of recordings were made, and subsequently auditioned and tagged before being added to a searchable online database which provides the public with direct multi-format access to listen to the documented sound fields from anywhere in the world. Five composers from around the globe, Ros Bandt, Leah Barclay, Ricardo dal Farra, Douglas Quin, and Garth Paine, used these recordings to create acousmatic compositions which were premiered in Tempe, Arizona in 2014.[4] In addition, 360-degree photographic panoramas were created at the location of each recording. The recordings and images have been combined in several experiential media outcomes: 1) as a navigable panorama on the website which ties together the 360-degree image with realtime spatial audio navigation of the 360-degree audio recording made using the ambisonic technique. 2) This experience has been further developed for offline high resolution deployment as an Oculus Rift VR experience called the EcoRift which offers a truly immersive engagement with the represented high-value natural environment, providing full 3D Point-of-view and stimuli in both the audio and visual domains.

A website containing the above recordings and information about the project has been developed in a manner that enables each community near the featured National Park/Biosphere Reserves to add to the recordings made by the Listen[n] team through audio, photographs, video, and text. The website is structured around each geographical location, with a single page for each site containing the 360-degree panorama, a description of the location, the UNESCO Biosphere Reserve data, a map showing the geolocation of the recordings available in the database, a search pane that provides direct listening access to the soundfields. It also offers a community PlaceStories portal where the local community can upload media related to the project using skills developed in Listen[n] project community workshops and equipment left in the communities for this purpose.

Initial experiments with the EcoRift system have shown that realtime dynamic movement through both the visual and auditory domains produces a strong sense of presence and immersion in the represented natural environments. We postulate that this is because the ambisonic soundfield provides full 3D auditory cues, and that linking the head-tracking to roll, pitch, yaw and zoom in the auditory field provides the same ability in the EcoRift experience of moving the head slightly to determine or check auditory spatial coordinates as would be experienced in the real world. When synchronized with a 3D panoramic visual representation of the recording site, users have reported a very strongly embodied experience of being present in these natural locations.

The final aspect of the first phase of this project is the development of a mobile platform application that allows users to select one of the documented National Park/Biosphere Reserves they wish to walk through; they then select a walking route in their local environment - perhaps their route to work through an urban environment - wearing noise-cancelling headphones and push go - the app geo-locates them in the desert soundfield as they walk through their local environment, providing an embodied experience of traversing, or sitting and listening in a unique natural environment. This application also uses ambisonic sound sources providing full spatial panning and zooming in the 3D soundfield and constructs contiguous soundfields by extracting features from conjoined static recordings to form a seamless sonic space.

Phase Two

In 2015 the Listen[n] team made public presentations in Joshua Tree and Sequoia & Kings Canyon National parks and offered workshops for young people on listening and field recording as part of National Parks Week. A further two periods of immersive community engagement will take place in each location. The first involves workshops on listening and recording natural environments and an exploration of the ideas of acoustic ecology for school children and visitors to the park respectively and a work-

[4] The compositions are: *Raptor* (Bandt); *Ground Interference* (Barclay); *Listening* (dal Farra); *Contested Landscapes: Singularities, Granularities and Sonorities* (Quin); and *Becoming Desert* (Paine). Paine also created the interactive work *Forest* (2015) which combines desert field recordings and live flute performance.

shop focusing on field recording by the Listen[n] team in locations suggested by the community followed by introductory and advanced workshops on listening, acoustic ecology, and ambisonic audio recording. The final stage of this period features participatory opportunities, including the sharing of field recordings on the Listen[n] Database and the publishing of digital stories around listening to desert sounds on the Listen[n] PlaceStories portal.[5] The longer workshops take place in collaboration with local community groups who will support volunteers in a long-term endeavor to re-record the acoustic ecology of each site at monthly intervals for the next decade(s), forming the basis for comparative studies of changing sonic ecologies due to changing climates, land use and habitation.

The second workshop period involves collaborations with the community in creative responses to the environmental field recordings made in the first workshops. The workshop participants will have the opportunity to make their own media art using Listen[n] project recording equipment left in the communities in the first workshop period. Participants will create solo and collaborative sound and media artworks based on environmental and heightened auditory engagement..

These Listen[n] project sound and media artworks will be curated into a touring exhibition and concert. The exhibition will include a dynamic website streaming the environmental field recordings for exhibition attendees (and local and global audiences). It will also offer unique 360 EcoRift VR experiences, The concert will feature immersive sound compositions disseminated on three listening stations and multi-channel acousmatic musical works drawing on the field-recording database..The exhibition and concert will premier at the ASU Art Museum in 2016.

Transmedia Approach

The Listen[n] project may remind of a number of endeavors involving nature sound recordings. However, it is unique in its scope, its many different and interdisciplinary components, its innovative technologies, its extended time span (designed to evolve over several decades), its concentration on national parks in the American Southwest, and its focus on community engagement.[6] The PlaceStories software, for instance, inspires the formation of strong cohorts by establishing a framework of Community, Project, and Story.[7] It allows for the development of extensible and dynamic communities by supporting the storytelling and communication needs of groups with a common interest. PlaceStories's application in the domain of acoustic ecology is well demonstrated by the Bioshpere Soundscapes project founded and directed by Listen[n] team member Leah Barclay in 2012.[8] Biosphere Soundscapes has built communities committed to "listening to the environment and exploring the value of sound as a measure for environmental health in UNESCO Biosphere Reserves." The Listen[n] project builds on the success of such trans-disciplinary ventures.

The distinctive components of the Listen[n] project combine in a single interface - each feeding into the overall vision of the project. This multi-platform approach is essential in our accessibility strategy and community engagement methods. The contemporary practice of a transmedia methodology requires cultural assets that fuse not just audio and visuals, but also design, interactivity, and a host of other disciplines. The multiplicity of digital distribution channels, balanced by the ease with which they connect to each other, demands that the artist of the future designs cultural assets that can seamlessly blend across multiple platforms. We are reaching an age in which audiences are consciously creating and viewing the narrative of their own lives across various platforms (e.g. via Instagram, Flickr, Facebook). Artists and humanities researchers should be aware of this trend when designing forms of community engagement and outreach. Listen[n] combines highly accessible outcomes (such as listening to high-quality field recordings) with technologies at the forefront of entertainment (such as the embodied EcoRift and mobile geo-locating walk experiences). It does so to enable communities to take agency in this project and to foster stewardship in their local environments whilst contributing to and/or driving the discourse of the project over decades and beyond.

Conclusion

Listen[n] gives voice to a wide range of constituencies: to communities living in proximity to the featured sites; to communities distant from these sites; and to the non-human and non-sentient constituents of these sites. The digital tools and dynamic website facilitate both a disruption of traditional visitation of pristine natural environments and simultaneously through this remediation, a broadened access. Listen[n] uses technologies to question embodied experience and to encourage new forms of embodied actions. It integrates significant discussions about sound, sustainability, and the place of human experience through creative storytelling, digital mapping, and community collaboration. Listen[n] builds important connections between the humanities, the environmental sciences, and media arts through development of new technologies, interdisciplinary research, creative endeavors as well as educational and outreach initiatives. It seeks to foster new en-

[6] Neither Marc Anderson's *Nature Soundmap* (a database of binaurally recorded nature soundscapes and satellite images), nor James Bulley and Daniel Jones's *Living Symphonies* (a work with sounds from British forests recorded in 2014 and sounds performed on Western musical instruments) or Canada's 2011 National Parks Project (involving nineteen film makers and thirty-nine musicians to create works about Canada's national parks) engage local and global communities directly in creative placemaking in such a multi-faceted manner as does the Listen[n] project.

[7] See http://placestories.com viewed 23 May 2015.

[8] See http://www.biospheresoundscapes.org viewed 23 May 2015.

vironmentally aware communities who through social media can use their voice as stewards of these protected, yet vulnerable landscapes.

Given such ever-growing challenges as environmental degradation and climate change, the multifaceted outcomes of this project will hopefully nurture more sustainable lifestyles and stabilize park ecosystems. The participating communities will learn to critically interpret their relationships to natural and built environments through new forms of listening enabled by technology. Across each of these outcomes, sound plays an important role for establishing and cultivating individual/community agency and environmental stewardship. In giving voice to individuals and community members to articulate their own positions in these natural spaces, Listen[n] opens up new opportunities for exploring the importance of place and the vibrancy of sound for its audience.

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Authors' Biographies

Garth Paine is internationally regarded as an innovator in the field of interactivity in experimental music and media arts. He is a Professor of Digital Sound and Interactive Media in the School of Arts Media + Engineering and a professor of composition in the Schoolof Music at Arizona State University. As an Associate Professor in Digital Musics at the University of Western Sydney, Australia, he established and directed the Virtual, Interactive, Performance Research environment (VIPRe). He is fascinated with sound as an exhibitable object, which has led to several interactive responsive environments where their inhabitants generate the sonic landscape through their presence and behavior. It has also led to music scores for dance works, generated through real-time video and/or bio-sensing of the dancers. Paine is widely published, retains positions on editorial boards of in the USA, UK, and Australia and performs his own compositions regularly at international festivals.

Leah Barclay is an Australian composer, sound artist and creative producer working at the intersection of art, science and technology. Her work has been commissioned, performed and exhibited to wide acclaim internationally and she has directed and curated interdisciplinary projects across the Asia-Pacific. Barclay's PhD involved site-specific projects across the globe and a feature length documentary exploring the value of creativity in environmental crisis. Her research has been published internationally and her creative work has been selected for major international festivals and conferences. She is currently an artist in residence at the Australian Rivers Institute investigating the creative possibilities of aquatic bioacoustics, the president of the Australian Forum for Acoustic Ecology and the founder and artistic director of Biosphere Soundscapes, a large-scale interdisciplinary art project connecting the soundscapes of UNESCO Biosphere Reserves across the world.

Sabine Feisst is Professor of Music and Senior Sustainability Scholar at Arizona State University. Focusing on twentieth and twenty-first century music studies, she published the monographs *Ideas of Improvisation in New Music* (Studio Verlag, 1997) and *Schoenberg's New World: The American Years* (Oxford University Press, 2011), as well as numerous essays in European, American and Australian professional journals, essay collections, and encyclopedias. She is currently editing the *Oxford Handbook of Ecomusicology*. With Denise Von Glahn, she is editing the book series *Music, Nature, Place* for Indiana University Press.

Daniel Gilfillan is Associate Professor of German Studies at Arizona State University. His research focuses on twentieth-century literature, film and media studies in the German-speaking sphere, with particular interests in avant-garde/experimental approaches to new forms of media in the past (radio, film) and the influence of these earlier instances of new media on contemporary artistic and cultural practices with telecommunications media. His first book, *Pieces of Sound: German Experimental Radio* was published by University of Minnesota Press (2009). He is currently working on a second book titled *Sounding the World: Sustainability and the Art of Sound*, which explores the role of sound within the key concepts of resilience and precariousness as they function across complex adaptive systems, and these systems' need for sustainable infrastructures.

[Session 3]

Art, Wellbeing and Society

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A Wearable Experiment to Radiate Prosocial Wellbeing Through Psychophysiological Mirroring of Laughter

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Abstract

Based on a practical somaesthetics framework emphasizing the values of self experiences, this paper presents the design rationale of a responsive dress, Laughing Dress, which employs laughter as an agent to highlight the unobvious and unspoken social distance between strangers and inverting our cultural notion of public self-containment. The proposed wearable dress is used to investigate the concept, "disruption for reformation". Throughout the design process, the prototype addressed the research question, "Can exposing self-representations through synthetic sound as inner voice and rhythmic light as somatic energy rattle and provoke reposition of us against existing social norms of private-public space?" The research instrument aims to break personal boundaries by magnifying wearer's self-presence, enticing a psychophysiological mirroring of laughter in another entity, and evoking a sense of curiosity through a display of visual aesthetics. The unusual display and magnification of self-presence within public setting contributes to disruption of social expectation on self-containment in public, reflection upon the organic form of human-to-human interaction, and initiation to realign our behaviour.

Keywords

Wearable Technology, laughter, responsive wearable, psychophysiological mirroring, social mimicry, emotion contagion, prosocial behaviour, social convention

Introduction

City is built upon decades of structures and regulations, where its culture plays a major role in its inhabitants' social behavior. Social changes emerged from new innovations and political movements reconcile behaviour incrementally, but the repercussion might be far-reaching. Advancing technologies have created a new era of communication where people of different location and time are able to connect and reconnect quickly and effectively via telecommunication. The emerging behaviour led to the major shift of attentional focus towards handheld devices and other forms of electronic, thus consequencing on a lack of face-to-face communication between one another.

Laughter is a universal form of human communication that indicates intrinsic emotion, mood or personal expression outwardly. Neuman et al. describe this involuntary mimicry of expression as mood contagion, which aligned with Van Barren et al.'s view point of a mirroring of postural, emotional, and behavioural reaction from the observer [9, 20]. Laughter's contagious ability makes it an intuitive, yet fitting medium outcasting positive energy from oneself to another, thus disturbs the social silence within a self-containing culture and invites a merging of personal space.

Research Potential

Advances in telecommunication technologies have allowed our communication across distances to be instantaneous, efficient, and dynamic. While they have allowed for users to remain socially connected across multiple platforms simultaneously in the digital realm, it has also created a phenomenon of physical isolation between users in our physical world, resulting in the loss of intimacy and connection between persons.

A recent meta-analysis of social interaction in Vancouver, Canada, demonstrates that large numbers of residents in metro Vancouver experience social isolation and disconnection [21]. The largest community foundation, Vancouver Foundation, conducted a mixed method study with 3,841 participants in 2012, where 34% of the participants felt difficult to build new social connection in Vancouver. 60 % of the participants only have short conversation with any of their neighbors less than 2 or 3 times a month. Moreover, 26 % of house tenants never speak with their neighbor more than once a year. 25% of the participations felt lonely, where young adults, new comers to the country, and new members of the neighborhood aged 25 to 34 experienced social isolation the most. In addition, Perissinotto et al. pursued a longitudinal cohort study of 1604 participants in psychological and health condition and found that 43% participants experienced a lack of social contacts and felt disconnected with their community [11]. They assert that the social isolation in adults older than 60 years could cause some functional decline in mobility of their body and even death.

The desire to revitalize the diminishment of face-to-face communication in our technological advancing society motivated a research exploration on the concept of "disrup-

tion for reformation" through interactive public art. We implemented a research prototype that encompasses materiality, poetics, and semantics of interaction for practical somaesthetics. The interactive dress aims to investigate whether a combination of synesthetic laughter with rhythmic light patterns provides sufficient somatic stimulations to provoke self-reflection and induce physiological mirroring of positive bodily expression for behavioural changes among others in public settings [Figure 1].

Research Domain & Related Work

Catalytic creations can cause social changes. We see the potential of disruptive innovation to trigger realization, reflect, and reactions to ingrained social norms. With the overarching inquiry of "whether a display of self-representations through synthetic sound as inner voice and expressive light as somatic energy rattle and provoke reposition of self among others within the same public space", the research instrument, Laughing Dress, ameliorates the domains of interactive body visualization art, psychophysiological mirroring of laughter, and practical somaesthetic.

Public Art on Body Visualization

The initiation to cause change in our society calls for a work that engages the public. This elicited researches and works to explore the notion of self as an agent to transform one's situated space. Rafael Lozano-Hemmer's Pulse Room [8] bio-detects and translates participants' unique heart rates into one of the 300 incandescent lamps within the overall installation space. This process leads to 300 individual flickering light patterns as means to explore self-regulation of one's intimate heart within public space. George Zisiadis's Pulse of the City [22] converts a pedestrian's real-time pulse data into music that projects through a speaker at one of Boston's city sidewalk. This installation aims to reconnect pedestrians with their body rhythms while celebrating their use of public space in a playful manner. Additionally, installation works such as Feel_Perspire [4] and Pulse and Bloom [14], highlight the potentials of displaying biofeedback interaction for audiences' reflections upon the relationship of their personal bodies within public and social realm. Thus, inspired by the problem of self-isolation within public spaces, the display of personal body visualization on the Laughing Dress is a viable form for a controversial interplay between private and public.

Psychophysiological Mirroring of Laughter

Laughing is one of the natural body expressions that represent joyful emotional states in ourselves [15]. Provine further highlights the contagious quality of the sound of laughter and its ability to increase feelings of warmth and connection between individuals [12, 13]. Fukushima et al explored the concept of psychophysiological mirroring behaviour by developing a system, which produces laughing soundtracks that synchronize with the user's desire to laugh in order to induce more laugher [3]. Through the experimental study, they demonstrated that the synthetic laughter extended the duration of user's laugh. Shahid et al.'s study [19] with the Adaptive Affective Mirror further reinforces the potentials of laughter as audiovisual feedback to elicit positive emotions from users. Through Laughing Dress, we hypothesize the following: Laughter is a contagion for happiness, which can foster opportunities for social interaction between strangers.

Practical Somaesthetics

Practical Somaesthetics is one of three fundamental branches of Somaesthetics introduced by Richard Shusterman [18]. It highlights the participants' aesthetic appreciation of bodily experience and their embodied reactions to the interaction. Through soft(n) [16], Schiphorst argues the consideration of poetics, materiality, self-experience, and interaction semantics as invaluable design resource in the craftsmanship of embodied interaction. Exhale [17], Cardiomorphologies [7], and Below the Belt [5] examine the correlation of personal breath and emotional expression between individuals during the making of interactive experience across bodily and social realms. These bio-interactive installations align with the framework as they afford somatic experience through the processes of self-awareness, -reflection, and -representations to provoke understanding on the research concept and engage the audience within their situated, public space. Wo.Defy [6] further highlights the use of this framework by crafting a wearable, narrative space that allows the wearer and audience to culturally reconnect and reengage with the Chinese suffragette history from the late 19th to early 20th century. In our motivation to reveal the self-lived experience to the public realm, Laughing dress applied the bodily practices in somaesthetics framework to magnify self-representation of wearer, disrupt social boundary, shift the attention of passerby, and reform social interaction.

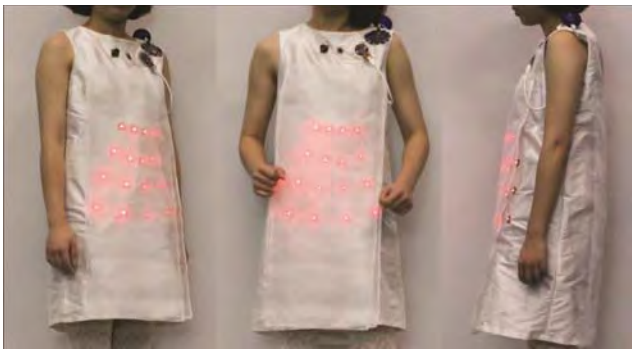

Figure 1. Laughing Dress. © SFU SIAT Soma Embodied Wearable Group 2014

Design Rationale: Laughing Dress

We aim to probe with the expression and communication of laughter on interactive wearable to encourage prosocial behaviour between the wearer and speculators within a public space. The materiality of raw technologies on the Laughing Dress and the poetic expression of wearer's presence as visual aesthetics serve to welcome interaction

through honest epiphany of the wearer's being. To help establish a connection between individuals, the prototype's interaction module is driven by interpersonal proximity to obscure the boundary between personal and public space. The subconscious psychophysiological mirroring of synthetic expression in the body and the generated opportunity to connect among one another stimulate thoughts about the disruptive experience as ways to reflect upon our being. Laughing Dress amplifies wearer's presence both visually and audibly as a non-conventional paradigm to rattle existing social structure of public behaviour.

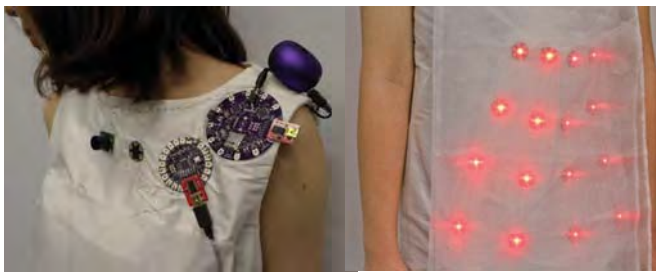

Figure 2. (Left) 4 series of Lilypad LED Pixels, (Right) From left to right: Ultrasonic distance sensor, tri-axis accelerometer, Lilypad Arduino microcontroller, Lilypad MP3 player, mini speaker. © SFU SIAT Soma Embodied Wearable Group 2014

Materiality and Poetics of Revealing Inner Self

Laughing Dress displays wearer's body state and presence as synthetic positive expressions to external entities to establish curiosity and conversation in hopes to foster social comfort and trust. With laughter as agent for emotional transference through psychophysiological mirroring, we translate the by-product of laughter into a series of expressive light patterns. The generated lights accompany the simulated sound of laughter on the wearable prototype as an allegorical reference to the invisible energy radiating from the wearer's laughter. The tri-axis accelerometer at the collarbone region cause changes to the LED light pattern at the lower torso region [Figure 2]. As the gestural movements of the wearer increase, the XYZ values detected by the accelerometer increase, which maps to a higher intensity output in the LED lights [Figure 3].

The exposing technologies on the soft interface align with the conceptual intention to reveal the authentic self; the work extends an invitation to the spectators to overcome self-containment. The visual aesthetics of Laughing Dress represents the wearer's presence, which breaks the veiled social boundary, initiates opportunities for social interaction, and aims to increase prosocial behaviour between the wearer and her spectators.

Interaction Semantic: Breaking Private-Public Boundaries

We employed a human-computer interaction approach to explore a solicitation of positive face-to-face communication; the dress elicits a positive feeling and fosters trust between strangers to disrupt against our culturally accepted practice on personal space. Research highlights that physical distance correlates to the social distance between two persons [2]. Using an ultrasonic proximity sensor at the collarbone region, we map the amplification of the laughing sounds to the physical distance between the wearer and spectator; the increase in volume indicates a closer social distance between the two. As a result, the expressions of laughter infers to the intensity of positive mood generated from the interaction between the wearer (conceptualizer) and participating spectators (interlocutor).

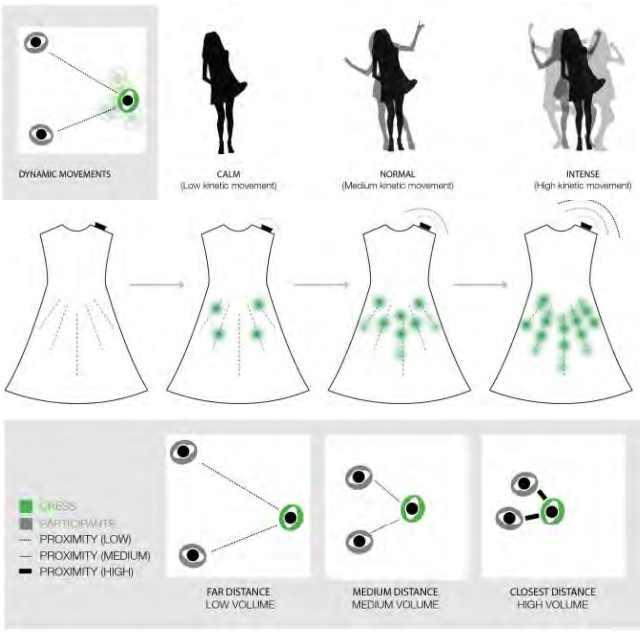

Figure 3. The Interaction Model (Wearer's Moveents, Sound & Light Output, Proximity) © SFU SIAT Soma Embodied Wearable Group 2014

Somatic Experience for Reformation

While individuals differ in their sensitivity towards emotional contagion [10], research indicates positive mood has greater inter-influences than negative mood [1]. As a result, Laughing Dress uses laughter as a positive emotional contagion to encourage social interaction between strangers within a public space. Through the wearable display of laughter accompany with light pattern expressions, the dress transmits enjoyment and positive mood from the wearer to the spectators through the involuntary mimicry of laughter. The interaction aligns with Neuman et al.'s description of mood contagion [7] and reveals a similar impact as Van Baaren et al.'s as they claim that the wearer's facial, postural, and behavioural expressions can produce movement, facial, and vocal mimicry synchronously as evidences of emotional responses [20]. To foster positive social bonding in a public space, Laughing Dress can be used to encourage spectators to smile, laugh and make eye contact, then stimulate prosocial responses and behaviour between the wearer and spectators through psychophysiological mirroring of positive audiovisual expressions.

Conclusion and Future Work

Laughing Dress is a research instrument that aims to investigate whether an interactive garment can repurpose an existing human quality, laughter, within an everyday design context to highlight the salient proximal distance between people within public spaces and bear prosocial behaviour through involuntary mimicry. This interactive public work employs a disruptive medium for self-reflection to cause reformation of self, towards others, and within our society. Laughing dress generates visual and audio expressions by means of one's physical energy and the proximal distance between individuals of a shared space. The alienation of this familiar bodily experience arises awareness, induces interest, and creates dialogues among strangers; the psychophysiological mirroring encourages prosocial behaviour towards one another, which challenges the existing self-containing culture.

We believe that laughter holds a charismatic quality where people of all ethnic background can understand intrinsically. We aim to take the responses from Laughing Dress experience to proceed forward to a practical solution where an appropriation of laughter can be used in an everyday application to elicit social connection, positive attitude, and prosocial behaviour in public setting.

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Art, Affect and Aging: Creativity Vs Deficit.

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Abstract

As the median age of the global population increases a larger proportion of the population will be what is considered old. The aging process causes physical, cognitive and emotional changes and shifts the individual's perception of their world.

Artists and designers are increasingly working with practices that intervene, interact and bring about transformation. They engage with publics that operate as participants and co-creators and as such are increasingly likely to engage with older people.

Western culture has increasingly pathologized aging with a focus on countering its impact and delaying the inevitable end. The individual is addressed as a less able version of him or herself and assessed in terms of deficit, lack and loss.

Art and design projects with older people often get caught up in the pathologizing of aging. They are viewed and assessed in terms of art therapies or positioned as assistive technologies within medical, scientific and technological discourses.

This critical analysis explores how aging can be addressed in terms of the capacity and potentiality of older people. It investigates how, by employing ethnographic, person-centered approaches focusing on personhood and affect, artists and designers can challenge and transform accepted views of aging.

Keywords

Art, Design, Media_art, Aging, Dementia, Health, Wellbeing, Affect, Ethnography

Introduction

Artists and designers increasingly work with socially and culturally engaged practices and technologies that intervene, interact, bring meaning, develop understandings and facilitate transformation. They engage directly with publics, are embedded within communities that operate as audiences, consumers and co-creators, and facilitate exploration of novel technologies and practices. The median age of the global population is increasing significantly with more people living longer. As a result a higher proportion of the population will be over 60, an age often considered the entry point to 'old age'. Therefore, the publics that artists and designers encounter will inevitably include older people including those, pre or post diagnosis, dementia. So, how do we ensure that older members of the public have access to the challenging and transformational aspects of art and design and are not limited or compromised by current perceptions of what it means to be old?

The increase in the median age of the population will have significant impact socially, culturally and economically. This shift will bring challenges to nation states, families and individuals. In addition, it will also challenge our perception of the aging process and what it means to be old, or be considered old. Western culture in particular, pathologizes the aging process, prioritizing scientific ways of understanding and situating aging within the domain of medical science and research. The focus here is on countering the impacts of aging, such as the perceived decrease in physical and cognitive functioning, and in delaying the inevitable end. The older individual is addressed in terms of a less able version of him or herself, or is compared, unfavorably, to an idealized younger societal norm. Thus the individual is viewed in terms of deficit, lack and loss

Art and design projects that engage with older people and communities, or age-related conditions such as dementia, all too easily get caught up in the pathologizing of aging. Projects are frequently assessed in terms of art therapy in the service of mental health professionals; craft is subjugated to occupational therapy or positioned in relation to restorative therapies such as reminiscence theory or behavior management. Here art is no longer an experience in itself, but operates as distraction. Design is no longer about choice, preference, and opportunity, but viewed in terms of its assistive potential.

Health care systems and health professionals are increasingly turning to person-centered care for older people and those with dementia. This involves embracing the concept of personhood, finding alternative approaches to care, that focus on quality of life and reassess the frequency of scientific and medical interventions. It involves a shift away from the pathologizing of aging and dementia and embraces positive approaches that recognize the capacity and potential of every individual throughout their life-course. It recognizes that aging and dementia involve changed perceptions of the world.

This analysis will provide an overview of the extent of the aging population and the changes in perception that occur as a result of aging and dementia. It will briefly comment on socially engaged practices, the impact of technology, and suggest that as art and design increasingly draw on medical and scientific practices and technologies, they can also draw on ethnographic methods to question the assumed aesthetics of deficit and counter the overwhelming scientific and medical discourse.

The aging population

Successes in scientific discovery, medical research and intervention, and improved social and economic conditions have resulted in people living longer and with the potential for more people to live well-beyond 100 years. The extended lifespan together with a reduction in fertility rates is causing an ongoing significant global shift in the median age of the population. More of the population will be in an age group that is currently considered old. The number of people over 60 is set to more than double by 2050 and

those over 80 will increase to almost four times that of 2001. By 2100 a substantial number of countries will have a median population age above 40. [1]

This substantial shift in the median age of the global population presents challenges. It will bring about change in relation to infrastructure, health and welfare systems, jobs and housing and resources generally. In addition, there are social and culture implications. Globally countries that have institutionalized aged care are now moving towards deinstitutionalization — driven, in the large part, by economics. Care of the elderly will increasingly be reliant on informal carers and immediate family members as older people 'stay in place' and remain in their homes and in their communities longer. As people live longer there is a predicted increase in prevalence of age-related conditions, such as dementia, which will inevitably become more apparent in many areas of everyday life.

The potential effects of an aging population on artists and designers are multifarious. Art and design, as acts of *doing,* engage with the social through an 'aesthetics continuum' that connects art to everyday life. [2] The majority (but, arguably not all) of art and design has a relationship, albeit often mediated, with an audience, consumer, user, co-creator or co-participant. Electronic immersive, interactive and screen-based works frequently foreground this relationship. As artists, designers, curators and theoreticians envisage an audience for these works, in the near future the audience will inevitably include older people and people with dementia.

However, it is not to suggest that artists or designers become intentioned about making work solely for older people or people with dementia. The issue is one of not unnecessarily designing out accessibility. It involves recognizing how the social is framed, and questioning what informs our understanding of what it is to be old. Artists and designers (who are also increasingly likely to be older people themselves) can then facilitate access to critically engaged work and transformative experiences for people regardless of their age.

Pathologizing of aging

While some cultures regard aging as the getting of knowledge, experience and wisdom, in Western culture the perception of aging is frequently one of decline of the body, mind, abilities, and functioning. [3] These views reflect a pathologizing of aging that can be located within the discourse of the 'medical gaze' identified by Michel Foucault. [4] Here the body is situated within scientific and medical domains. [5] Pathologizing leads to a medicalization of the aging process with the potential for over-reliance on pharmacological interventions. Such approaches focus on maintenance of the failing body and mind in order to achieve long-life, often to the detriment of the quality of that life. [6] The perception of deficit, lack and loss are compounded in relation to persons with dementia. The disruption to memory processing, that occurs in many dementias can signal the loss of the person. With loss of memory the body is seemingly 'emptied' of the mind and with it the person that once was. [7] A diagnosis of dementia can change how family and friends view a person, almost overnight. Focus shifts from ability to lack and loss. [8]

Simon Biggs suggests that the perceived 'failings' of the body and mind have broader implications leading to the construction of perception of aging as, not only physical decline, but also a process of economic and social decline. [9] The aging person, then, is positioned in terms of what they are no longer able to do, achieve, or generate, as 'failing', lacking, having deficits, and not the person they once were.

The 'system' of caring

This 'loss of person' also has implications for how the individual is treated and cared for. [10] The pathologizing of aging is predominant in health and social care systems and impacts, often to the detriment, on how people — who enter the 'caring professions', with the intention of improving quality of life — provide care. All too often health care professionals are not given time or resources to even get to know the person they are caring for. [11]

There is growing concern about how quality of care is delivered and assessed. Particularly in relation to the increased focus on 'evidence-based' standards of assessment through 'data gathering'. Increasingly, claims are made that the top-down approaches to quality care, which frequently require such measurement are not conducive to individualized quality care. [12] Over emphasis on data and measurement serves to reinforce perceptions as body as object, rather than body as subject. [13] Whereas alternatives such as ethnographic and narrative approaches can bring insight and meaning to what warrants successful or quality care. A recent colloquium of health professionals, academics and patient representatives in the UK identified tensions between scientific and person-centered approaches, these included:

— biometric assessment versus affective engagement;
— measurement versus description;
— scientific evidence versus imagination;
— treating the person as the 'end' versus treating the person as the 'means';
— knowing versus not knowing;
— universal generalization versus local experience;
— trust in 'practice' versus confidence 'in the system'.

[14]

Person-centered and embodied

Healthcare professionals are now exploring ways to ensure that quality health care focuses on the needs of the individual as they transition through the aging process. This involves organizing systems that meet the needs of individuals, engaging in person-centered care, and creating person-centered environments. [15] The aim of such an approach is to recognize that every journey through the aging process is individual and different, and none more so than for those impacted by the many forms of dementia. Person-centered care focuses on Personhood, that is, it recognizes

every individual as an individual with capacity and potentiality. [16] While such approaches do not reject medical intervention and scientific research they present a stark contrast to the view the 'medical gaze' gives us of aging and dementia as ongoing deficit, lack and loss, without reprieve.

Sustainability of existing care systems

The sustainability of existing healthcare systems, and in particular aged care, is in question as both established and emerging economies seek solutions for how to shape and support the healthcare needs of an aging population. Social, cultural and economic imperatives are increasingly driving towards effective alternatives to expensive clinical interventions and increased self-management of general good health and wellbeing by individuals, carers and communities. Visions of future healthcare systems foresee individuals negotiating health systems (as opposed to *healthcare* systems). In these scenarios "Super-empowered individuals" will manage their own health and wellbeing through "healthy living" and lifestyle decisions, with access to medical and social support as consumers, and systems that enable community engagement and participation. [17]

Perceptions of aging

The view of older people remaining engaged and active and retaining agency over their own lives for longer is increasingly being reflected back to society through media and marketing. Western culture, in particular, is embracing the notion of active, wealthy retirees. Slogans abound that encourage older people to go 'SKIing (Spending the Kids Inheritance), to go Gramping (camping with their grandchildren), to engage in 'adventure before dementia', and to become a 'gray nomad' and spend the 'gray dollar'. While not everyone has the financial freedom or inclination to travel or take on extreme challenges marketed to them, older people and those facing retirement frequently stress their desire and need to remain engaged, active and to contribute. [18] With the sheer numbers of 'baby boomers' reaching retirement age, the economic implications, and issues of sustainability means that their needs are more likely to be acknowledged than at any time before. [19] Supporting healthy, engaged older people is now becoming an imperative and increasingly our expectations are beginning to be challenged with regard to the visibility and engagement of older people in public sphere(s); the agency afforded older individuals; and how to meaningfully engage in negotiations between generational groups. [20]

Increasingly focus has turned to the importance of creativity and the role of the arts. Community interventions have been established to enable groups to engage, interact and participate in art and design projects. [21] However, we might question the extent to which artists, engaging with older publics in creative projects, are operating with assumed, inherited, and pathologized understandings of what it is to grow old, think of oneself as old, or be considered old.

Old age happens to the majority of people. Aging brings challenges, but also has potentialities. It is a process of ongoing change that is personal, individual and transformative. [22] Changes happen physically and psychologically; there are socio-cultural shifts; there are changes to environments as a result moving house, home, workplace or in giving up work; there are changes of status at home, in work, in social relationships; changes to the individuals' sense of self, belonging, who they are and what they like to do. [23] Aims, ambitions, desires and needs are refocused. Overall there is a change of perception, a change in how the world is viewed and how meaning is made. [24] For persons with dementia the physical, psychological and social changes are likely to operate at greater speed and the change of perception is profound. [25]

The contribution of art and design

What then is the role of artists and designers? How do they work with concepts of person-centered and personhood, and in creating art and design practices and experiences that are inclusive for older people and people with dementia? Socially engaged art and design and practices that foreground their relationship with an audience aim to engage with and challenge perception. But, whose perception? Aging as a process begins from birth physical changes to the brain and body continually impact on how the world is sensed. The aging process causes physical changes to, for example, the eyes. Aging and dementia can bring about a changed spectrum of color and color intensity. [26] Sound is spatially shifted and 'flattened' and older people are sometimes not able to differentiate between foreground and background noises. Taste and smell and propriocentric and kinesthetic functioning are attuned differently. [27] Our perception of the world is constituted through our bodies. In bringing about a transformative experience art and design engage with embodied experiences. If we accept that aesthetics "is primarily concerned with material experiences, with the way the sensual world greets the sensate body, and with the affective forces that are generated in such meetings" then we must also give consideration to the potential range of aesthetic experiences and bodies experiencing. [28] Focusing on the aesthetic and the embodied, lived experience, foregrounds the ongoing capacity of the aged body. This body viewed through personhood reiterates the concept of a person endowed with capacity and potentiality even in late stage dementia. [29]

Works that aim to directly address older people or persons with dementia often by default focus on deficit. For example, on memory loss and memory recall. It should not be taken as given that addressing memory loss is necessary, wanted or is helpful for the older individual or person with dementia. Families and carers may take comfort in displays of memory that enable stories to be shared, or to see that their loved one is 'still there'. But this approach does not necessarily address personhood and the capacity and potentiality of the individual.

However, there are some excellent art and design projects that draw on memory that do not dwell on recall, nostalgia and reminiscence, but offer experience, capacity and

potential. [30] Certeau offers a view of memory as construction, possibility, and potential, related to social and sensory experience. He suggests:

> [memory's] details are never *what* they are: they are not objects, for they are elusive as such; not fragments, for they yield the ensemble they forget; not totalities, since they are not self-sufficient; not stable, since each recall alters them. [31]

So, in coming to understand personhood, the capacity and potentiality of the individual constituted through the aged body we might begin to think the individual through construction rather than recall, and in terms of changed perception, aesthetics, and affect rather than deficit and loss.

Affect

Eliciting affective response and engaging with the experiencing body has long been the domain of art and design. Affect arrives through "visceral perception"; through the sensate body". [32] Feeling builds on affect, and implicit memory builds on feeling to create emotion. The body throughout the life-course retains sensing and is receptive to the forces and intensities of affect and to feelings and emotions. [33]

Research in relation to persons with late stage dementia shows that while explicit memory, memory of events, places, people, may be lost, implicit, tacit, procedural and pre-reflexive memory is retained. Unconditioned physiological responses and emotional responses continue to be accessible to the individual throughout the life-term, and the potential to experience in the moment joy is retained. [34]

Examples of affective responses can be seen in a number of videos released to YouTube by various organizations advocating for a broader understanding of capacity and potentiality of aging persons and persons with dementia. For example, Henry, a person with late-stage dementia is withdrawn with only limited abilities to verbally communicate and engage. But, he is physically and mentally transformed when listening to music. Gladys is seemingly an example of the 'loss of a person' as a result of dementia, but, she is able to re-engage and connect through singing. [35] These examples reiterate how affective responses show potentiality and capacity, or personhood, and reveal the presence of the individual. Furthermore, what such examples can show is the contagious nature of affect. They show how, as Anna Gibbs suggests: "Bodies can catch feelings as easily as catch fire; affect leaps from one body to another…" (quoted in S. Ahmed). [36] However, we are not speaking of one affect that is generalizable, but affects; operating in a myriad of ways and operating at different levels of pre-personal, precognition, pre-reflexivity. [37]

Socially and culturally engaged practice

In engaging with aesthetics and affective experiences artists and designers draw on a range of practices and technologies to promote engagement, interaction, and to challenge and transform. Artists are increasingly working outside the 'studio' and seeking alternative ways of engaging with publics. Such approaches are couched in terms of socially engaged art, community-based art, experimental communities, dialogic art, littoral art, interventionist art, relational aesthetics, social justice art, participatory art, contextual art and social practice. [38] These approaches focus on processes such as activating communities, increasing public awareness of social issues, and expanding models of art. They are characteristic of art practices of the last twenty years and may be considered a 'social turn' they produce effects and affects instead of placing a focus on form" Such works have been undertaken in school, prisons, hospitals and supermarkets and are designed to integrate with and challenge the everyday. [39] Projects that engage with publics will inevitably include older peoples and persons with dementia, pre or post diagnosis. An example of a successful projects\ that explores the capacity of older people can be seen in the work of the Danish art group Superflex and their project to set up internet streaming for older members of a Liverpool community. [40]

While some of these projects signal that they are 'art' through performative and theatrical approaches the 'art' element is not always clear. There is often a tension with regard to whether the projects is assessed as 'art' —which may set up an hierarchy — or through its efficacy. [41] This tension is compounded when socially engaged art projects engage with older publics and persons with dementia. For example, how does a socially engaged art project in an aged care center retain it's art status when the flow-on effect of the pathologizing of aging means that art that has any engagement with older people or age-related conditions, is at risk of being reconstituted and represented as therapy; addressing perceived deficit and loss. In addition, they may be couched in such terms to 'tick the boxes' or satisfy Key Performance Indicators (KPIs) of funding organizations. Such issues have been prominent in relation to socially engaged practices from their outset. As Hal Foster suggests in 1996:

> artists today may seek to work with sited communities with the best motives of political engagement and institutional transgression, only in part to have this work recoded by its sponsors as social outreach, economic developments, public relations…or art. [42]

Methodologies for engagement

Socially engaged art approaches are complex and often problematic as negotiations are undertaken between the art, the social, and the practices. In engaging with publics such approaches involve "careful listening, thoughtful conversation and community organizing". [43] Adaptations of anthropological and ethnographic methodologies are employed to understand the environment, the people and the social practices at play, with varying successes. Artists draw on interviews and methods of observation to research and gain an understanding of existing social and material practices, communities and customs. However, Bishop suggests embracing positivist social sciences approach from which these methodologies emerge is not always useful. [44] Foster also highlights the problematic position of artists engaging unconsciously in such practices and ap-

proaches and the risk of becoming the self-other in taking on the role of the anthropologist or ethnographer. [45] Facilitating the co-constructed, the collaborative, and the participatory, requires breaking down 'othering', and reflectivity and reflexivity from the artist on their position as artist and researcher. However, this should not deter artists from engaging in empirical research using interpretive and critical qualitative anthropological and ethnographic approaches to enable artists to challenge existing discourse; observe; engage with social practices; experience in an informed and embodied way; and to affect and be affected.

Design

It is not within the scope of this paper to fully explore the blurring boundaries between art and design. However, it is useful to note how artists employing socially engaged practices operate within design parameters. Here the 'art' work requires creative design approaches to structuring, logistics and planning, organization and in investigating social and material practices. Similarly, designers frequently use art practice approaches in the production of one-off designs, or 'design art', they work with socially engaged practices in the form of co and participatory design, and offer transformative possibilities through affective engagement. When electronic media and new technologies are brought into this mix we see individuals and groups operating as both artist and designer at once, using scientific technologies to explore aesthetic experience and affective responses. It is useful to note the role that technology has played in contributing to the amorphous nature of art and design. Particularly in relation to media art practices and the use of 'new' technologies. [46]

While socially engaged art projects are positioned in terms of a 'social turn' or 'affective turn' design is engaging with a 'semantic turn'. [47] It's role is not to make objects for manufacture and distribution *per se,* but to provide meaning and "to support a society that is in the process of reconstructing itself in unprecedented ways". So while design may include the production and distribution of objects, it exists in the "*proposition* of the realizable". Designers are motivated by

> challenges, troublesome conditions, problems, or conflicts that have escaped (re) solution; Opportunities to change something for the better — not recognized by others — to contribute to their own or other communities lives; possibilities to introduce variations into the world that others may not dare to consider…creating something new and exciting…aimlessly and for fun. [48]

As with socially engaged art, this semantic turn heralds a shift towards engaging with the social and the individual. Human-centered and user-centered approaches explore how technologies impact on what human beings are, can be and what it is to be human. In claiming a human, or person-centered approach, designs' challenge, then, is to truly prioritize the human, the person, and embodied enacted experiences. Assistive technologies and design then become ways to *extend* what it is to be human. This extension can only occur when design is not the technology, but becomes part of language and is implicated in the development of meaning. Design can become a condition for understanding self, other, and of enacting reality, presupposing the bodily participation of human beings. It becomes a constructivist enactment of understanding. [49]

In understanding design as a language we understand that design describes what is already in existence, contributes to the ongoing construction of meaning, and in doing so changes phenomenon. Design as language is subject to the restrictions of language, in that it opens up possibilities while also creating traps that can restrict and confine. For design discourse is developed in and through the artifacts created.

With a focus on embodied, human centered, individualized approaches, design is shifted from one of a top down technical problem solving approach to one that accommodates the participation of stakeholders at the very core of the design process. [50] It takes into account existing social and 'everyday practices', 'ways of operating', and ways of doing. Things, are not the 'obscure background' of social activity, but the very essence. [51]

In the same way that Bishop cautions artists against qualitative positivist social science approaches, designers aiming to assess human experiences, or user-experiences, need to engage with embodied perception. This requires interpretive and critical qualitative approaches. Ethnographic approaches can allow the designer to gain an understanding of the aged person at an individual level to counter the existing pathologizing discourse, to engage meaningfully with the person in person-centered and human centered approaches.

Electronic arts, new media, and digital technologies.

The difficulties facing artists and designers using electronic and digital media are compounded. For the most part art and projects are not about technology *per se* but how technology facilitates interaction, engagement and aesthetic and affective experiences. [52] Artists working in this field face the same issues discussed with regard to socially engaged practices that focus on the human being as source and form. [53] In addition, they are also impacted by the legacies of the military, industry complex and scientific approaches that have shaped expectations of, responses to, and the form of many of the technologies currently used. [54] In addition, artists working with scientific and medical data, such as neuro imaging, Magnetic Resonance Imaging (MRI) and biometrics etc., risk being caught up in the scientific paradigm.

If engagement and interaction is to be meaningful with human beings then acknowledging that our perceptions of each other are socially and culturally constructed, mediated and framed. This is key to facilitating authentic and transformative experiences. To this end increasingly ethnographic methodologies are being employed in researching the audience, user, consumer and in facilitating co-participatory and co-design approaches. [55] In addition, such approaches can provide deeper foundational insights for artists seeking to gain access to the person behind the

data, and as source material and form for media art works. [56] Such approaches not only enrich 'data gathering', they provide insights about human beings as potential audience, user, consumer, co-producer, co-designer, source, content, and form of work but also reveal how particular groups are framed.

Discussion

Artists are increasingly working in socially engaged practices; designers engage in meaningful non-hierarchical collaborative, participatory, co-design approaches; and electronic, digital and media artists foreground the relationship with the audience. There is usually intent to intervene, interact and facilitate transformative experiences. Inevitably as the population ages these approaches will engage with older members of the population. As incidences of dementia grow at significant rates artists and designers will engage with people pre and post-diagnosis dementia. But, all too frequently older peoples voices become lost, as they are perceived as lacking, this is particularly so for persons with dementia, who from the time of diagnosis undergo 'prescribed disengagement' where they increasingly have less power over their own lives and reduced access to social and cultural interaction. [57] The aims, ambitions, and desires, and perception of the world, differ for older people and people with dementia. Therefore, as artists and designers gain an awareness of the different views of aging it may prompt them to engage with individuals as subject rather than object.

In attempting to gain an understanding of aging publics artists and designers encounter risks when borrowing from other disciplines. In trying to understand older publics as audience, participators, makers, and collaborators, artists and designers, and the sponsoring institutions, organizations and funding bodies, all to frequently adopt a scientific and medical approach of pathologizing the aging process and age related conditions. This means aging individuals are addressed through deficit and lack, and art and design projects positioned as therapy and assistive technologies rather than about experience, meaning, and potentiality. Ethnographic approaches borrowed from the social science risk 'othering'. 'Borrowing' scientific and medical understandings and technologies may bring with them pathologizing and quantifying tendencies not appropriate to human or person-centered art and design practices.

However, artists and designers can learn from some of the advances that are being made in health care particularly in relation to the increasing focus on person-centered care, person-centered environments and personhood. In focusing on quality of life such approaches are embracing a whole range of alternative 'therapies' and lifestyle possibilities alongside the medical and scientific. The aim being to take a broad approach in exploring capacity and potentiality—personhood—and in provide meaningful opportunities to individuals, throughout the life course. Artists and designers have the potential to be co-facilitators, and enablers, not in addressing deficit, but contributing to potentiality through offering art and design experiences, not as therapies.

Conclusion

Art and design engages with emotional and affective responses and can promote wellbeing, be transformative and have physical, cognitive or emotional therapeutic, and assistive qualities. However, if the therapeutic and assistive aspect of art and design are the only aspects that older people or persons with dementia have access to or are made inclusive of, quality of life, capacity and potentiality are being curtailed. Art and design for older people or those with age related conditions can challenge, provoke and broaden horizons and need not be reduced to therapeutic outcomes or be limited by the perceived deficit that a particular view of aging gives us.

While recognizing the important role of clinical and therapeutic approaches this analysis challenges the scientific and medical dominance of the aging process and suggests that art and design practices can challenge the existing discourse that pathologizes aging and dementia. Assumed hierarchies need to be questioned with regard to the contribution they make to societal quality of life. Again we might look to de Certeau in discussion of art and science and the complementarity:

> …art is a kind of knowledge essential in itself but unreadable without science. This is a dangerous position for science to be in because it retains only the power of expressing the knowledge which it lacks [58]

Art and design has opportunities to engage meaningfully with publics consisting of older people and persons with dementia and those with different perceptions of the world and improve quality of life. By engaging with ethnographic and approaches on more than a surface level, artists and designers can gain a critical understanding of the current state of the domain. By thinking of audiences in terms of personhood, that is, capacity and potentiality; affect; meaning; and by building on pre-existing social practices, artists can gain alternative perspectives on aging. Artists and designers are then in an informed position to include older publics in a meaningful way, offering engaging, challenging and transformative experiences that enhance quality of life.

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The Patient Subject: Collaborative Biomedical Art and Curatorial Care

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Abstract

How can curatorial practice bring into contemporary art programming/contexts and to visiting publics, the profound collaborations between artists and scientists in the creation of biomedical art? This paper outlines a curatorial proposal that investigates the practice of three artists working at intersections of the Museum, the Laboratory and the Clinic, they are: John A Douglas, Helen Pynor and Guy Ben-Ary.

This research addresses the atmosphere of openness between individuals and institutions across art and medicine, and the increasing porosity of institutions that allow artistic biomedical collaboration to take place. As a curatorial project, it questions the hidden nature of experiences surrounding disease, disability and bodily transformation and experimentation within our culture, and attempts to shift paradigms around corporeal representation, exhibition design and public knowledge.

Central to the research is theory on the body, including feminist theory; a review of literature engaging with the connections between art and medicine, particularly bio-art; and recent discourse around curating and collaborating. The program aims to interpret and transform artistic and scientific reciprocity in clinical, laboratory and museum contexts, where curatorial presence is essential and involved through all stages of collaborative research & development and presentation.

Keywords

Biomedicine, Curation, Artist, Patient, Care, Clinic, Laboratory, Museum, Collaboration.

Introduction

This short paper outlines curatorial research addressing new, collaborative artistic work being produced in the realm of biomedicine and the questions and possibilities the work raises for the presentation of biomedical art exhibitions and experiences to visiting publics.

Informing this research is the history and practice of Bio-Art over the last two decades, and observing the ways in which pioneering work of artists and collectives including Eduardo Kac and SymbioticA among many others have generated an atmosphere as well as contexts for exchange between art and science, encouraging collaboration. While these artists and groups, whose projects have variously speculated on scientific futures, experimented with genetic material and evolutionary processes, or engaged provocatively and fantastically with many forms of life, the work of artists in this research use the possibility for biomedical collaboration to delve deeply into both scientific and experiential examples of human life, illness, death and life's prolongment. Rather than reaching outwards and forwards towards "the entire gamut of life processes and entities", and an expanded biological spectrum, they are tuned-in to comprehending and elucidating the complex present/presence of human experience. [1]

Museum, Laboratory and Clinic

As a curator with over fifteen years professional practice, I have become increasingly involved in artistic projects related or proximate to research in science and medicine, across artforms, from photomedia and video to performance and forms of art as social engagement.

Through this research into interdisciplinary, collaborative, biomedical art, the capacity for an exhibition space and program that can encompass and integrate the differently culturally inscribed white-cube contexts of the museum, the clinic and the laboratory will be designed and tested. These are the places in which biomedical art is negotiated and fabricated by artists and their collaborators, but can these spaces be integrated conceptually, aesthetically and ethically to form another kind of space and exhibition experience? As a curator in the 21st Century I find myself and the cultural institutions I engage with as part of my practice, lagging somewhat conservatively behind the modes of enquiry and artistic outcomes of experimental, collaborative artists.

The artists engaged for this research and exhibition connect with the three spaces of the museum, the clinic and the laboratory in different ways and to different extents. While Guy Ben-Ary's practice is located predominantly in the laboratory, the use of his own cells has taken him into the clinic as patient in the harvesting of his own biological material. Helen Pynor's work roves between the clinic in her work with communities of former patients and their support groups and carers, to the laboratory for her study of cellular life, death and growth. While John A Douglas's practice has been undertaken predominantly in the context of the museum, he is a transplant recipient whose experiences are punctuated by visits to the clinic and his new work enters the space of the laboratory for the first time.

I want to discover through curating, if audiences can be brought inside the collaborative relationships that inform the production of biomedical artistic practice. Would an exhibition that integrated the social, political, scientific and historical situations that informed the making of the work enhance viewer experience and comprehension of the concepts and ideas in biomedical art?

Interdisciplinary Intersections

Bio-Art is an area of experimental arts practice in which all of the case study artists have worked to varying degrees in support of, or as the main focus of, their work. Artist and academic Eduardo Kac has written a comprehensive history of this field, which includes his own practice and the work of his peers. In *Signs of Life* he articulates three "defining principles" for bio-art, which may be "wholly or singly adopted by bio-artists." They are "(1) the coaching of bio-materials into specific inert shapes or behaviors; (2) the unusual or subversive use of biotech tools and processes; (3) the invention or transformation of living organisms…"[2] Kac takes the position of the objective scientist in his definition of bio-art with a focus on subversion, "randomness," "transgenic" future life and radical possibilities of intervening in evolutionary processes. The artists with whom I am engaged however, seem to be involved in a critique of the possibilities of the heterogeneous, human present, and a deeper understanding of life, cognition, health and death as we think we know it.

One of the key questions in my research is whether the sciences and the humanities are moving closer together? Australian medical sociologist Deborah Lupton's book *Medicine as Culture: Illness, Disease and the Body in Western Societies* (2003) outlines the present context in which the supposedly benign, neutral or truthful realm of medicine has been challenged – by feminists, sociologists and theorists – over several decades from the late 20th Century onwards.

Through reference to the work of Michel Foucault in particular, and his conception of the body as "the ultimate site of political and ideological control, surveillance and regulation," as well as the work of key feminist theorists such as Donna Haraway in arguing the social construction of the body, Lupton charts the relationship of society to medicine – its ethical, philosophical, political and moral dimensions. This text provides my research with important grounding and a broader understanding of Medicine in a social context, including its presence in art, literature and mass media. [3]

Also in the realm of medicine as culture, Susan Sontag's *Illness as Metaphor* (1978) is a key text written from the perspective of author as patient. It engages with the spiritual, religious and artistic representations of disease throughout history and its affects in contemporary life. For my research it provides background for the kinds of tropes and metaphors that the case study artists use in their new work – either consciously or though pervasive social doctrine. [4]

Contemporary artists have been working in the realm of body-based performance practice since the 1960s, through conceptualism and the second wave of feminism. For this research I am particularly engaged with the scholarship of Petra Kuppers, whose work has drawn attention to the practice of artists undertaking performance-based projects through their experience of illness and disability, and through the support of communities of care.

Her book *The Scar of Visibility: Medical Performances and Contemporary Art* (2007) is grounded in her research and personal work with artists, at a grassroots level, as an artist and activist living with disability. The book presents a phenomenological approach to performance art practice and an "affective way of knowing bodies". Using the metaphor of the scar, Kuppers discusses the knitting together of biomedical and artistic concerns, of procedures and the experience of them. Kuppers is concerned with the ownership of knowledge and expression around these issues and so her analysis traverses the celebrated contemporary artists of recent history including Kiki Smith, Mona Hatoum and Orlan, and then work by lesser-known, "community artists" which can be found at railway stations or in shopping centres. [5]

Kuppers' focus on both the experience of artists and the experience of audience/publics is of particular significance. I am investigating the possibilities of bringing together an encounter in space where the ethics, aesthetics and processes of art and medicine come together – the knitted "scar" space that she evokes.

Artists that have worked in this realm as patients, through embodied processes of pain-management, surgery and treatment include Bob Flanagan, Jo Spence, Hannah Wilke and Orlan. Wilke's final work, with Donald Goddard was Intra-Venus (1992-93) a documentary portrait series of the artist while she battled lymphoma, depicting Wilke in the last months of her life. This work completed a life's work making photographic portraiture as a means to address the "trauma of illness." [6] The embodiment of pain in Bob Flanagan's *The Pain Journal* is an important reference point to my work in terms of valuing the artist's first-person perspective.[7]

The work of SymbioticA and particularly its directors Oron Catts and Ionat Zurr is crucial to my research and practice related to the ethical and moral questions involved in the presentation of live and 'vital' material in the space of the gallery. Their work has frequently been at the provocative forefront of conversations about museum ethics in relation to the presentation of living material. In Janet Marstine's Museum Ethics, Ellen K. Levey uses the exhibition *Design*

and the Elastic Mind at the Museum of Modern Art in New York in 1999 and Catts & Zurr's project *Victimless Leather* to illustrate the need for a different curatorial approach to the maintenance of live materiality in the gallery space. [8]

A key curatorial and research project engaged with the embodied space of the biomedical is *PITH – Hybrid Bodies* in Montreal, including the collaborative work of academics, artists and writers Margrit Shildrick, Ingrid Bachmann and Alexa Wright. The program explores specifically the heart transplant process, and the patient experience of living with a hybrid, transgenic body. The work is of particular note for my research as it engages in both biomedical enquiry as well as the engagement of transplant recipients as interview subjects. [9] Science-based foundations and institutions including The Wellcome Trust and the Science Museum, Dublin have a substantial history of engagement with contemporary art and artists in the context of their object-based, historical collections as well as producing exhibitions, events and experiences which transcend the arts and science divide. Pedro Reyes' project *Sanatorium* (2011), a transient 'clinic' presented by the Guggenheim Museum, New York is a key work presenting challenges to the uses of the museum for different kinds of audience engagement around ideas of health and wellness. [10]

The 'care' undertaken through the process of curation and collaboration within my three artistic case studies and final presentations will also examine a shift away from the care of objects, to the care of subjects, artists and audiences. My practice links conceptual rigour with logistics and real world concerns which I am considering through the lens of Donald Schön's *The Reflective Practitioner*, and the work of Lizzie Muller in interpreting his theories towards the realm of curatorial practice. [11] [12]

Curatorial Care

Ben-Ary, Douglas and Pynor work in a materially 'alive' way in muesum and gallery spaces through their performative presentations and their presentation of living material. Experiencing the laboratory contexts in which they create these works will enable an analysis of creative and institutional collaboration between art and science, as well as inform decision-making processes around exhibition design, care for the artists, their works and audience care as they encounter them.

John A Douglas is an artist who until recently as been living with renal failure. He began addressing his medical experiences directly in his art practice from 2011, by performing during the process and timeframe of dialysis treatment. Douglas's upcoming work *Circles of Fire,* "investigates the artist's life-changing experience and embodiment of his recent (April 2014) renal transplant, drawing upon the aesthetics of medical imaging, landscape as metaphor and the relationship of the performing body to medical treatment. Douglas aims to inform and engage audiences, awakening them to the medical and non-medical (emotional) experiences of a transplant recipient and the challenges that need to be met in order to prevent rejection."[13]

Douglas is working collaboratively with artist Helen Pynor, Derek Williamson from the School of Human Disease and has undertaken a preliminary artist residency at SymbioticA. Through his work I investigate relationships between artists-as-patients with scientific researchers, and the opening-out of art and science discourse into embodied territories.

Helen Pynor simultaneously addresses emotional and physiological questions around the liminal space between life and death in her work. Pynor's new work (as yet *Untitled*), engages on a tissue-based and microscopic level, the testing of the 'liveness' of animal flesh presented for consumption on supermarket shelves. Concurrently, the artist is interviewing both surgeons and former patients around experiences of lucidity and awareness during periods of actual, clinical death.

"The proposed art work will reflect on the contested boundary of death in deeply provocative but empathic ways, proposing instead a form of continuity between the states of living and dead. The project makes use of Pynor's unique position as an artist with scientific training which enables her to engage with science practice at depth and make a rare and insightful contribution to art-science interdisciplinary practice."[14]

Pynor has undertaken research for this project at the Max Planck Institute of Molecular Cell Biology in Dresden, Germany. Her process of interviewing patients and Doctors will take place in London, UK where she is currently based. Through her work I explore the integration of hard scientific data, alongside a community-based approach to information sharing and art-making. The project will expand ethical issues of using animal flesh in the context of research, to bringing this material into an exhibition, as well as the presentation of deeply personal life-after-death experiences to public audience.

Guy Ben-Ary is an artist long associated with the SymbioticA Centre of Excellence at the Department of Anatomy and Human Biology, University of Western Australia. Ben-Ary has been at the forefront of innovating around tissue culture and art for the past fifteen years. The method of his enquiry has generally involved the harvesting, growing and culturing of neurons from fish and rats and other small animals bred specifically for the laboratory. When advances were made in stem-cell research in 2007 - Induced Pluripotent Stem Cells (iPSc) - that enable human subjects to have living skin or any other cells engineered

into stem cells, Ben-Ary adopted this technology in his practice.

The artist has since undertaken a biopsy procedure where his skin cells were harvested. The tissue was grown and then induced to become stem cells for a project called *cellF* – a self-portrait as sonic, biofeedback loop. Ben-Ary is now working with neurological scientists to grow his stem cells into neurons that are then attached to an electronic circuit. Simultaneously he is working with a musician to create synthesiser feedback for the neurons, and a feedback loop so that the activity of the neurons is stimulated by its own synthesised sound. [15]

For *cellF*, Ben-Ary has reconnected with the scientist he engaged with for previous work, Dr Douglas Bakkum, who continues to work on the project for the potential value that it brings to his own research into neurological trauma. *cellF* brings into sharp focus for my research, ideas of 'care' around object-subjects that are semi-living and curatorial 'care' for these works as well as the artist, from whose body they stem.

The Patient Subject: Meeting the Public

The exhibition I will be curating for the Galleries UNSW titled *The Patient Subject* in late 2016, will be an exhibition in three parts: *New Enquiry, Documents & Engagement*. The exhibition and its three constituent parts will offer space for immersion in new artistic works by the case study artists, reflection on historical precedents in the field of art and medicine; and provide context for audience and specialist engagement, discourse and scientific experimentation. Through research and case study engagement I intend to create an exhibition environment that brings together participatory aspects of the clinic, experimental aspects of the laboratory and communication aspects of the museum.

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Bec Dean is a curator and writer who trained as a visual artist. She is currently a PhD candidate and casual tutor at UNSW Art & Design, University of New South Wales and Curator at large for Performance Space. She joined Performance Space as Associate Director in 2007 and became Co-Director with Jeff Khan in January 2012 until February 2014. Bec was previously curator at the Australian Centre for Photography (2005-2007) and Exhibition Manager at Perth Institute of Contemporary Arts (2002-2005). Bec's curatorial interests revolve around interdisciplinary and participatory practices, performance, site-specificity, biomedical art and art/science collaborations. Bec is the co-curator of the recent iteration of the interdisciplinary art laboratory *Time_Place_Space: Nomad* produced by Performance Space and ArtsHouse, Melbourne. Her current research on collaborative biomedical art will be presented as a large-scale exhibition and touring project, *The Patient Subject* in 2016. She has been published widely in Australia since 2000.

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[Personal Nature]: An Artist's Approach to Assistive Technology

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Abstract

[Personal Nature] is an artistic intervention rooted in assistive communication technology. By using physiological sensors on the body a sonification is created, this is to amplify the minute non-verbal communication cues found in our heart and breath rates, temperature, and in the amount of moisture found on our skin, all processed through time. The goal of this sonification is to replicate the sounds of a park through real world recordings including birdsong, children's laughter, wind and water as to create a space conductive to communication. The intended user of this technological intervention is a person who is in a coma or is otherwise (seemingly) unresponsive and their loved ones. This article explores the artist's process of using art, design and research methodologies. By looking at the disruption through the lens of different philosophies while considering the benefits of nature, music therapy and communal healing this paper attempts to fully explore aesthetics within the hospitals critical care unit.

Keywords

Assistive, Communication, Sonification, Embodiment, Art, Design, Therapy, Music, Data, Generative

Introduction

When tragedy strikes and a loved one is in an accident or their illness increases causing them to lose consciousness there is an abundance of emotions including anxiety, stress and confusion. These emotions can cause an even larger disruption in communication. Families have been known to talk about the patient as if they were not present or even worse sit in silence. [1 – 3] Considering Shusterman's somaesthetics, these emotions can be transferred to the patient through unintentional communication such as touch and tone of voice. [4, 5] Current medical information tools greatly support the medical staff but do not necessarily benefit loved ones. This information is compounded when consciousness is viewed on an axes between awakeness and awareness meaning that many seemingly unresponsive persons are more awake or aware than they appear. [6]

[Personal Nature] is an interactive intervention rooted in medical informatics research [1, 2], where the autonomic nervous system (ANS) is regarded as a great indicator of stimulus and response particularly emotion. [7] The *[Personal Nature]* prototype is guided by artistic intuition and aesthetic research with aims at shedding light on the lack of aesthetic consideration in the hospital soundscape. Using sonification concr te methods, recordings containing snippets of real world sounds and synthetic representations are triggered to play and have their variables change according to sensor data (speed, L/R, volume, etc.). The goal is to create a virtual space which is conductive of positive communication, specifically that of a park or picnic setting. By using birdsong, children's laughter, wind and water sounds an expectedly relaxing yet cognitively alert environment is created. [8] At higher levels of awakeness and awareness the environment changes reflecting the non-verbal communication of the person with impaired consciousness' ANS when these levels are lower a presence for the individual is still created, both of these outcomes and the spectrum in-between can be conductive to community healing.

Disruption

Reflecting on Lefebvre's rhythmanalysis the body is viewed as a bouquet of rhythms, from the individual rhythms of the cells to the variety of cycles in the organs. [9] When a person is ill it is thought that there is an arrhythmic function in the body or in parts of the body. This could be an invasive bug, constantly reproducing cells or a malfunctioning organ lessening blood filtration. For Lefebvre in rhythmanalysis there is embodiment which involves being in tune with one's body in order to cognitively catch the arrhythmia as early as possible. This can lessen or even prevent disruptions in one's health and wellbeing.

When this rhythmic function is disruptive to the point of impaired consciousness (IC) communication channels are obviously strained. This is when well-intentioned loved ones can unintentionally increase stress or anxiety in the person with IC. Not knowing whether you can be heard or understood can be very stressful to loved ones and medical staff. This can cause them to lose their perception of personhood for the affected individual "because they cannot demonstrate the putative cardinal human attributes of co-presence and reciprocity." [1, p. 2] All of this could become apparent to the person with IC through the somaesthetics (touch, tone of voice, goose bumps, etc.) of their loved ones and caretakers. [5]

When lifesaving machinery is employed there is often an abundance of tubes, pumps and sensors. This dras-

tically changes the visual and auditory appearance of the affected person, further complicating the already strained communication channels. The beeps and whirs of the machines indicate certain aspects of the ill person's health but their meaning is often only clear to medical staff and trained professionals. This is troubling considering many persons with IC can hear and/or feel (physical touch) more than they are able to visibly or audibly indicate. Is this technology not disruptive in this case?

Un/disruption

The person may lie completely still, present in the room yet lacking presence. However they most certainly embody presence. Even if the person is in the deepest coma their presence is still important for communal healing. By externalizing the recovery process communal healing means that the "healing transformation may take place in the group rather than the individual." 10, p. 36 This is where the loved ones having a more relaxed and confident somaesthetic is important as it may be interpreted by the individual with IC.

Lefebvre described the present as static whereas presence is the present when time is considered when poetry is considered. 9 Take into account the medical staff on their routine visits only a stationary number or small range of data is collected. However projects such as *[Personal Nature]* look at these physiological signals through time, amplifying the smallest changes in nonverbal communication. In most medical settings the presence of the unconscious person is reliant on disruptive albeit lifesaving technology whereas rather than attempting to add an additional layer of perception and communication. Initial research into using sound and the ANS such as Holland Bloorview ids Rehabilitation Hospital's (HB RH) *biomusic* has shown an increased perception of personhood for the seemingly unresponsive person 5 to me this indicates an improved projection of embodiment because of or resulting in greater empathy. The individual's non-verbal communication and rhythms are being made poetic through sonification, generative music, and technology.

Out of my experiences with my immediate and extended family members I put great thought into how this technology could be used as an artistic medium. *[Personal Nature]* is the result of my empathy and experience combined with an extensive literature review and artistic intuition. I knew the resulting sonification had to be unobtrusive yet the ebb and flow of its rhythms had to be obvious. An environment conductive to positive communication is to be achieved. Through the simulation of a natural setting a picnic or backyard barbeque soundscape is created. A place of communal conversation, of reminiscence and laughter rather than the clinical and sanitized setting.

Nature

In our increasingly technological society many people are separating further and further from nature. This is exceptionally true for those in the hospital, though the need for sterility is understood. Surgical patients whose "rooms with windows looking out on a natural scene had shorter postoperative hospital stays, received fewer negative evaluative comments in nurses' notes, and took fewer potent analgesics than 23 matched patients in similar rooms facing a brick building wall." 11, p. 420 Nature art has also shown to reduce visible restlessness, noise level, staring and queries to the reception desk while increasing social interaction in hospital emergency waiting rooms. 12 Similarly patients supported by respirators and in mild comas (Glasgow Point 9 and above) showed and reported reduced anxiety, agitation and lower blood pressure when played nature sounds on headphones over a matching control group of no intervention. 13 The generative and rhythmic elements of nature and evolution as well as their effects on our health greatly inspired *[Personal Nature]*.

Music Therapy

Working with persons suffering IC and their loved ones is familiar ground for music therapy. From gathering loved ones to reminisce and write personalized versions of the affected individuals favorite song 3 to active adaptive music therapy sessions where the therapist plays an instrument and/or sings a song in response to the individuals heart and/or breath rate. 14 Throughout Leslie Bunt's book *Music Therapy: An Art Beyond Words* whistles which sound like birdsong appear always being linked to the feeling of freedom. 15 Music therapy techniques and methods greatly influenced the creation of *[Personal Nature]*.

Sonification Concrète

Applying Edgard Var se's concept of musique concr te to sonification Paul Vickers saw the need for a spectrum between concrete and abstract as well as scientific and artistic sonifications. 16 This created a space for a variety of scientific and artist sonifications within the same sphere allowing for a focus on listenability and aesthetics while still offering scientific material. John Neuhoff describes how evolution has affected our neurological and cognitive architecture making us exceptionally sensitive to real world sounds our brains process these sounds differently than erratic beeps and buzzes. 17 Often times we neglect how often we use our ears to measure. Think about boiling a teapot: listening to the level of the water as it reaches the top, the clicks and subsequent whoosh of the gas stove lighting, the groan as the boil begins and finally the whistle (or if you're like me the 'almost whistle'). By using real world sounds there is a chance to "tap into perceptual and 'meaning making' processes that cannot be accessed with sounds that are more artificial." 17, p. 80

Implementation

Data for this work was obtained through Thought Technology's Biofeedback system which includes non-invasive sensors for: heart pulse rate, breath rate, skin temperature

and galvanic skin response (GSR). I applied the sensors to my body gathering a baseline as well as emotionally stimulated (ouTube) data. This data was stored to a CSV file to be accessed in the prototype creation. *[Personal Nature]* is composed as follows:

Heart Rate – Birdsong/Children: Peaks in the heart rate data trigger a randomized clip of either birdsong or children playing/laughing. The greater the peaks distance from below zero (louder on the left side) and above zero (louder on the right side) this is to amplify the influx in the heart rate. Birdsongs are often considered auditory signifiers that all is well in the environment 8 , I believe that the sounds of playing children enhance this concept.

Breath Rate – Water: The breath rate controls the speed and volume of a looped audio recording of water gently lapping at the shore. As the breath quickens so does the pace of the water lapping at the shore which also becomes louder. Schafer is very explicit in his writings on the connection between waves and human breath 18 , one that I found pertinent for this project.

Skin Temperature – Wind: As the temperature rises and falls so does the volume and speed of looped recording of wind rustling leaves. A warm breeze or a cool wind can often affect our perception of temperature often bringing attention a change in weather.

GSR – Wind: Using a prebuilt open source wind generator the data from the GSR changes different aspects of the pitch and tone. The sound replicates wind as it moves past the ear. Similarly to skin temperature the moisture on our skin is often made apparent when a gusts of air flow over our bodies.

The system is built using Max 6 a visual node based programming platform. The values of the sensor data are highly manipulated as to scale them to useable values in the sonification process. This is a part of the amplification process as it is the fluctuation in values that are important not the specific numbers themselves.

Discussion

I am aware that this is an area of research full of ethical questions, ones that as an artist may require more scrutiny. I remain worried that some may question the artist's role in this sensitive situation that they might consider me all too hopeful. I understand that the patient may not have any response that it may not be interpreted clearly or *[Personal Nature]* may be more of a hindrance than help. et I feel compelled to try. For example take Thomas a child involved in the *biomusic* research at HB RH. His parent went from describing their interactions with him as this:

> "You're coming in [to the room] and you aren't really sure if they know that you're there (C2)" 1, p. 6

to then speak of him in this way:

> "It makes me feel like before [his disability] when he was very lively. It makes me think of the lively boy before. The sound represents his character… I would want to have it on. The sound keeps on it feels like my son still exists." 1, p. 6

It is this dramatic emotional shift that compels me.

My work process has changed drastically in the creation of *[Personal Nature]*. During different parts of this transdisciplinary project I have viewed it from many perspectives including artist, designer and technologist but also as patient, loved one and hospital staff. By employing different creative strategies I found that I was able to overcome many technical, psychological, theoretical and aesthetic issues.

This media calls for an artist's intervention, for artists' intervention. As someone who has spent countless hours confused at the side of a loved one I believe it is a media worth investigation. I believe I am able to help ease this disruption. I find inspiration and solace in the words of R. Murray Schafer: "The sense of hearing cannot be closed off at will. There are no earlids. When we go to sleep, our perception of sound is the last door to close and it is also the first to open when we awaken." 18, p. 11 *[Personal Nature]* may reach the person with IC and it may not either way it fills the silence 1 and could possibly complete the other side of a conversation for their loved ones at their side.

Conclusion and Future Work

This work aims not to heal in the traditional sense but to provide comfort and presence for often but not purposefully objectified persons, their caretakers and loved ones. As this is a media project the aim is to provide a means for communication no matter how minimal, a dialogue which offers a greater chance for connectedness. Considering Baumgarten's sensual aesthetics and the bodies reaction to human contact, the sensed beauty of a loved one speaking and touching us, exposed through the ANS. The automatic reaction invisible but now audibly represented though time. *[Personal Nature]* is really at the starting point at the moment. Currently sound is the major focus and offers a wide range of location options to replicate for instance beach or rainforest environments or even possibly replicating a home environment with all the hums of electronics and sounds of loved ones. However I see the chance for a full perceptualized experience. By this I mean I see room for visualization and haptic options. By doing this I believe there will be a more immersive experience allowing for an even deeper connection.

As sensor technology is continuing to mature and become more affordable I also see growth in mobile iterations of this project. By using Bluetooth and smartphone technology the options for gathering and interpreting data grow immensely. For example the current wearable sports and training technology is a market *[Personal Nature]* may add to among other novel possibilities.

Finally as an artist I see great potential for performative and installation iterations as well as the ability to explore a variety of emotions while recording the data. Being

able to create a space sonically, visually and haptically using such personal and raw expression excites me.

[Personal Nature] Example

A sample sonification can be found at this URL: https://soundcloud.com/davee d/personal-nature-examples

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Author Biography

David Dowhaniuk is an artist, designer, technologist and theorist in the area of digital media. He has a Bachelor of Fine Arts from OCAD University and a Master of Science from the University of Bremen. Experimentation has always been a focus of his work, from the early year's double exposing film through the fast-paced visual effects industry to his current interest in patient/doctor communication and emotional aesthetics in the hospital. He draws much of his inspiration from spending time in nature often hiking, cycling. canoeing or tobogganing.

[Session 4]

Communities: Culture and Art in the Field

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Fostering A Community of Innovation at the Intersection of Art and Technology in the Pacific Northwest

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Abstract

The Pacific Northwest is a top region for innovators at the intersection of art and technology. This density of technology creatives – artists, programmers, technologists, designers, entrepreneurs – combined with the Pacific Northwest's uniquely community-oriented zeitgeist has had a meaningful impact on the local arts community, creating fertile ground for genres of interdisciplinary, technology-mediated art. In order to help foster this growing community of artists/technologists in pushing the bounds of what is possible in their work, we organized a workshop bringing together key stakeholders in the region. The workshop was structured as a focus group including a brief questionnaire to generate feedback for how to best support this community. The unique concerns and collective agenda of this interdisciplinary group are discussed as they would apply to broader contexts.

Keywords

Community development, community of practice, art and technology, new media art, focus group, interdisciplinary collaboration

Introduction

In the past decade, a growing, integrative genre of art has been taking root in the Pacific Northwest of the United States. In an area dominated by a thriving technology industry – including software giants such as Microsoft, Xbox, Amazon, and Adobe, and a very active startup culture – so too has the local arts culture become increasingly infused with technology as a medium for creative expression. These works often exceed the bounds of traditional exhibition spaces and thwart gallery space business models. Due to the affordances of the medium to sense people and respond, they also tend to be interactive and participatory with special space and maintenance requirements. Given the specialized skills typically required to implement these works, some of the most inspiring pieces tend to be interdisciplinary with hybrid collaborators including scientists, technologists, designers, and more traditional artists. Their interdisciplinary nature further points to the importance of developing a welcoming community of practice, where innovators may find each other, develop trust, collaborate, and through open sharing accelerate innovation.

Although there are a number of organizations and individuals practicing at this intersection of art, design, and technology in the Pacific Northwest, we see a need for more cross-organizational awareness and communication in order to nurture a thriving community of practice that works effectively together to achieve its goals. To help foster this growing community of artists and technologists, we organized a workshop bringing together key stakeholders in the region to map out the space, discuss a collective agenda as a community, and spark next steps for actively achieving these goals.

In this paper we:

1) Map out the community, defining its special characteristics.
2) Articulate and prioritize the community's common goals.
3) Propose a series of activities (e.g., knowledge sharing, events, and communication vehicles) as next steps toward fostering this and similar communities.

Definition & Historical Context

"Technology (from Greek τέχνη, techne, "art, skill, cunning of hand"; and -λογία, -logia[1]) refer to the collection of tools, including machinery, modifications, arrangements and procedures used by humans." — Wikipedia

Art and design are at the very root of technology. This paper is specifically looking at the forms of art that embrace the emerging technologies that open up new domains of artistic expression. Artists, designers and hybrid creatives that explore the immanent qualities of these many new technologies disrupt accepted conventions in order to forge a new language of creativity.

The exploration of modern technology for art has roots as early as the 1960's, when a group of avant-garde artists embarked on a series of collaborations with electrical engineers at Bell Telephone Laboratories (Bell Labs), known as Experiments in Art and Technology (E.A.T.). These performative experiments exploring emerging technologies for making art were considered the forerunners to current technological art collaborations.

"The 9 Evenings artists and engineers came from collaborative experimental subcultures with similar values and practices. These included open, egalitarian approaches to experimentation; discipline boundary-

crossing and respect for diversity; concern about technology as both a tool and a sociopolitical and cultural phenomenon; and a process-based approach to creative production influenced by new ideas that included cybernetics theory of man/machine communication systems." (Oppenheimer, 2013)

In the next wave of art/technology collaborations, technologists started actively developing creative tools in collaboration with artists. For example, Kenneth Knowlton, while at Bell Labs, wrote BEFLIX, a program developed for animation. More recently, Casey Reas and Ben Fry developed Processing, a programming language currently driving much of the computer-mediated visuals and data visualizations in the arts.

Concurrently, there was a rich precedence of art playing an important role in the technology innovation research process. Nam Jun Paik was interfering with electronics and pioneering video art and installations in the 1960's. The Xerox Palo Alto Research Center's Artist-in-Residence program (PAIR) was started in the early 1990's and continues to be an on-going research effort at Xerox Palo Alto Research Center. The program pairs artists and designers with research scientists and engineers who use similar media technology as a common language to push artistic and scientific innovation. More recently, the creation of the Internet provided another space for creative technological collaboration. Pioneers using the Internet include Roy Ascott's telematic art events linking artists and engineers around the world. Western Front, Vancouver and Pittsburgh's DAX group in the 1990s pioneered real-time global art events.

The range of artistic activity engaged with these distribution and experiential spaces transcend traditional artistic practices through the birth of new hybrid forms of technology creatives. Artist/programmer, designer/scientist, artist/filmmaker, social networker/artist, engineer/artist are hybrid creative identities that blur the boundaries between art and science and the ways in which art may be enmeshed within our culture. Mapping the community of current artistic collaborations between art and technology would include domains as diverse as social networking, bio systems, gaming, programming, film, media, apparel, mobile media, robotics, sound design, mediated performance, information science, data visualization, education, and government. Modern distribution opportunities continue to expand the impact of these works, including screen technologies (tablets, phones, computers, televisions, digital signage) and mass-produced objects.

Although we have observed a growing presence of these technology creatives in the Pacific Northwest, the question remains; who are the people and places that are engaged in this activity? How can the community be evolved in order to stimulate more activity and opportunity?

Why the Pacific Northwest

Seattle has long been heralded as *"the city the future"* (McGinn, 2012), and the Pacific Northwest has been at the center of the explosion of the new digital economy. Many of the technologies that drive the digital economy were developed in this area and have attracted technologists to the region from around the globe, including ecommerce and new media distributions such as Microsoft and Amazon. Due to this vibrant creative technology economy, in 2012 Seattle was rated #1 city for technology jobs by Forbes (Kotkin, 2012). Similarly, a report by Enterprise Seattle ranked the city as #6 in Interactive Media based on the concentration of those employed by the interactive games industry (Mefford, 2012).

"The Interactive Media industry is a high tech industry that blends art and technology for both entertainment and more serious or practical applications. The core of the industry is the development of digital content, driven by talented individuals with expertise in software and artistic development, including computer game enthusiasts." – Enterprise Seattle Interactive Media Industry Assessment, May 2012 (Prepared by CAI Community Attributes Inc., Commissioned by Enterprise Seattle)

As they further note, throughout their interviews, an important theme affecting growth in the Pacific Northwest is *"the quality of life and amenities that align with the Interactive Media workforce demographic."* (p. 31).

Alongside the commercial and industrial evolution of the region, there is a growing integrative genre of arts, design and technology.

"Today, Seattle's creative vitality is nearly three times the national average—among the highest in the nation. The arts not only inspire and fuel discovery – they improve our quality of life, create jobs, help attract and retain business, make our city a major destination for tourists and play an important role in the economic revitalization of our community." – Mike McGinn Arts and Economic Prosperity Report, 2012

In June of 2012, the Americans for the Arts, a national nonprofit arts advocacy group, released the most comprehensive economic impact study of the nonprofit arts and culture industry ever conducted in the United States (Arts and Economic Prosperity Report IV, 2012). According to their report Seattle has seen $447.6 million in annual economic activity from the nonprofit arts and culture industry, with 10,807 full-time equivalent jobs – almost three times that of similarly sized cities. As of January 2011, Seattle, WA is home to 4,571 arts-related businesses that employ 20,616 people. The confluence of thriving arts and technology communities in the Northwest has created a fertile ground for inspiring arts/tech collaborations.

A Community with an Innovation Culture

As we discuss how to foster a thriving community of practice at the intersection of art and technology, we may draw inspiration from past work (Wenger, 2000). To start, it has been well-established that conversation is the main activity

of any thriving community. While we need regulars to provide stability and historical knowledge, the conversation must be open and welcoming to all participants (Oldenburg, 1989). Members of an effective community can articulate their common goals, and the steps they are taking to accomplish them. In a thriving community people know each other and regularly interact with each other. We cannot emphasize enough the importance of helping people develop trusting relationships, where they have a feeling of identity and belonging toward the community and are willing to contribute time and energy toward these common goals. People develop these relationships not only through their collaborations, but also by having fun together.

As a community of practice, it is also important to develop a shared understanding of best practices within the field, and host repositories of knowledge and shared artefacts. When seeking to foster a culture of innovation, it is important to expect and reward change, to foster an openness to new ideas across social hierarchies, and to collaborate across organizations and disciplines (Bryant, 2014).

In organizing this workshop, we very much embraced these principles, seeking to include a diversity of voices, across roles and organizations. For example, in developing the workshop agenda and facilitating the workshop conversation, we welcomed the contributions and emerging leadership of any individual or organization in the space. We also sought to provide increased opportunities for conversation and to infuse that sense of play, by wrapping up the workshop with an art show.

Workshop

Broadly speaking, the goal of the workshop was to bring together diverse stakeholders in the ecosystem of the arts and technology worlds to discuss how to foster a community of innovators, increasing awareness, collaboration, and collective efficacy toward common goals. More specifically, the workshop agenda was to map out the space, identify core goals of the community, and develop concrete next steps toward fostering these goals. The workshop was structured as a four hour focus group including a) a brief questionnaire to generate individual feedback for how we should best support this community, b) introductions where participants described their own activities in the space and their own goals, c) breakout brainstorming discussions around emergent themes, and d) a discussion of concrete next steps. See Figure 1.

Workshop Participants

Participants were invited through two phases. We first generated a list of potential attendees known to the organizers who would reflect a diversity of roles and organizations in the community. In the process of inviting participants we asked whom else they believed should be attending. Names frequently mentioned or identified by community leaders were then invited in the second round of invitations.

Figure 1. The workshop was optimized for conversation.

41 people attended the workshop, 23 female, 18 male. Participants were asked to categorize themselves in the questionnaires in terms of what primary roles they play in the arts and technology community. Figure 2 below illustrates the breakdown of innovators (67%), educators (52%), advocates (50%), researchers (45%), organizers (30%), writers (30%) and curators (28%).

Figure 2. Participants represented a diversity of roles.

The term "innovator" was used to encompass artists and technologists who created new works. We further asked innovators to identify themselves according to following categories: artist, technologist, designer, maker, hacker or entrepreneur. Figure 3 shows the breakdown of innovators. It should be noted that many of the individuals in the room wore multiple hats, reflecting the interdisciplinary nature of the community even at the individual level – artists who were also entrepreneurs, hackers who were educators, and community organizers who were also designers.

> *"We had become interested in the process we were involved in, which was the meeting, marrying, and mating of artists and scientists that was a kind of coupling, some form of, hopefully, a synergistic new wrinkle in artistic thought and scientific thought. That they would repel each other, and attract each other in some strange*

dance, and we would get out of that the flowering, the explosion, the evolution of something for the future." (Steve Paxton, Open Score - 9 Evenings film by E.A.T., 1966/1997; from Oppenheimer, 2012)

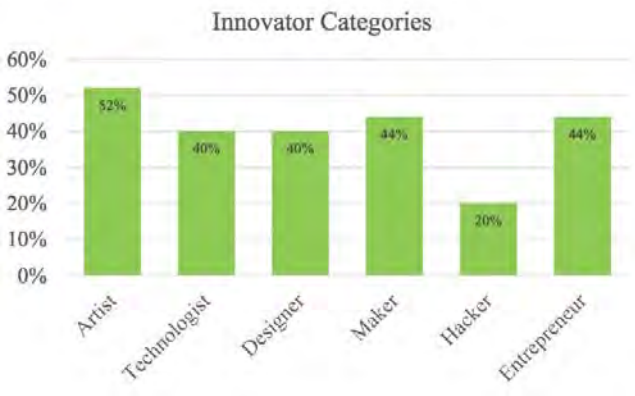

Figure 3. Attendees included many types of innovators.

Mapping the Community

A key goal of the workshop was to map out who were the organizations and people actively engaged at the intersection of art and technology. Through the process of generating the participant invitation list we first developed an initial list of categories, and then populated the list with prominent exemplars in each category. At the workshop, we asked our participants to further indicate those organizations, individuals, news sources, and so forth, that they keep track of or are most representative or influential in the arts/tech community.

Figure 4. Network map of workshop invitees, with their roles (orange), interests (blue), and organizations (green)

Across categories of educational groups, exhibitions spaces, maker spaces, companies, and social groups, we found there are few organizations devoted specifically to the arts and technology space. Rather, they tend to be only partially involved or have overlapping interests with the arts and technology space. For example, while exhibition spaces like the Henry Art Museum have art shows with technology-oriented art, not all of their exhibitions are focused on this area. The exception to this is in the maker spaces, which tend to be focused specifically on supporting technology as a creative medium. We similarly did not find that participants acquired information about activities at the intersection of art and technology from any one unified source.

When we asked participants to indicate how they kept up to date with information and events about the arts and technology community, they reported largely relying on social media and mailing lists. Few mentioned more traditional news sources. See Figure 5.

Facebook/Facebook Groups (9), group/organizational mailing list (8), Twitter (7), Wired(3), Internet(2), Rhizome(2), LinkedIn (1), email (1), ars electronica (1), NYTimes (1), Geekwire (1), The Verge(1), FastCompany(1), Skype (1), ITP (1), Omnivours (1), Leonardo(1), Word of Mouth (1), Stranger(1), Makerhaus(1), Zero1 (1), Blogs(1), Gizmodo(1), Engadget(1), Create Digital Music(1), Meetup(1).

Figure 5. How people keep up-to-date.

We asked the innovators a few questions to test our assumptions about the nature of their work. When we asked how they used technology as a creative medium, there were a wide variety of responses, with programming, physical computing, design, and rich media being the most prominent categories. See Figure 6.

Programming (10), Microcontrollers/Arduino(3), electronics(3), graphic design(3), fabrication (2), dance(2), Kinect(1), computer science (1), 3D imaging, digital mapping (1), response technology (1), math(1), logic(1), code(1), sensors(1), cameras(1), rapid prototyping tools(1), film(2), choreography(1) lighting(1), sound/music (1), Photo/video editing(1), metal work(1), word working(1), processing(1), openFrameworks(1), social media(1), CAD digital fabrication(1), visualization(1), web/app(1), Robotics(1).

Figure 6. Uses of technology as a creative medium.

We observed a dichotomy in how the innovators employed technology in their art. Many perceived their use of technology simply as a tool or means to an end.

> *"I use technology full stop. It is the set of tools I use to do what I do, it is the means not the end."*
> *"I use digital tech in my artwork whenever I need it to achieve my goals, for interactivity...also use those tools in creation of animation"*

Whereas for others, technology was an important theme integrated into their work.

> *"I use technology to enhance the way humans sense the world and to explore the intersection of the physical and digital worlds"*
> *"[technology is] "Instrinsic to the platform of the art"*

As expected, the majority (56%) of innovators reported all of their projects were collaborative, with another 38% reporting they had both solitary and collaborative projects. Only one person reported that her creative projects were only solitary. Collaborative projects ranged in size from 2 to 50 collaborators, with most being in the 3-5 person range. We also found that when people reported their projects were collaborative, they often sought out people with different skills as collaborators. Many of these cross-disciplinary collaborations combined technological skills such as programming or CAD fabrication, with more traditional artistic skills such as dance or design.

In terms of work spaces, people reported using a mix of their own studios, maker spaces, work sites, and online spaces.

> *"living room, backyard, café, bars, labs, maker spaces, Cornish residency"*

When seeking to learn skills, people reported a mix of a) finding information online, through search, Wikipedia, Youtube tutorials, and technology forums, b) through local universities, c) through the maker spaces, and d) by seeking people in their personal networks who have the desired knowledge and skill.

As illustrated by these survey responses, the innovators in this community actively used technology as a creative medium, sought out cross-disciplinary collaborators as a part of their work, worked together through a mix of personal and shared spaces, and engaged with ongoing learning around specialized skills through online resources, educational resources, and their personal networks.

Collective Goals

Perhaps the most important agenda for the workshop was to articulate the shared collective goals of this community of people at the intersection of art and technology. As organizers we had developed a preliminary list to inspire discussion, but also asked participants to describe their own agenda and what they hoped we might achieve. To start the conversation, we asked participants in our survey to rate the importance of possible goals.

As can be seen from Figure 8, most of the goals were rated fairly highly, with more diversity in perspectives, across gender, race, and socio-economic status, being rated the most highly. Following this, the desire for more exhibition spaces, increased educational opportunities, an improved sense of community and social support, fundraising opportunities, access to collaboration spaces, access to specialized tools and machinery, and better promotion of arts/tech related activities were all rated as equally important. Less important were networking events, an online directory of artists, or better collaboration tools.

In the second phase of the workshop, we reviewed people's introductions and their stated interests, and then we broke apart into four discussion groups around the four most prominent themes in the discussion: diversity, education, bridging communities, and the underlying philosophical perspective of technology as a medium of art. Further discussion of these and other emergent themes are below.

More Diversity

Given the specialized skills, educational resources, and funds required for works using technology as a creative medium, the population of those active in this space tends to be higher in socio-economic status. Furthermore, given the gender discrepancy of those in the technology industry, it also trends towards being more male. For those at the workshop, this was a great cause for concern. One element of low diversity is the perception in disadvantaged groups that this genre of art may not be for them, and a key issue is how to increase individual agency to leverage the resources available. In the discussion, attendees suggest a number of approaches to increasing the community's diversity, including a) mentorship programs between novices

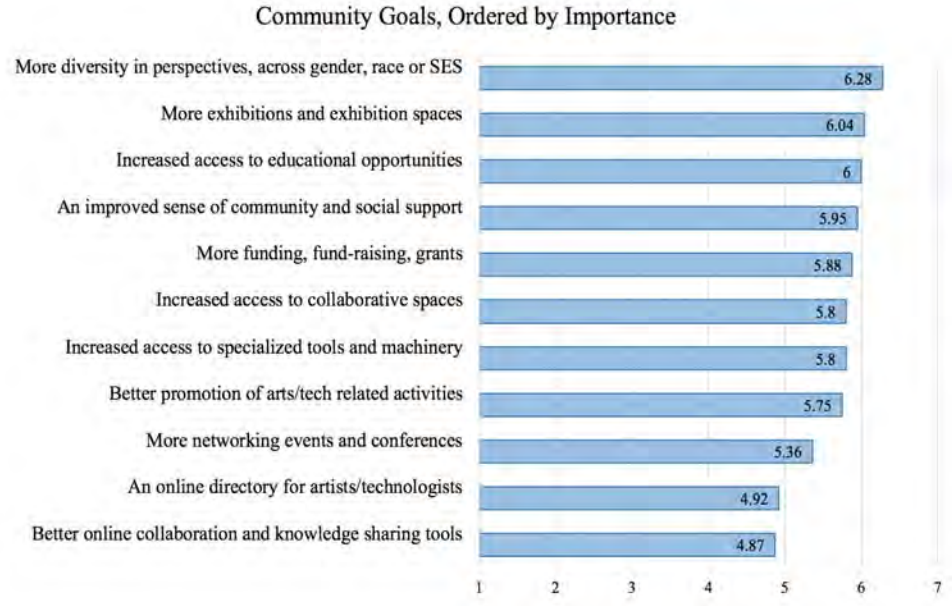

Figure 8. Average ratings of community goals

and experts, b) a sharing platform for sharing resources, c) educational programs such as ArtsCare and ReelGrrls, and d) increasing the prominence of role models in news and social media.

More Exhibition Space

> *"Consistent exhibition opportunities that are healthy in traffic online and in real time".*

Although the Pacific Northwest has a thriving technology industry, there are no dedicated places for exhibition of works at the intersection of art and technology. Participants agreed there is a potentially vast, virtually untapped market of patrons and buyers for interdisciplinary tech and art that needs to be engaged if we hope to finance growth in this field. The biggest issue with those spaces seemed to be a lack of sustainability. It is a major cost to our city if creative entrepreneurs spend years and thousands if not millions of dollars on under-supported ventures. So, as we look to encourage local artists we must also look to those space makers to learn from their experiences and improve access to financial supporters, community resources, and possibly more adaptive business models.

Workshop artists also expressed that they wanted accessible space that comes well-promoted to an audience who will show up and interact with the work, plus a robust online platform to share the work beyond our local market. One unique aspect of the technological art space is that it must extend gracefully into the ether. As such, ideal spaces need to be connected, and relevant to a wider audience.

Increased Access to Education and Makerspaces

> *"Education, diversity, and access are the biggest holes. Most of this has to do with affordability, and perhaps cultural exclusivity."*
> *"Education: more context for teaching/mentoring youth by art/tech professionals."*

Access to life-long educational opportunities emerged as important due to the ongoing need to maintain and learn new skills as new technologies evolve. There are many educational opportunities in the Pacific Northwest that include traditional educational institutions, online tutorials and courses, Meetups, conferences and events, as well other networking opportunities. Groups such as Dorkbot and the Seattle Robotics Society are largely structured around providing peer learning opportunities. That said, in the past decade makerspaces or hackerspaces have emerged as important community centers, with tools for turning data into 2D and 3D objects. They provide valuable resources for artists, designers, engineers and educators, including life-long learning opportunities. Educational institutions that do not have adequate funding or resources can use these types of public technology spaces to enhance and facilitate technology-focused art programs. Students can develop concepts and final designs in a classroom setting and cost effectively outsource the production. This coordination between institutional education and non-institutional production is becoming a model of technology education in the future.

Access to free or inexpensive education is also important because differential access to education decreases the diversity of the community. Although we are increasingly in a world where people may learn many new skills online – particularly skills around technology – many are not aware of said opportunities or do not feel empowered to seek them out. The success of maker spaces further illustrate the limitations of online learning, given the importance of hands-on access to specialized machinery and related skills training. Independent artists and designers often cobble together various combinations of resources to produce their projects. Complex projects may involve several types of expertise from quite different disciplines, and embedding projects in shared makerspaces provides serendipitous access to such cross-disciplinary knowledge.

Social Impact

An important emergent theme of the workshop was how should we use art as a tool for social impact – that is, not just as a vehicle for aesthetics and communication, but also for helping the world be a better place. To the extent that art can be perceived as shaping the nature of cultural conversations, how can it be used to impact culture, particularly given the affordances of technology-mediated art to reach broader audiences. This issue is related to that of diversity, in that if technology is being used as a means for artists to have a voice in shaping cultural change, it is important that a diversity of voices be participating in that conversation.

Bridging Communities

> *"Better bridging/defining of what is art to tech community"*

As illustrated by the number of groups and individuals engaged in this space, in one sense the Pacific Northwest already has a thriving arts and technology community. That said, there is no clear name for the community, no clear home or hub online, no one central place for people to convene, and no one communication channel for them to subscribe to. Because the community is inherently interdisciplinary, there will always remain the need for different organizations and individuals to support the specialized concerns of their constituents. For example, the Seattle Robotics Society and DXARTS at the University of Washington, while having some overlap in their missions and their people, also serve very distinct purposes. Consequently, an important theme that emerged from the workshop is the need to adopt more of a coalition model as we consider how to foster a growing interdisciplinary community – that is, we should work to build bridges across diverse communities around the common interest of innovating at the intersection of art and technology, rather than trying to

merge them. One such coalition approach, for example, might be to work together to host an event specifically designed to connect people from different disciplines or groups. Similarly, we might work together to more effectively help people find collaborators through online tools.

> *"Art and technology hackathon, w/peer mentoring, matching artists with engineer/ designer".*
> *"An easier way to discover compatible individuals and new projects/technologies".*

Financing Technology-based Art

> *"We have an Arts Incubation series for helping to generate new ideas but are very limited in terms of our digital technologies resources. So the best would be funding access to technology for artists to experiment."*
> *"A critical understanding of how to develop, market, and commerce relate to art based on technology".*

Traditional business models for gallery art do not easily apply to technology-based art. That is, consumers of such art are rarely in the position to purchase it for personal display at home, either because it would be too expensive considering the cost of actually implementing it, the art is too large, it is too ephemeral, or it is not sufficiently tangible. Given the high wage to be earned in the technology industry by those with specialized technology skills, few technology artists actually make a living from their art, but rather use their work wages to personally fund their art. Thus, when asking our workshop participants what resources they needed to reach their full potential in their creative projects "more time" was frequently mentioned.

Philosophical Substrate and Critical Voice

> *"Dedicated art/tech critic in the city".*
> *"The role of art as a form of research/interrogation as it relates to envisioning technology and how we understand our lives, and the ways in which we (as a community) can work together to intensify and externalize the A/T conversation, helping it feel relevant and accessible to no-traditional/non-"art" audiences."*

Whether technology is perceived as simply a tool for creative expression, or as an object of the conversation itself, the issue of how this community stands relative to other genres of art is an important one. It is only through a shared understanding of technology-based art as a genre that we may also develop a critical voice for identifying and promoting standards of excellence in the domain. However, while the term "technology-based art" brings to mind specific creative tools and artefacts such as programming languages, digital media, and electronics – the word technology itself is somewhat conflated with the meaning of word art. As noted by participants in the workshop, the meaning of the word technology is rooted in the greek word, tekhnologia merging art and skill.

> *"Technology, like art, is a soaring exercise of the human imagination. Art is the aesthetic ordering of experience to express meanings in symbolic terms, and the reordering of nature—the qualities of space and time—in new perceptual and material form. Art is an end in itself; its values are intrinsic. Technology is the instrumental ordering of human experience within a logic of efficient means, and the direction of nature to use its powers for material gain. But art and technology are not separate realms walled off from each other. Art employs techne, but for its own ends. Techne, too, is a form of art that bridges culture and social structure, and in the process reshapes both." -- Daniel Bell, "Technology, Nature, and Society," The Winding Passage, Abt Books (1980).*

How then, do we best argue that technology is a medium of art, a category in its own right equivalent to "visual art", "theatre", or "dance", or "music", which as a discipline should evolve its own best practices, and develop its own critical voice for excellence? Moreover, how can we blur the lines between technological envisioning and art (which relies heavily on design and other activities leveraging creative voice), in order to illuminate alternative, generative pathways for the creation of the technologies that will shape our lives in the future. Essentially, how can we embed artists into the technology process as an important means of discovery and innovation.

Next Steps: Community Building Activities

Having mapped the space and community goals, the next step for the workshop was to discuss concrete next steps toward achieving these goals, which fell into three main categories: documentation, communication, and events. In line with the "coalition model", we believe different people and organizations must take leadership, no one organization can complete the whole list of activities.

Documentation and Sharing

How do we develop a central repository for documenting who's who (organizations, projects, and people), best practices, knowledge sharing, digital assets, and so forth? The obvious solution to this is some form of website and/or social graph, but who should host this web site, and who would fund it? These questions require further conversation, however in the short term, we decided to create this summary report to share lessons learned, and have started exploring developing a social graph including individuals and organizations in this community.

Communication and Collaboration Channels

As discussed earlier, a primary requirement of any thriving community is an ongoing communication channel. To fa-

cilitate ongoing conversation and community updates, it is important to leverage existing communication channels, such as mailing lists, Twitter, and Facebook. For example, to help us more easily find each other on Twitter, we decided upon the"#ArtsTechNW" hashtag and created a related @artstechnw account.

Community Building Events

Events undoubtedly have a substantial impact in fostering a thriving community. The best mix includes a large number of intimate opportunities for individuals with specific commonalities to convene, with a few larger shows and parties to bring together the wider communities. In addition to producing our own events, however, it is most important to suffuse larger culture-building events with the thinkers and artists who represent the community and to assist in the promotion and attendance of those instances. One project we considered undertaking as a community would be to increase the technology/ interdisciplinary art presence at relevant local festivals and as programming at a range of venues. A consortium of art and technology organizations could coordinate speakers and shows featuring local innovators and visiting luminaries by noticing opportunities that already exist in our market. This kind of integration helps us build bridges into the larger cultural landscape while providing a new audience and potential resource pool to our members.

Another approach to is use regular meetups as a platform for investigating collaboration and experimentation in the arts, technology and design. For example, as a followup to our workshop, a group called ArtsTechSea will be organizing educational programs and social/networking events for individuals working at the intersection of art and tech to share ideas, strategies, successes, challenges and failures.

Coalition

Seattle has a strong creative community. However, in order to truly maximize the individual contributions of institutions, organizations, creative professionals, makerspaces, non-profits and individual agents-provocateurs, and take their work to the next level, the need for an interdisciplinary art and technology coalition arises. Through a coalition members from diverse groups and backgrounds may meet at regular intervals to share their work, calendar, methodologies and visions, with the ultimate goal of creating cross-institutional, cross-community work that leverages and expands on current assets towards the creation of a truly vibrant, globally relevant, creative culture.

Synthesis

In organizing the workshop, our goal was to bring people together to map out the community, clarify common goals, and initiate concrete next steps toward achieving these goals. Coming out of the workshop, we found our goals had broadened considerably relative to going in. Given the excitement of the people in the room and the expressed need for this community to grow, we elevated the conversation in how we define innovation to take leadership in community building and risk taking. As suggested by one of our participants, we decided to embrace *"Let's be dangerous thinkers"* as the motto. Creating an environment for interdisciplinary arts and technology collaboration requires special efforts in community organizing, including creating tools for knowledge repositories, leveraging social media, and organizing cross-organizational events. By sharing lessons learned we hope to support other community organizers with similar ambitions.

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Smash the Black Box – designing for creative mobile machinery

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Abstract

With the rise of the 'visual web' the visual design capabilities on feature- and smartphones are increasingly expanding. We investigate how young resource-constrained people in Cape Town, South Africa are using the free tools on their mobile phones to make instrumental visual designs. We suggest that an alternative space for production of, and learning about, electronic arts and design is offered by ubiquitous mobile phones among this group. We offer a discussion of this repertoire of tools in relation to 'professional' design software, such as Adobe Creative Suite - describing the need for software that blurs the distinctions between professional desktop tools and casual mobile tools. We relate experiences from the participatory design and development of an open-source design tool for mobile in response to such a need, and find that many of these design processes are, in turn, hampered by limited developer libraries for visual design on Android. We posit that, in order to promote cultural diversity within the public domain, and in mobile-centric young people's lived realities, it is becoming increasingly necessary to expand and democratize visual design tools for the mobile ecology, in order to explore local design needs and visual vernaculars.

Keywords

Visual Design, smart phone, South Africa, mobile creativity, resource-constraints, DIY

Introduction

> *Computing is a structural enterprise, but we are not structural creatures. How do any of us create lives, our own rich lives, in the constant presence of the reductionist properties of the computer? In this sense, computation is a colonization that we all face.* [1]

Mobile phones have often been hailed as the device that will connect Africa to the global information economy. [2] Yet, they are currently predominantly described as a means to consume information, and not produce it. [3] Diverse and inclusive participation in the cultural production of visual online content, as with other cultural production, is crucial in promoting cultural diversity in an increasingly globalized world. [4] As smartphones are becoming affordable to a larger portion of the South African population, this might signal an increase in such visual cultural production – allowing a new generation of visual creatives a platform for networked artistic expression and instrumental visual design, a ticket to participation on the 'visual web'.

The creative capabilities of the average smart phone or tablet user to produce electronic arts have recently exploded: app markets are brimming with new tools that enable the production of visual creations. These 'consumer' tools exist within a certain genre of 'casual' mobile creativity, restricting the user in its use – often imposing a certain style or workflow. I discuss a case study that investigates the media ecologies of a group of aspiring designers who operate within this mobile-first paradigm. Many have hacked these informal tools to produce instrumental designs. However, the institutions where they are studying Extended Curriculum Programs in Visual Design do not expand on these 'mobile-first' [5] visual design literacies. These institutions, like the majority of design schools, promote the industry standard packages of desktop design software, namely the Adobe Creative Suite. Although Adobe has adapted many of their packages to function well on mobile devices, these are intended as "companion apps" to the primary desktop design environment, excluding many resource-constrained young people who are mobile-primary users from using these tools to their full capabilities.

Unpacking these issues, we introduce the context and method of our study by first offering a representative narrative based on the lived experience of a participant. Thereafter, we situate the need for the expansion of design capabilities on mobile phones towards fostering a more inclusive creative landscape, by giving a short overview of Cape Town's design industry as culturally non-representative. We then describe the establishment of Extended Curriculum Programs (ECPs) for visual design as contributing to growing the design industry, but due to capacity, only being partially successful in combating this hegemonic order.

Looking at mobile phone creativity, we offer a discussion that seeks to differentiate 'casual' creative tools, from 'legitimate' creative tools, as positioned by gatekeepers at these institutions. In response to this view of mobile tools as low-brow design tools, we discuss the development of *Molio: the mobile portfolio,* a creative app that attempts to blur these distinctions within the limiting affordances of the mobile phone. The app was ultimately deemed a failure, and was severely hampered by the embedded aesthetics of existing developer libraries for mobile design tools.

We argue that these developer buildings blocks can make it increasingly difficult for artists and designers to "open the black box" – as Bruno Latour would have described the "need to examine the practices whereby technologies and 'facts' are naturalized" [6] – on the tools that facilitate their creativity. In other words, students cannot see the inner workings or logic of creative tools beyond the mediated interfaces as authored by others – their creative tools are "black-boxed". This naturalization of pre-packaged digital arts tools can limit innovation and alternative modes of image making, and ultimately threaten to colonize the shape and nature of electronic visual creativity by imposing a globalized design vernacular. [7] Resisting the agencies and structures that perpetuate this, we posit that, it is not only necessary to disrupt the colonization of digital tools for visual creation, but also to "smash the black box" and allow for the cultivation of young creatives who can build their own creative digital tools, particularly on and for mobile.

Context

Akhona flips through the photographs on his Samsung Galaxy S III, a special gift from his grandmother on the eve of his first day at the University. He is the first of his family to attend a University, and she was very proud. Perched on his bed, hunched over the phone, he scrutinizes each image carefully. The photographs are mostly of his illustrations, 3 years' worth. He has to decide which picture he wants to use in a composition for his ad: he wants to advertise his services as a portraitist among his peers on Facebook. He desperately needs the extra money for materials; otherwise he might as well not bother with going to class at all. The lecturer gave him a final warning: he has to use gouache; he's not allowed to use the cheap powder paints he's been using as a substitute in class. He really hoped she wouldn't notice, but she did. He can't afford gouache at the moment, but he also can't afford another embarrassing moment like that.

The photos document three years of illustrations andrecent school projects. He laughs at an old portrait he did about a year ago – that was before he knew anything about drawing: the eyes look bewildered; the strokes are awkward and too carefully executed. Without a high school introduction to drawing and the arts, it was difficult to adjust, and he very nearly failed the June exams. For those first few months, he spent every moment he could on the computers next to their studio at the University, researching. Even those were hard to get used to – they didn't have any computers at his high school. He practically only ever accessed the Internet from his phone back then. Whenever he didn't know what the lecturers were talking about, he would run and Google it – there was lots to become acquainted with in this new world.

He lands on a photograph of a friend from class, Neo. She has long braids that are hanging over her face and wears a shirt designed by another friend of his, Sabelo. Sabelo has his own clothing brand called "Kasi-stylez" – 'Kasi' means 'the hood': the township. The graphic is of a breakdancer mid-spin, but he is clothed in traditional beaded Xhosa attire. Akhona breaks out his pencils and his drawing pad, for the next hour he whips his gaze between the small screen balanced on his left knee and a piece of white paper, fastened to a wooden clipboard pressed down on his other knee, carefully observing the lines so that he can copy them. Pausing occasionally to sharpen his pencil, he ponders the possibility of fitting a tiny desk in the already cramped three-people-per-room shack. When he finishes he switches the phone to camera, and takes a picture of his drawing. He opens the image in an app called PicsArt, pushes the contrast, ups the brightness, so you can't see the shadows on the paper. He crops the image slightly, so the composition is stronger. He uses his fingers to zoom in and then meticulously paints the word "AkhonArt", his latest design moniker, at the top. He saves it out, and Whatsapp's a copy to both Neo and Sabelo – they would appreciate it. Sabelo might even feature it on his brand's Facebook page. He closes the app, and opens another one called Studio Design, imports his picture. He adds text and social media icons to make it look 'legit' – "custom portaits between R50 – R300 ($4 - $25)*", "contact Akhona" – and lists his number next to the Whatsapp icon and his BBM (BlackBerry Messenger) pin next to the BBM icon. This takes a while: the app keeps crashing. He downloaded both icons from Google images to make the ad look more legit: hopefully that venture didn't eat too much data. He then taps the share button, selects Facebook, and sends – he silently prays he still has enough data left on his bundle to upload the image, but is relieved when the image appears on his timeline. He thinks for a moment, and then opens Whatsapp – he hates broadcast messages when other people send it, but this is an emergency – he broadcasts the image to a select group called "Frendz". Luckily he can Whatsapp for free with his service provider. He looks at his design again – if only he could be as quick in Photoshop already…*

Akhona is a 20-year-old aspiring graphic designer from the township of Gugulethu – he is a participant in my research project that revolves around young aspiring visual designers, enrolled in Extended Curriculum Programmes (ECPs) for Visual Design. Through a Participatory Action Research method, I have followed the trajectories of 60 students across two such courses, for little over a year. I have utilized ethnographic methods (including participant observation and in-depth interviews with 33 of the participants) three iterations of Participatory Design workshops (Figure 1), as well as two user-testing sessions to collect my data. I obtained formal ethical clearance and participants provided written consent on condition that all personal information would be presented anonymously.

These participants come from a variety of backgrounds, but a large portion hail from low-income, low-resourced

neighborhoods; have often had negligible exposure to the formal skills associated with visual arts prior to applying for these courses; and, for the majority of their lives, have accessed the web directly from their feature- or smart-phones.

Figure 1 Akhona demonstrates his method at a participatory design workshop, 8 September 2014

Akhona is a typical South African young person: his grandmother, their sole caretaker, earns around R2600 ($222) a month, working as a domestic worker for a family in one of the wealthier suburbs. This is slightly above the average median income for a single-income Black household which stands at R2 167 ($185) per month according to the most recently available statistics. [8] He went to school at an inner-city township-serving school where he wasn't able to take Information Technologies, nor Visual Arts, as school-leaving subjects – putting him among the 99% of secondary school-going children in South Africa who do not have formal exposure to these literacies and skills at school. [9]

South Africa celebrated 20 years of democracy in the year 2014, sharing a birthday with Akhona. Prior to this, the country had in place a system of *Apartheid*: legislation and reinforcement that curtailed the rights, associations and movements of the majority Black (under apartheid, Black people were broadly termed "non-white" and specifically classified as either 'black', 'coloured' or 'indian') inhabitants of South Africa. [10] In effect, this meant that racial groups were segregated in public spaces, education, medical care, and most all other aspects of everyday life. [11] During this time, the artistic and creative voices of the Black majority were systemically suppressed, manifested in a lack of arts education at school level and limited support for Black artists. [9,12]

The City of Cape Town, located at the most Southern tip of the African continent – the first point of colonization in South Africa – remains one of the most economically unequal cities in the country today. [11] Geographically, the city is still divided in racially, and economically segregated districts, despite the promise of integration that democracy held. In the Central Business District (CBD) lives the wealthy elite of whom the majority is White, and along the periphery of the city, in slums and government housing called "townships", live the Black working class.

World Design Capital For a Few

For the year 2014, the City of Cape Town was declared the *World Design Capital,* a title previously held by cities such as Helsinki and Seoul. According to the official press release, the *World Design Capital* is a "distinction awarded to cities which recognize design as a tool for social, cultural and economic development". [13] This precarious title has been met with skepticism from critics and activists throughout the year 2014, with one such critic bitingly writing: "Cape Town is a pretty city. It is also a city using art and design as a means of bullshitting its way through its social and racial inequality". [14] Many have had similar issues with what they perceive as a cultural and artistic palimpsest – ignoring the blaring absence of diversity in the Design industry, a "symbolic battlefield" reflecting an unequally designed social system. [15]

In a case study that perfectly demonstrates this "battlefield", art-activist group *Tokolos* defaced a Rayban-sponsored 'homage' to Nelson Mandela titled "Perceiving Freedom" [16] which was installed as an official World Design Capital event. The piece was a giant pair of steel Rayban spectacles resting on the Sea Point (a sea-front suburb on the Atlantic seaboard) promenade, framing the far-away view of Robben Island. Robben Island is where the late statesman spent 27 years of his life, incarcerated by the Apartheid government, for his involvement in the Freedom Struggle. *Tokolos* called the piece "myopic" – criticizing the artwork's representation of "freedom" as shortsighted – a commodity to be consumed. Their critique bit into Elion and Ray-ban's co-opting of the Mandela legacy, further drawing attention to the fact that this piece (like the majority of public artworks in the city) was produced by a White male artist. [17]

This controversy touches on the conflict between the social and political role of design as democratic, sustainable and transformational with the profit-driven cosmopolitan notions of visual design and art as distinct leisure activities of the upper classes. [18] Ideological conflicts in the matter of public art in general, and related to the World Design Capital in particular, has drawn a great deal of attention to the limited number of Black African voices in the creative fields – a direct result of a schooling system that neglects the creative and technical literacies and skills that are necessary for a tertiary education in visual design [12] beyond the basic introductions to often-stereotyped traditional 'cultural crafts'.

In *Arts Under Pressure* political scientist Joost Smiers draws attention to the importance of diversifying the perceived modes of legitimate creativity, naming cultural diversity in the arts as one of the pillars of a democratic society – "A characteristic of democracy is that many different voices can be heard and many different opinions expressed. The public domain in any democratic society is the mental and physical space in which the exchange of ideas and an open debate about all sorts of questions can take place without interference from state agents, who may

have their own agenda, or from commercial forces whose only purpose is to sell as much as they can." [4]
The ad-hoc creativity of young people like Akhona and his peers start revealing an alternative creative space - providing "novel means for civic engagement, bringing new voices into public debate" [6] through personal expression and visual creativity.

These specific young people have gained access to the courses that could potentially allow them passage into the exclusive inner circles of art and design; this in itself makes them exceptional. Yet such case studies allow us a means to re-evaluate the institutional training of these designers and the naturalization of their suggested tools.

The South African Mobile-First Generation

Although the South African Design industry places importance on formal degrees and accreditation, when we look elsewhere in the world these institutions of learning are being decentralized to online communities of practice and genres of participation. [6,19,20] They allow young people who have frequent online access, and access to communication technologies, to explore digital creativity in a casual capacity. To many of these young people, these creative activities offer a "first touch" [21] or introduction to instrumental (in other words, towards a productive or profitable goal) visual design, and possibly a means to leverage these literacies and familiarities into formal education. Customizing a WordPress blog can spark an interest in web design, Instagram can be a springboard into photography, and character customization in a free online game can cultivate an interest in digital game design or animation. For others, this informal skill development can offer a "Hackademia" allowing them a means to be functional, if not accredited, designers. [22]

In South Africa, the majority of young people access the Web from their mobile phones. [23,24] Few have frequent access to computers or stable Internet connections. But with increasingly quick and affordable online access from ever-cheapening smartphones, these young people are finding ways to participate in digital cultural production. [9] Kids like Akhona have made do with the technologies and resources at their disposal to familiarize themselves with these creative industries. They have also, often with great difficulty, managed to navigate the difficult application process and financial strain of formally obtaining a degree.

Extended Curriculum Programs: Gatekeepers addressing the Bottleneck

Akhona, like the other 60 participants in my research project, was enrolled in Foundation courses for Visual Design. These courses have appended a pre-first year to bring inexperienced and untrained young creatives up to speed with the formal skills deemed necessary to continue with the standard 3-year design course: serving both a diagnostic and remedial purpose. These courses are government-initiated and -funded, and specifically designed to offset the disadvantages of young people who have had negligible exposure to the skills and literacies that would allow for success in tertiary Visual Design education.

These programs have been met with varying degrees of success, despite compassionate course conveners who constantly work to evolve programs. At one of the field sites for this research, for example, the pass rate for 2013 was 10% - course conveners identified an external selection process as the main contributor to this staggeringly low pass rate.

In addition, students struggle with fees, transport, language of instruction, the foreign social and cultural environment, and gaining access to the epistemologies of their chosen programs. [25]

Hegemony in Visual Design Education

In the global North, studies conducted by researchers such as James Gee [26] and Brian Street [27] have suggested that academic success is to some extent related to enculturation earlier in students' lives – which in turn has direct connections to race and class identities, suggesting that "the university privileged some cultural ways of being and knowing over others". [25]

Within the Design courses I observed (which varied between the traditional visual design fields of Graphic Design, Industrial Design, Surface Design and Fashion Design), for example, the formal design principles as set out during the formation of the Bauhaus are taught and hailed as the benchmark for good, clean design. Theorists such as Victor Papanek took issue with this widespread Bauhaus-first influence over Design sensibilities in education. [28] For Papanek, the design student was a person with a unique set of skills and knowledge, which came from their situated lived experiences. Each design student would therefore be able to bring unique expertise toward designing solutions for their own local environment based on this situated and personal wealth of knowledge – formal education needed to compliment and naturally expand on what the student already knew. By assimilating all designers into an international school of design thought, or globalized parameters of legitimate design, we would be negating these valuable localized insights, dismissing unique cultural design vernaculars [28] and tools – reinforcing a hegemonic order for visual design where Northern tastes and aesthetics are seen as the ideal.

Figure 2 various examples of participants' mobile-produced and distributed content (c)

Very few ECP students complete the 4-year degree, and find work following their studies, indicating that these courses are only partially successful in allowing more young people access to the 'spaces of appearance' – as Hannah Arendt would have described "reality [as it] can be witnessed and its value judged by a 'plurality' of individuals who exchange the role of actor and spectator with each other" [29] – in design industry today. We suggest that an alternative space for production of, and learning about, electronic arts and design is offered by ubiquitous mobile phones among this group.

Casual versus Legitimate Design Tools

Although Akhona and his classmates are actively engaged in an emerging mobile-centric creativity, these modes of creativity are not recognized as legitimate forms of design. This dismissal is three-fold: firstly, with limits in processing power, mobile phones offer far less rendering "muscle" than their desktop counterparts. Secondly, the mobile platform is often seen as an accompaniment or an extension of the desktop environment in an ever-increasing convergence of computational technologies, not something that should be designed for, or on, as standalone platform; and thirdly, these tools are 'casual' by nature and do not contain the kind of customizability and uninhibited open creativity offered by material tools (such as pencils, paints and inks) and industry-standard design software such as Adobe PhotoShop or Illustrator.

PhotoShop and Illustrator offer maximum customizability, from canvass sizes and resolution, to which tools the user would like at hand at any given moment, and individual settings for each tool. For example, new brushes can be created, assigned properties and saved out for future use. Layers can be created, deleted, shuffled around, assigned effects, opacity, and assigned styles. Colour swatches can be picked from any image and saved out into a palette that can be named, additionally providing the user with the exact colour profile in a variety of industry mark-ups. Patterns can be created, defined and added to the library. Most aspects in the interface offer the user a way to edit, create, define, and save out their own personalized creative assets. These can then be saved out in working files, and any project can be picked up with the full scope of adjustments at a later stage. In addition, these programs have large online communities who provide each other with textures, fonts, brushes, elements and tutorials for sale or free download.

Mobile tools are usually intended as a means to publish on mobile, with few giving the user control over canvass size, resolution, or settings for print. Few offer the user access to the working files for later additions or editing. Creative tools for mobile are often connected with very specific brands with particular aesthetics – colours, filters, typefaces, shapes and elements are limited within each application. These are usually connected to a social network, where users rate these images within the paradigms provided by the brand. Some of these offer libraries (fonts, textures, frames, 'stickers', colour palettes, etc) that can be updated through the applications' official store, but these are all brand-sanctioned, and not user generated.

Studio Design, for example, offers a selected variety of typographic styles that are minimally customisable – rendering most photographs overlayed with these to look similar. *MyPicStory* gives users a variety of frames to place their photographs in, and although there are often new frames for download, this gives young creative people very little freedom in customizing or creating their own frames beyond editable phrases.

Furthermore, these tools are often separated into distinct categories – photographic apps (abundant), drawing apps (less so) and vector drawing or design apps (scarce). These separations can and do often dictate to the user what the purpose of the creative artifact should be – a photo app creates a decorated photo, a drawing app allows for finger painting, a vector app allows for quick sketches and trac-

ing. A stark contrast to the kind of unbridled creativity offered by desktop programs.

Molio – the Mobile Portfolio

The ubiquity of mobile phones in South Africa, along with their increasingly sophisticated capabilities and rapidly dropping prices, make them the ideal digital creative tool for young people who do not have access to the traditional tools for visual creativity, nor the opportunity to formally study visual design. *Molio* was conceptualized as a design project that would allow for sophisticated design capabilities within the parameters of constraints offered by the mobile platform, disrupting the notion of mobile phone as an exclusively 'casual' or 'accompaniment' tool.

Iketsetse – DIY in a mobile-first creative ecology

In order to start conceptualizing *Molio* we first explored the existing creativity that was happening on mobile phones through in-depth interviews and two preliminary mobile-making participatory design workshops.

We found that users, in this mobile-first ecology, were equipped with a toolbox consisting of mobile camera, physical materials (such as felt-tip markers, pencils and paper), design apps (including *MxPix, MyPicStory, Instagram, PicMix, Studio Design, Pixlr Express, VSCO Cam*, and *Android Photo Editor*, to name a few) and social networking apps (*Facebook, Whatsapp* and *Mxit*), and produced a wide range of visual artefacts (Figure 2) for a variety of purposes.

These ranged from personal advertisements, branding for grassroots organizations and labels, decorated selfies, fan images, humorous memes, event flyers and visuals for musical projects.

Describing this, one participant said: "It's 'iketsetse'…that's Xhosa for 'do-it-yourself'. We didn't have all the things, the computer and the money…but you still have the ideas, so you just make it with what's around." Below follows a brief overview of some of these creative artifacts.

Kasi clothing brands

The emergence of clothing brands, deeply entrenched in a local *kasi* habitus [30] and particularly influenced by local *Izikhotane*[1] and international hip-hop subcultures articulates a distinctive style, which plays on a visual bricolage of "bling", urban decay, and traditional African 'tribal' aesthetics. These items consist largely of t-shirts, hoodies, and caps. Young people come up with slogans or logos and sell them on a made-to-order basis. These are commonly run from Facebook, Black Berry Messenger or Whatsapp.

Selfie-expression

Decorated selfies allow young creatives to dialectically author and craft identities for themselves through symbolic embodiment in spaces of appearance – reflecting the view of the self that the author wants to project to their peers and the world. [31]

Phonefolios

In lieu of high-resolution digital cameras, computers and hard drives, mobile phones offer a way of documenting work. Participants back these images up directly onto *Facebook* through mobile upload, creating an ad-hoc cloud backup. These devices also allow for the carrying around of work as a means for display in co-located interactions.

Subcultures and visual vernaculars

Often images are authored as stand-alone electronic artworks, or visual poems, creating images that make sense of lived realities. Young people tell stories of crime, violence, poverty, love, hope, God, family, good, evil, and their everyday experiences which they share with friends over social networks or messaging services.

Yet, as discussed, many of these artifacts are severely limited in terms of available typefaces, colours, workflow, editing capabilities – curbing creativity on mobile platforms. Furthermore, many of these young people make their designs and artworks in relative isolation, where exposure is limited to their existing Facebook friends or Whatsapp contacts.

Participatory Design as Intervention

Borrowing from the Scandinavian tradition of Participatory Design [32], we looked toward uncovering local design vernaculars that originated on mobile phones in order to design a mobile exclusive, open source design tool in tandem with a larger social network that would enable sharing, mentorship, critique and community among young South Africans who were interested in the creative industries. The first tool would help with the creation of design artifacts, and the second would allow young people to network with these creations, find inspiration, and share ideas, resources and customized tools. This paper focuses on the development of this first application.

Prototypes and Collaboration within the academic space

Towards the development of the app I recruited a number of Honours Computer Science students and together hosted multiple workshops with participants. The result was the blueprint for an app which would include an integrated environment for both vector and raster editing; allow the user to prepare documents for print or web; include the option to produce custom libraries and save out custom tools, shapes, or textures; and work within a layered framework.

Molio – Another Black Box

By the end of the 2-month development period, the tool was a mutation of every other existing mobile visual editing app on Android, with added bugs. Multiple reasons contributed to this flop, but at the center of these awkward

[1] A local South African subculture where young people compete in displays of showmanship or dance battles as a display of wealth. Expensive material items are often destroyed during such displays to demonstrate the competitor's lack of concern for such possessions.

utilities, lay the building blocks of the Android libraries - intended as casual tools for casual design.

We developed the app for Android 4.4.4 KitKat, and the developers largely modified existing Android libraries to populate the app. There was the exception of the vector graphics editor, which was developed using the C language and required an interface to pull its functions into Android. This was done in lieu of any Android or JavaScript libraries that could produce SVG rendering to the full specification. A necessity for printed output, and a means for artists to edit individual nodes of vectors. The C library didn't have a touch interface, and had originally been designed for a desktop environment, which meant that the development team spent a large amount of time simply trying to make the tool respond in a mobile environment. These issues indicated the very limited development that was happening within the open source space for producing visual design on mobile. These limitations both indicate a gap to be filled by developers with dual interests in visual design and programming, and challenges for developers who rely on libraries to build their apps.

Smash the Black Box: A New Era of Mobile Creativity

In light of these troubling drawbacks, we advocate for a larger community of artists, developers, hackers and makers to produce alternative tools and open-source libraries, which break out of the linear, limiting vision of what is possible on mobile (for example, the processing power of a mid-level smartphone today offers roughly 2000 times the computational ability offered by the Macintosh computers that ran the first iterations of Illustrator '88).

Additionally, we believe that formal education should explore a larger repertoire of design tools, building on what young people are already using for artistic practice, and for their dominant modes of exhibition (social media). This will also possibly allow them to "smash open the black box" through exposure to programming languages such as Python, Java and PHP.

Among a mobile-primary generation of users, designing on mobile, for mobile, appears to be an emerging practice. For these young people, the development of local and custom built tools lies at the heart of finding and connecting with an online audience and expressing their voice in the public domain. The necessity to produce a design tool that allows for customization, crowd-contributions, and a natural evolution can take place 1.) Outside of the formal institutional aim to assimilate students into the traditional visual design principles and 2.) The commercial aims of profit within the mobile development sphere, remains critical.

Although formal design education offers a well-trodden path into formal design industry, the formal educational realm is increasingly struggling to keep up with the fast evolving technologies that enable the electronic arts [20]. This changing attitude toward the value of formal degrees might benefit young people who are already hacking the formal skills that could make them functional, if not accredited, designers. This is not to say that these courses do not have significant worth – but just that they do not have the capacity to assist the majority of aspiring young South African creatives who may benefit from a more casual, networked, mode of digital Do-it-Yourself cultural production.

Conclusion

Mobile phones offer a powerful tool for visual creativity, offering a "first touch" of instrumental design practices for a majority of young South Africans through photography, sharing practices and casual image editing and drawing. Yet development and recognition of this emerging creative tool remains underexplored outside of 'casual' apps and basic developer libraries.

The prolific 'hacking' of instrumental visual design that is happening on mobile phones among select students enrolled in Extended Curriculum Programs indicates a potential democratization of visual design skills outside of formal design education, without access to desktop computers and fast, stable internet connections.

These practices might also start indicating what differentiates these students from others who did not attain access to these courses, supporting the notion that casual exposure can be leveraged into formal skills.

These emerging forms of creativity need to be further developed, hacked, networked and expanded if they are to graduate beyond the current 'lo-fi' mobile aesthetics of casual use.

Toward this, we call on open source communities, artists and hackers to develop visual tools that "smash the black box" of mobile creativity, allowing young people to play with and customize the tools that allow for open-ended visual creativity on their mobile phones. We also advocate for a shift in formal education where educators explore existing creative ecologies and allow young people to "smash the black box" on the technologies that enable their creativity, by including app development languages such as Java, Python and PHP in their curriculums.

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The Virtual Mandala

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Abstract

This paper presents the *Mandala*, a multimedia live performance piece that explores the use of body movement and virtual imaging to enrich musical expression. This project combines an interactive 3D bimanual interface with a computer imaging application designed to graphically render and physically simulate the interactive construction and deconstruction of the ancient Tibetan Buddhist sand arts, called *Mandala*. *Mandala*, an agent of ancient arts and philosophy, uses technology to lure the next generation into traditional cultural practices, disrupting the boundaries between ancient arts and leading-edge interactive imaging technologies.

Keywords

Tibetan mandala sand arts, multimedia live performance, CHAI3D, body motion, human computer interaction, augmented-reality, dynamic simulation.

Introduction

Human beings are deeply expressive. We use body language, and speech to communicate our thoughts and feelings to other individuals. During musical performances, audiences often connect to the performer and mentally model thoughts and feelings in the performers mind, in what is called emotional contagion (Hatfield et al., 1993). In addition, humans are highly skilled at reading bodies, and voices; this ability begins at infancy and is refined to an art by adulthood (Darwin, 1872). Body motion and gestures are natural artistic expression forms worthy of further study and implementation in live performance. The aspiration of the Mandala project is to capture the natural forms of human expression and embody them artistically in real-time by bringing an ancient art form of Tibetan Buddhism to the digital world.

As new technologies have appeared, inventors and artists have been driven to apply new concepts and ideas to improving multimedia live performance or creating entirely new means of controlling and generating dynamic sound and graphics. In the past two decades, with the explosion of digital technology, the computer has become an essential tool for creating, manipulating, and analyzing audio and visuals. Its precision, high computational performances and capacity to generate or simulate audio-visual signal make it a compelling platform for artistic expression and experimentation. Moreover, the availability of many new forms of human interfaces, ranging from camera trackers to tactile displays, offers an infinite spectrum of possibilities for developing new techniques that map human gestures on sophisticated audio-visual events. Although many approaches have been proposed to use body movement to drive interactive arts and musical instruments (Hunt et al., 2000; Knapp and Cook, 2005; Machover and Chung, 1989; Overholt, 2001; Wanderley et al., 2001; Winkler, 1998), to the best of our knowledge, few studies have explored the use of vocalists' digitalized body motion to simultaneously control real-time dynamic simulation and to enhance musical expression during multimedia live performance.

Related work

Previous work in movement tracking can be categorized in two groups: movement sensor-based and position tracking based. Movement sensor-based recognition is most suitable for mobile applications in which the user may traverse large workspaces. These systems typically rely on small accelerometers or joint sensors that capture the movements of the human body. Such systems have been mounted on instruments and used for musical performance conducting systems (Rekimoto, 2001). Furthermore, wearable devices such as glove-based interfaces designed for capturing sign language (Hideyuki and Hashimoto, 1998) have demonstrated the capacity to sense even subtle finger motions. Tsukuda and Yasumura (2002) introduced the Ubi-finger, a wearable device that uses acceleration, touch and bend sensors to capture a fixed set of hand gestures.

In contrast, position tracking based devices are used for stationary applications and generally require a tracker or camera to be set up, and often calibrated, at a fixed location. Iason et al. (2011) present different strategies for recovering and tracking the 3D position, orientation and full articulation of a human hand from marker-less visual observations obtained by 3D Kinect sensor. More advanced multi camera systems such as the Vicon 8 have also been used to capture human motion during large stage performances where optical occlusions may occur (Dobrian and Bevilacqua, 2003).

In the area of musical expression, systems for interactive control of sound and visuals in virtual reality can also be traced back to 1990s. Meskers et al. (1999) used the electromagnetic to track the "Flock of Birds" in shoulder motion research. Robyn et al. (2006) further explore the use of motion tracking techniques to extract musical data to gen-

erate responsive imagery. Through a series of his own work, Pritchard (2010) theoretically analyzed "the body as object", and how body, body motion and gesture can be used in both musical and visual expressions. Our research attempts to expand upon the musical applications of these technologies as well as the theoretical implications of gesture control in live, multimedia performance.

The Mandala

In Tibet, as part of a spiritual practice, monks create mandalas with colored sand (Bryant, 2003). The creation of a sand mandala may require days or weeks to complete. When finished, the monks gather in a colorful ceremony, chanting in deep tones (Tibetan throat singing) as they sweep their Mandala sand spirally back into nature. This symbolizes the impermanence of life.

In this project we strive to create an intriguing work that translates this ancient philosophy to an arts and cultural experience as spiritual expression through interactive multimedia art and music composition. As the engineer Richard Hamming pointed out (1997, cited by Roads 2015), it is insignificant if the novelty and innovation make no cultural impact on human history. Through this piece, we innovatively provide a quick, yet rich presentation to simulate the Tibetan Mandala sand arts with musical expression; we aesthetically explore the ancient Buddhist philosophy of impermanence; and we increase the visibility of traditional cultural practices to the "twitter generation", who has less patience to rediscover those transcendent human treasures.

Figure 1: Construction and destruction of a sand Mandala.

The Piece and the Performances

As part of a multimedia live performance created at Stanford University and an invited performance at the Third International Buddhist Youth Conference in the Hong Kong Institute of Education, an interactive display of sand Mandala was dynamically simulated and choreographed with the vocal and instrumental compositional-improvisation. The musical and visual expressions through body motion were further explored and documented. The first performance at Stanford University took place before an audience of engineers and young Silicon Valley entrepreneurs, while the second performance occurred in Hong Kong, before an eastern, Buddhist audience. Both audiences showed enthusiasm for the culture content, and the science and technologies behind the scene that creates the magic, both during and after the performances.

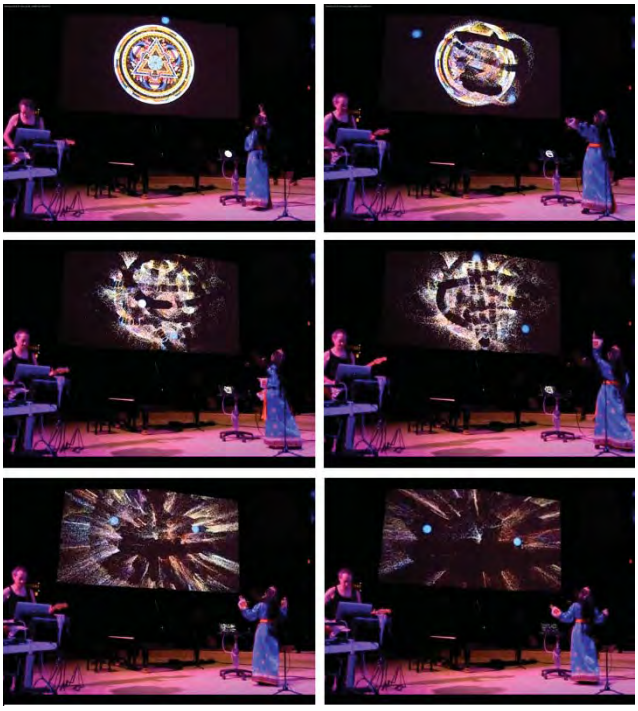

Figure 2: Live performance of the *Mandala*.

The proposed system is composed of two applications that operate on a single laptop computer and handle both the motion tracking and audio-visual processing events. The motion tracking application connects to the Hydra Razer interface and acquires the position, orientation, velocity and acceleration values of each input device at 100 times per second. Additionally, the states of the input switch and configuration of the miniature joysticks mounted at the extremities of both end-effectors are also retrieved. These measurements are then converted into events that are used to interact with the dynamic model of the virtual Mandala and real-time audio processing. The different parts of the systems are further developed in the following paragraphs.

The piece Mandala includes three movements: *Construction*, *Climax*, and *Destruction*. At the beginning of the piece, hand motions from the vocalist were directed to initiate the *Construction* of the virtual Mandala. Music composition for this part includes implementing additive synthesis and FM synthesis techniques (Chowning, 1977) to create an ocean-wave-like musical landscape with dynamic high pitch notes moving through the body movement. The backbone of the piece is made of rhythmic loops in Logic Pro with outputs and lives guitar processor inputs, routed through a Mark of the Unicorn 828mkII interface for 10 channels of spatialized output. Live guitar sounds are generated by a Fractal Audio AxeFX Ultra processor.

Mixed sounds of electronic guitar, rhythmic drumming, Buddhist chanting, synthesized sound waves and celleto start to create and build up an imaginary world from tran-

quility and emptiness to intense passion and complex glamour. During the *Climax*, musicians were focusing on musical improvisation while the virtual Mandala was self-directed and presenting animation, such as rotation, twisting and glitter effects. Granular synthesis, along with audio panning and spatialization techniques, are implemented to create bursts of variously-pitched pieces of sound fractions which, when put into interaction with experimental low-tone throat singing and explosions of violent soprano interjections, comes to symbolize the extreme conflicts and ecstasy in life, the extraordinary highs and lows, the sharp rises and falls of life as it is experienced, ending with a sharp fade out into the deconstruction of the mandala. The *Destruction*, which underscores the eternal nature of impermanence, occurs near the coda of the audio-visual piece through the hand motions from the singer.

A video of this multimedia live performance piece's premier can be viewed at: (http://tinyurl.com/ku5cg4f)

3D Human Interface

The vast majority of motion-controllers available today rely on small accelerometers that detect hand motions generated by the operator. Although such inertial sensors are used in almost any game controller or smart phone available today, their precision remains limited, and they lack the ability to track absolute positions in 3D space. For this project we selected a new type of interface called the Razer Hydra. As compared to accelerometer based, ultrasonic or camera driven motion sensors, the Razer Hydra uses magnetic motion sensing. Magnetic motion sensing enables this new interface to track in true 3D space for absolute position and orientation with its magnetic field. This technology also allows for full six degree-of-freedom movements tracking with sub millimeter accuracy, while eliminating the need for a line of sight to operate.

The user interface adopts a paired system, with a base station emitting a low energy magnetic field that both hand controllers record to estimate their precise position and orientation. The controllers and the base station each contain three magnetic coils. These coils work in tandem with the amplification circuitry, digital signal processor and positioning algorithm to translate field data into position and orientation data. The raw data are then processed using a first order filter and converted to a MIDI protocol before being broadcast to the audio stage.

The audio processing application, designed using the ChucK language (Wang and Cook, 2003, 2008), interprets MIDI signals from the motion-tracking module and activates a selection of audio filters and generators according to the desired musical expression. The application communicates all input and output audio signals by using the Unicorn 828mkII interface, which supports multiple channels that include both voice and electronic instruments.

Because of the real-time nature of the technology, the interface delivers near instant response between the hand motions generated by the operator and the actions commanded by the computer. An illustration of the device is presented in Figure 3.

Figure 3: The bimanual Razer Hydra interface

Dynamic Simulation

The virtual Mandala is composed of 4.5 million digitized sand particles that are physically modeled and updated 100 times a second. Force interactions are modeled in real-time by capturing the position of the performer's hands and by computing collision events with and between the individual sand particles. A graphic and dynamic modeling framework CHAI3D (Conti, 2003) is used to simulate in real-time the physical interaction between the captured hand motions of the performer and the small mass particles composing the virtual Mandala. The mapping between the hands of the performer and their models in the simulation is performed using a new mapping technique (Conti and Khatib. 2005) called *workspace expansion* that relies on progressively relocating the physical workspace of the devices mapped inside of the virtual environment towards the operator's area of activity without disturbing his or her perception of the environment. This approach allows the operator to interact with high accuracy in a very large virtual environment while moving his or her hands within a reasonably small workspace.

Conclusion

In this paper, we presented a human interactive simulation framework to explore the imaginative relationships between singing, dancing and natural emotional expression by using gestural and motion control to modulate and shape the texture and contour of sound and visuals. By demonstrating the motivation, compositional structure and methodology to achieve our aesthetics and technical goals of the multimedia live performance piece *Mandala*, we combined state-of-the-art technology in simulation and human interaction with ancient eastern philosophy and Tibetan Buddhist arts. Repeated performances of this piece with multiple audiences have confirmed not only the successful application of this technology, but also the ability of this technology to work with music to bring to life ancient art forms and philosophies for worldwide modern audiences. These preliminary results validated the intuitive design of our application and its capacity to respond with real-time audio-visual performances and confirmed our original idea toward exploring natural human motion and gesture as an effective way to instinctively enrich musical and artistic expression.

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Authors Biographies

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François Conti: Originally from Switzerland, François Conti is a co-founder of Force Dimension, a company that has earned international recognition for designing and manufacturing high precision haptic interfaces that are used today in research, entertainment, and medical fields. François also leads the development of the CHAI3D open-source haptic visualization libraries and is a lecturer of the Experimental Haptics course at Stanford University. François holds a B.S., M.S. from the Swiss Federal Institute of Technology in Lausanne, and a PhD from Stanford University.

[Session 5]

Intangible Heritage

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Can Art Save Hong Kong? - A Case Study of Preserving Hong Kong Cinema as an Intangible Cultural Heritage

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Abstract

In media arts discourse, the term post-digital describes art practices in relation to digital technologies. However, its concerns are humans and cultures rather than the technologies themselves, and the emphasis is on the aesthetics inherited through audience participation in artworks. This research project introduces a post-digital strategy for the preservation of local cinema and, at the conjunction of ubiquitous post-digital technologies, arts and the humanities, seeks to foster a new public awareness of the issues at stake in the city's most representative cultural industry. The aim of the project is to re-forge the severed link between citizens and the cinematic representation of their own living space in the post-digital era. It argues that in the years to come, Hong Kong's public cultural institutions should be able to conserve the city's technological edge while reaffirming its modern specificity; to create a renewed sense of its own identity; and ultimately to propose to the general public an innovative feature of heritage mediation.

Keywords

post-digital, augmented reality, Hong Kong cinema, intangible cultural heritage, local culture, ubiquitous technology

Introduction

At the crossroads of the arts, social sciences and ubiquitous technologies, this research project aims to explore, in the still broadly defined field of the digital humanities, new ways to create academic knowledge through a collective process. Therefore, a corpus of definitions is required to create a collective vision of how the consumption of Hong Kong cinema is evolving in the post-digital era. In the process of rethinking the use of cinema practitioners through participatory methods, the project will reassess the foundational position of Hong Kong cinema in Hong Kong's identity. The project will also develop a Participatory Action Research (PAR) plan to unite, drive and understand the many processes at stake in such an interdisciplinary project.

Historical Background

Hong Kong offers a unique case in world history, where a colonized space, once returned to sovereignty, had very little in common with its pre-colonial past. In the meantime, it has returned to a so called "motherland" that it ignores completely.[1] Furthermore, the lives of most of the Hong Kong population have been tempered in one way or another by the dramatic events that occurred during the difficult first decades of the People's Republic of China (PRC) and the throes of exile.[2] For these reasons, Hong Kong has created a very resilient and spirited way of doing things that is best illustrated in its unique cinematic production.

This very broad historical overview provides an understanding of the evanescence, the very fragility of self-representation, in a space and time borrowed from colonialism and exile. It also provides an important key to understanding the very peculiar importance of cinema as an identification tool within the *very* tight boundaries of the territory. In 1984, the already mature movie industry received a blow, along with the rest of the population, when Hong Kong learned that it would be handed back to the PRC in 1997. This decision created intense anxiety among Hongkongers and triggered intense reflections on the very existence of a rich and distinct Hong Kong Chinese culture and identity. Through this process, Hong Kong cinema encountered its most innovative momentum, as the only discursive medium able to interpret the depth of this introspective moment. This surge of imaginative talent gained international fame for the inventive skills and artistic achievements of Hong Kong cinema.

[1] Hong Kong was lost by the Manchu during the Qing Empire and returned to the Han Chinese People's Republic of China.

[2] Over a million mainland Chinese flooded into the city in 1949 alone, mainly businessmen, artists and writers, transforming it into an illegitimate daughter of twentieth century Chinese culture. Most of the movie industry in Shanghai settled in Hong Kong at that time.

Since the handover, the Hong Kong film industry has met the challenge of multiple crises that seem to have severed the link between the city, its inhabitants and their most representative creative industry. First, the global pursuit of the logic of (neo)liberal economics in creative spheres has resulted in a global "depoliticization" of issues that has flattened the realist and self-conscious outlook of the industry. Second, the PRC has recently emerged as a central actor in the entertainment business, both as a market and as a financial resource, under the conditionality of political correctness.

Since the beginning of the 1980s, the arts and cinema in Hong Kong have been haunted by reflections about the city's space and history, and by the search for an identity defined by local specificity, often reduced to fragile vestiges, or even to their absence (PERNIN, 2014, p. 659). The latest official research on the cinema industry suggests that the situation for Hong Kong's industry is "astounding" in terms of financial, technical and artistic collaboration with the outside world (mainly the PRC). Revenues are growing steadily under the auspices of the Closer Economic Partnership Arrangement signed in June 2003 (HKTDC, 2014). Nevertheless, reading a little further on the same official website, doubts seem to remain about the real potential of such an organization (SHACKELTON, 2014). The number of movies made in Hong Kong is decreasing steadily and Hong Kong's "starring role" in the movie business in China seems less evident or certain.

Finally, the ever-increasing rhythm of technological invention in recent years, combined with the ever-increasing number of images at our disposal, has changed the nature of film production, consumption and preservation, and has thus imposed a redefinition of the basic features of the cinema experience on the whole industry.

Pocket Cinema Hong Kong (PCHK)

The PCHK project was born from this array of complex but contiguous issues, with the modest conviction that if it could not answer those questions, it could at least create an innovative podium to further reflections on the central questions at stake, with the core idea that researching human experience through the arts makes complete sense to people. At the crossroads of the arts, social sciences and ubiquitous technologies, this research project aims to explore, in the still broadly defined field of the digital humanities, the triple direction at the core of the problem.

First, and most importantly, it is now officially recognized that the Hong Kong Chinese identity is problematic. The PCHK project, in fostering reflection on a creative industry located at the heart of its creative cultural distinctiveness, aims to contribute to the formulation of a singular global identity for Hong Kong, drawing on the possibility, the relevance and the legitimacy of a modern, cosmopolitan and legitimate Chinese ego that is at peace with itself and aware of what is at stake both inside and outside its own boundaries. Within this soul-searching effort might lie a free and open future for the Chinese identity in the contemporary world.

Second, using the latest ubiquitous post-digital technologies, the PCHK project aims to acknowledge the telescopic time-scale of contemporary obsolescence that seems to condemn, simultaneously, all of the past habits of our cinema practitioners. Indeed, regardless of their status, analog films, videos and DVDS, and even the Web, all seem to be dying in the face of the new needs and requirements of a borderless, individual, digital mobility that is urging us, as individuals and as a community, to re-think the modality of cinema to re-invent the extent of and dependence on technology. All of those essential questions for our time must nurture a global reflection on how cinema in general, and in terms of our interest, Hong Kong cinema in particular—as an art form and as a cultural assessment—needs to cope with evolution. This mandatory exercise imposed by the era is necessary to confirm and pursue the technological edge that Hong Kong has always had, and to reaffirm its pioneering role in scrutinizing the future. This epochal change should be seen not as an obstacle, but as an incentive to invent new means of survival and dissemination for Hong Kong's cinema heritage.

Third, regardless of how much it is transformed, caricatured, fabricated and sublimated, Hong Kong is the central actor in Hong Kong cinema. The city is a contender for the title of "cinema city" along with Rome, Paris or New-York. As such, the purpose of the PCHK project is to develop a coherent and innovative digital strategy for urban cultural development. The institutions involved in the artistic development of Hong Kong will be able to propose a cultural guided tour of the city through its memorable cinematic moments. In other words, as Vivian P.Y. Lee brilliantly put it, if cinema and heritage can be jointly defined as two modes of cultural production, the PCHK project needs to rethink heritage through cinema, and to rethink cinema through heritage. The PCHK argues that in the years to come, Hong Kong's cultural public institutions should be able to propose to the general public an innovative feature of film and urban heritage mediation in relation to the development of Web technology and digital services in mobile situations.

Research Methodology

By the very nature of the issues it tackles, the PCHK project can only be a collaborative undertaking. Combining the latest technologies in satellite localization (GPS) with nomadic application design, the PCHK project can be considered a post-digital undertaking because technology is not its end, but only a means to its end. It is much more concerned with humans and culture through a process in which art—both the film corpus and the application, a form of digital art—are the basis of the research. Methodological breakthroughs using art both as an end (cinema) and as a means (application) are needed to focus/foster/invent a community of practice. Therefore, an emphasis on the process rather than the method will allow an active space for participation that lies between existing disciplines and their methodologies while proposing the formation of new methodological criteria. It is this process space that alludes to the conditions for the research.

PCHK aims to penetrate the city, film and the public, and to question the symbiotic nature of those three elements (technology – humanities – art). The art of the arts-based researcher extends to the creation of a process of inquiry. In its eagerness to explore new ways to create academic knowledge through a collective process of urban development and cultural heritage, the need to involve the local public to feed and further our research creates the need for a participatory methodology, whereby public feedback can lead us to develop a more acute sense of our purpose. At the crossroads of Participatory Action Research (our method) and Art Based Research (our assessment), the project intends to reassess the foundational position of Hong Kong cinema in Hong Kong's identity.

Project Description

Imagine wandering through the urban setting of Hong Kong, where your steps are loosely driven by your own mobile device, through a game of digital image recognition that takes you through the different steps of a seminal movie abstract, filmed on the very same spot. You would, at the very same time, share the space with its cultural significance—a meaning probably unknown to others. A way to (re)create an intimacy with the evolving setting of Hong Kong's moving urban disposition and to (re)discover how much the city is a central part of its own representation.

Once the application is downloaded onto a mobile device, the public audience, transformed into a mediated *flâneur*, will be invited to join cultural tours in which they are free to stroll through the cultural identity of the territory and experience its intense physical heritage through its rich cinematographic legacy. The superimposition of dynamic data-dense spaces over physical ones ultimately creates a kind of aesthetic paradigm that questions how spectators can interact with a renewed experience of cinema and a renewed experience of the city. A constant engagement between the informational and the material space finally creates an informational continuum that informs the technological transformation of our relationship with urban spaces while simultaneously seeming to renew our experience of cultural heritage.

Figure 1. One of the tours with around 15 participants. ©Hong Kong Baptist University.

Ultimately, the potential extensions are limitless. Depending, of course, on the participation of private and institutional partners, one could develop the PCHK by movie genre, by actor, by director or by area, with each trail providing a different perspective on the city. The Web platform could help in planning the walks by providing information on the area, on the movies and its players. Participants could create their own stories about the city with their memories of films and/or places. Then, the PCHK could also be translated into different languages to deepen the understanding of visitors to Hong Kong by giving them deeper access to the city's intimacy more eloquently than the obsolete and speechless East/West binary cliché. It will allow a reinvention of Hong Kong's story by rewriting stories with insiders and outsiders. Official institutions that specialize in the preservation of cultural heritage (museums, archives, libraries) are well aware that making a heritage alive and meaningful to insiders and newcomers involves its usage and distribution through ubiquitous new media forms. Preservation today seems to turn to usage within the frames of nomadic consumption.

The application is now functional and, although it is

still only in a beta version, it is already advanced enough for us to use in practice. We organized 4 initial tours with our partners. We programmed 7 steps, each related to a place and a movie abstract from three films that were filmed on the available spots. Total number of 35 people was provided with information about both film and place to connect and react automatically to the digital location and to the image recognition device.

To conclude our first trial, we gave the audience a short questionnaire to collect some feedback on the experience. The answers were encouraging. The three questions regarding the fluidity of the application usage and the will to follow its development suggest a great deal of confidence. More remarkably, the process seemed to trigger the interest and the curiosity of a majority of participants in the pursuit of PCHK for Hong Kong cinema production. Finally, learning more about the films through this new application seemed to provoke a desire to further the experience with the prospect of seeing more local films in their home environment.

Figure 2. Participants experienced the film “My Life as McDull” during the tour. ©Hong Kong Baptist University.


Figure 3. Participants experienced the film “Crossing Hennessy” during the tour. ©Hong Kong Baptist University.

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Author Biography

Annie On Ni Wan is an international media artist, often creates artworks focus on relationships between spaces and sites, materials and immaterial. In 2012 she earned a Doctor of Philosophy at the University of Washington in Digital Arts and Experimental Media, United States. Wan is currently an Assistant Professor in the School of Communication (Academy of Film), Hong Kong Baptist University.

Her works have been exhibited in festivals in Europe, Asia and North America, including Art+Communication Festival 2004 (Riga, Latvia), Multimedia Art Asia Pacific Conference 2004 (Singapore), ZeroOne/ ISEA 2006 (San Jose, United States),

FrenchPavilion in10th Venice Architecture Biennale (Venice, Italy), Ogaki Biennale 2010 (Ogaki, Japan), Hong Kong Contemporary Art Awards 2012 (Hong Kong, China) and International Festival of Creativity, Innovation & Digital Culture (Canary Islands, Spain) etc. She was also an Artist-in-Residence at the Institute of Advanced Media Arts and Science (IAMAS), Japan in 2010.

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De-totalizing Capture: On Personal Recording and Archiving Practices

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Abstract

This paper serves as an overview of a part of the research conducted towards a PhD at the School of Arts and Communication, Malmö University in Sweden. In the context of the changing nature of the archive, big data exhaust and data surveillance, the research explores alternative and voluntary recording and archiving practices mapped among artists and media practitioners concerned with self-tracking and collecting personal data.

Today's media-scape presents recording and archiving as one of the major media practices performed by an increasingly growing number of people. Practically every personal digital device is equipped with some recording function allowing to capture and categorize texts, sound clips, images, video sequences, geographical location and increasingly bio-physiological processes. On the other hand, often without us being aware, the same technology passively tracks and records ever more detailed information about our behaviours, movements and decisions. As some scholars suggest, latest advancements in technology made the dreams of recording one's whole life come true. This total capture becomes a condition that calls for reaction. In this paper I interrogate the idea of a passive and automatized capturing by confronting it with a concept of a reflective and proactive recording practice. As an exemplification of the latter I introduce a set of artistic practices I have been performing regularly since 2009. These practices aim at constructing a record of my life and the space I find myself in. Contesting the enthusiasm around the technologically enabled possibility of recording entirety of one's life I argue that recording and archiving are generative and active processes requiring reflective and critical approach to media technologies that they inherently rely on.

Keywords

Recording, Archiving, Life-logging, Total Capture, Media Practices,

Introduction

The following three sections propose a critical and analytical perspective on different modalities of relating to recording and archiving media. In the context of the discussion, the term *media* ought to be seen not as representing material objects, tools or institutions, but as a constructive and vital process, an entanglement of media technologies and humans resulting in a conception of particular, media-aided practices of recording and archiving one's life.

Living *in* recording and archiving media

Marc Deuze suggests in his book Media Life that we no longer live merely *with*, but ever more often *in* media. Parts of our lives increasingly migrate, resettle and are exposed *in* media where they form realities that can be accessed, shaped and remixed, also by other people [1]. Christiane Paul describes contemporary, post 2.0 culture as characterized by a "fascination with visibility" where an increasing number of tracking technologies "enforce people's need to make the world aware of them and be observed by it" [2]. While this exteriorization of the self happens in relation to or as perhaps a dominant form of interaction with others, simultaneously a new form of self-witnessing emerges as Deuze describes it: "we have now entered a time in which we can see ourselves live" [3]. As Deuze elaborates further: we need to conceptualize strategies that would enable "to safely, authentically and ethically keep track of our lives in media" [4]. As he clarifies, such a survival technique requires a good degree of digital literacy and skills in using media as both producer and consumer [5].

Looking from a different perspective, Deuze's scenario of the proliferating settlement of life in media can be seen as a result of a somewhat neo-colonial expansion of mainstream media infrastructures, such as social media platforms or Google [6] into ever-larger (mental and geographical) territories of human activities. From such perspective, practices of recording and archiving appear as gradually becoming unified into the logic of so called 'pro-sumerism'. Coined by Alvin Toffler, the term 'prosumer' became characteristic for the Web 2.0 [7]. Applying this merge of two dominant forms of relating to media – producing and consuming – to the then new media landscape, was intended to demonstrate the more democratic and horizontal character of the Web 2.0 and subsequently social media, where everyone can be seen as both a producer and consumer. However as convincingly

argued by Edward Comor, practices of prosumers do not contribute to de-massification and de-hierarchization of media. Quite the opposite, prosumers "extend" and "revigorate" capitalism by "being involved in mostly entertainment and branding activities" [8]. In other words, seemingly immersed in individuation, self-realization and the projection of their uniqueness, prosumers remain in and contribute to the reproduction of commodity-driven relations. Consequently, personal recording and archiving practices in such light can be seen as being highly conditioned by two elements. Firstly, by the ontological substrate of the very media framework that these practices are bound to (e.g Facebook's chronology of the wall display, Instagram's nostalgic filters, etc.). Secondly, by the epistemic enclosure by which I mean an intensive circulation and replication of popular representations, themes and motives contaminating processes of personal enunciation and individuation[1].

To sum up, in the aforementioned scenario of living *in* media the formation of one's record (and hence the knowledge of oneself) happens extensively in relation to the pervasiveness of other media content and hence often as a mere response to its affective presence. The form that this response takes (the display of the recorded material) is determined by a rather inflexible architecture of the storing platform and its intrinsic mechanisms of hierarchization (e.g. Facebook). Moreover, this architecture predetermines the very formation of the record[2]; the decision of making a record (for instance snapping a picture) is a result of one's self-assurance that the particular situation, event or moment is aesthetically, formally but also socially appropriate enough to make a 'good' entry on a given social media platform (consider a growing popularity of phrases such as an *instagramable* or *facebookable* picture[3]). In other words, a condition of living *in* media, which paraphrasing Deuze can be equalled to 'living *in* the digital archive', implies a need to adapt to a set of socio-technological standards according to which one begins to perceive, structure, record and therefore experience his/her own life events. Such a record of life is readable only in the context of the socio-technological conditions that made the very record possible in the first place. In the 'living *in* recording and archiving media' scenario, as Brouwer and Mulder mark "there is no position outside of the (storing, linking, reprocessing, transforming and complexification of data) flows, an external position from which you can criticize or transcend the flows" [9].

[1] Although the number certainly differ today, in 2009 Manovich pointed out that only between 0.5 and 1.5 of Internet users were contributing with new content while the vast majority were primarily consumers, Manovich, L. (2009) *The Practice of Everyday (Media) Life*: *From Mass Consumption to Mass Cultural Production?* Critical Inquiry, Vol. 35, No. 2 pp. 319-331

[2] Consult Vilem Flusser' *Into the Universe of Technical Images* (2011, University of Minnesota) in which he argues that societies are ever more often being perceived, constructed and operate according to the rules imposed by technical images and apparatuses.

[3] Source: http://www.urbandictionary.com, accessed: 21.12.2014

Living *through* recording and archiving media

Although being highly predetermined, recording and archiving in the 'living *in* recording and archiving media' scenario allows for a certain degree of control by the subject. Generally speaking, taking a snapshot or pressing and holding a record button is a result of a conscious choice of the subject. However, latest developments of recording, sensing, tracking and storing technologies have given rise to ever more fully automated forms of logging one's life. As an effect, life-logging becomes one of the mainstream modern media practices.

As Kitchin and Dodge suggest in their often recurring definition: life-logging is "a form of pervasive computing, consisting of a unified digital record of the totality of an individual's experiences, captured in a multimodal way through digital sensors and stored permanently as a personal multimedia archive" [10]. What distinguishes life-logging from earlier forms of recording life is an increasingly automatic character of this process and consequently its wide scope that ambitiously aims to cover "a totality of an individual's experiences" [11]. Lifelogging as opposed to more active and voluntary forms of recording life such as through journaling or taking photographs, deliberately "operates in a passive manner" [12] Thus, allegedly active in lifelogging are only the moments of initiating and stopping the process of recording. What happens in-between is a "passive" and "unobtrusive" documentation of "'facts' around the episodes of our lives but not of their emotional interpretation"[13].

Life-logging is not concerned with collecting qualitative or semantic information. Rather, it increasingly prioritizes collection of quantifiable data that can be later utilized to devise pragmatic models for improving one's health, wellbeing or memory. The focus on quantification is what particularly draws attention of information technologists and computer scientists. In consequence, life-logging has been commonly debated as a domain of techno-enthusiast and developers operating much in the spirit of techno-determinism. We might argue that today, life-logging continuously misses critical and reflective attention from humanities and more specifically cultural and media, art and communication studies. The majority of debates on life-logging typically presents the idea of a total capture of one's life experiences as being rooted in Vannevar Bush's Memex- a technical device aiming to supplement the memory of a scientist. Consequently, stark attention is given to Microsoft researcher Gordon Bell and his project My Life Bits described as "a life story of everything" and a "fulfilment" of Bush's vision [14]. Assuming that the "total recall" [15] is technically possible, the majority of challenges in relation to life-logging are presented as being primarily of a technological nature: recording, storing and processing technologies have to be improved to allow ever more discrete, seamless and accurate capture, and what's becoming the most burning issue - a retrieval and comprehension of exponentially growing amounts of personal data.

Given a particular technological actuality in which life-logging happens, it captures or rather produces data that is technologically

Figure 1 Narrative clip, an automated life-logging device as attached to the shirt before starting a few month long comparative study of passive and active life-logging. January 1st 2015. Photo by the author.

'capturable' and 'producible' at a given time. Here Derrida's deconstruction of the archive as a neutral instrument of accumulating information can be once again recalled as a reminder: "the technical structure of the archiving archive also determines the structure of the archivable content even in its very coming into existence and in its relationship to the future. The archivization produces as much as it records the event" [16]. In this light, if as the earlier mentioned definition suggests life-logging is a form of personal archiving, then it produces as much as it captures one's experience. A life-log says as much about its subject as it does about the technological infrastructure *through* which the subject's life is being mediated and analysed. Proponents of automatic life-logging believe that in order to make life-logs really usable, and reach the potential of providing an objective record of one's life, there is a need to continuously perfect technologies so they can capture as much data as possible [17].

Despite some research proving that the focused and selective capture works better for supporting human memory[4], "the idea of 'total capture', sampling life experience in high fidelity is believed to provide for a more useful, future-proof and flexible lifelog" [18]. Gurrin and others further elaborate this statement arguing that: 'many of the computational techniques may not be known yet, so it is more useful to capture as much data as possible now. With total capture the "wouldn't it be great if I had a camera' moment will become a relic of the past" [19]. While making such a statement, they however seem to ignore the fact that while the future will certainly bring new, ground-breaking technique, it will simultaneously render some of the current ones obsolete. Many technologies used today for tracking, recording and analysing data will be out of date and replaced with more advanced versions or even completely new ones. Retrieving and utilising today's data and making sense of it when confronted with future ones might become problematic. Moreover, some methods of recording and inquiring data, prevalent and seen as highly accurate today, might even become entirely questioned and discredited in the future.

Life-logging, an automatized capture of the totality of one's life, appears as a return to the positivist idea of the archive; in this case however being personalized and distributed, as opposed to centralized and collectively relevant. In the positivist archive history is believed to be passively accumulating, "exactly in the manner in which the sediments of geological layers form, progressively, constantly" [20]. Just as in the 20th century, the alleged neutrality of the archive has been gradually demystified; the belief in the passiveness of automatic life-logging has to be further interrogated. The logic of seemingly passive operations of ubiquitous sensors, recording devices and algorithms that track one's life is founded as much on the third parties' decisions, political agendas and viewpoints, as on technological constraints and affordances that considering the current pace of developments might be operational only during a limited timespan. From the perspective of memory studies, automatic capture appears as an antidote to forgetting. Yet, there is an intrinsic paradox in such a position. If one does no longer have to remember to record (as recording takes place automatically), the effort to memorize becomes similarly redundant. We can hence argue that such devaluation of memorizing lead to an ignition of forgetfulness. Growing automation of recording practices dissociates the recording subject from his/her life. Life events are being fragmented, quantified and equalized by automatic procedures of capturing and, subsequently, recalled and analysed not by the associative and reflective capabilities of the subject, but *through* the appliance of quantitatively operating algorithms (consider life-logging applications quantifying stress levels or automatic photo-capturing wearable devices such as Narrative clip recording a unified stream of snapshots taken every 30 seconds [fig. 1]). In life-logging, it is the consultation not of one's own memory, but a memory of the tracking or storing device that gives rise to a recall of an event. Consequently the tracking and storing device might give priority to events that the subject himself/herself would not necessarily have been attentive to. Thus, the actions as recorded and presented to the 'automatic life-logger' are results of filtering his/her life *through* criteria deriving from what not he/she, but the life-logging technologies recognize and register as memories.

[4] Sellen and Whittaker (2010) suggest that rather than the over-ambitious goal of "logging everything," creators of life-logging systems would be better off directing their efforts at the kinds of data people find most valuable and the issues they find most problematic.

Living *with* recording and archiving media

Figure 2 A prototype of a self-designed wearable microphones embedded in gloves while being a student at Konstfack University of Arts, Craft and Design in Stockholm, 2008. Photo/illustration from the author's private archive.

The previous section describes recording and archiving practices as turning into ever more automatized processes eventually dissociating subjects from their own mnemonic capacities. Such a scenario recalls Stiegler's concerns with technological developments giving rise to what he calls *a dissociated milieu* [21] In the *dissociated milieu* the technological development contributes to the widening of the distance between humans and their memories, or more general their cognitive operations. In other words dissociation is a process where a know-how type of knowledge disappears in favour of technologized knowledge of which mechanisms are inaccessible to individuals for inspection and appropriation.[5]

It becomes harder, soon perhaps even unimaginable to lead life that takes shape apart from increasingly inescapable mechanisms of digital archiving, cataloguing and categorizing mechanisms that, metaphorically speaking, seem to constitute today 'backends', a sort of technical modus operandi of numerous social, cultural, professional or leisure-related practices we engage in on a daily basis when interacting with technologies. Since, to some extent we all have become micro-archivists every attempt to study this subject begins inherently from within the studied field. Thus, advocating for practical commitment to studying and reflecting on possibilities of personal archiving, in an autoethnographical manner, I bring in my own set of practices that in the light of the preceding discussion I perceive as personally tailored, an intentional disruption of the proliferation of automatic technologies for recording and archiving one's presence.

[5] Such mechanisms are often described in terms of a *black-box* – a technical instrument that facilitates processing of input data and production of an output information yet with no availability to inspect the very stage of processing data.

I propose to read them as practices accentuating the positive value of discipline, effort and attention that become jeopardized by the growing automation of personal recording, and archiving practices.

Figure 3 An illustration presenting the author and a set of recording devices he has been continuously applying and carrying with himself since the conception of the project

Since 2009 I have been systematically developing and implementing a number of media-aided practices aiming to record and archive different aspects of the surroundings I would find myself in. The concept of the On-Going Projects, as I refer to them, stemmed from one documentary practice I was working on in the summer 2008 while enrolled in the MFA programme in Experience Design at Konstfack University of Arts, Crafts and Design. In the project named Soundtracking I was experimenting with prototyping different technologies and performative techniques of interacting with, recording and mapping sounds of public places (for instance wearable gloves with little electret microphones installed on top of the fingers allowing to metaphorically grab sounds and shape them in hands [fig. 2]). These early experimentations with recording site specific sounds inspired other practices that deployed different existing media technologies to record selected aspects of my being in space. Affirming the obvious subjectivity characterizing decisions on what (and how) to record (and hence what to exclude), made me rethink the project as being a form of a cross-media journal reflecting the life of an individual in relation to the public space. Thus, the projects from an initial attempt to map my surroundings turned into a kind of sousveillance[6] - a set of self-tracking practices not solely pointing at the self or positioning it in the centre of interest, but rather

[6] Sousveillance, as the very term suggests (from French 'sous' meaning below, and veiller' meaning to guard, to look after, watch over) is a practice of watching that takes place below or under some other, dominant form of surveilling. The term was first introduced by Steve Mann et. al (2003) to describe a subversive practice of individuals closely monitoring operations conducted by authorities.

using it as a filter for reflecting on different aspects of the space it occupies and generates.
Ever since, I have been regularly using affordable and portable devices such as audio recorders, GPS watches or pocket size video cameras [fig. 3] to record sonic, visual, textual and spatial data reflecting on selected aspects of my presence in space. Gradually I have started introducing more discipline and consistency, which eventually led to a crystallization of a dozen of practices, each driven by its own, specific behavioural constitution, rhythm and a disciplined use of medium [table 1].

Name of the practice	Starting date and place	Short description of the practice	Medium used	Format of the collected data	Frequency of the practice
Acquainting	12.2010, Stockholm	Looking at teh society as being formed by professional profiles of people whose business cards I find and collect in public spaces	Scanning, text, processing software	Digital file, odt, jpeg	Each time the item is found in the public space
Facing	07.2012, Stockholm	Constructing a series of portraits of randomly encountered people in different means of public transportation	(digital) pen, paper, scanner	digital file, jpeg	Each time a trip using public transport is taken
Interpreting	10.2009, Krakow	Video recording and interpreting situations that inspire different associations.	video camera	video file, mp4 (10sec)	Each time when attracted by thought-inspiring circumstances
Minuting	07.2010, Jerusalem	Composing a sonic narrative reflecting my attentive presence in the public space and consisting of at least one 1 minute long sample to represent a day	audio recorder	audio file, mp3 (1min)	Everyday when attracted by an aural situation (Dependently, usually more than one sample a day is being collected)
Misquoting	04.2011, Stockholm	Constructing a collage-like memory-map made of daily news headlines and photographs from free newspapers and magazines	collage (paper, scissors, tape) scanner	digital image file jpeg	Once or twice a week, after picking up a free newspaper
Passing	10. 2011, Gdynia	Recording temporality of travelling between places by capturing a portion of the landscape each time when taking a long distance form of transportation	video camera	video file, mp4 (30 sec, 1 min, 1min30sec)	Each time when using long distance public transport
Scribbling	07.2011, Stockholm	Commenting on reality around me. through employment of an unbound writing triggered by an attentive observation of the surrounding and its actors as well as inclusion quotes and commentaries	smart phone, computer, text editor, Evernote application	text file, txt, odt	Each time when attracted by thought-inspiring circumstances
Self-tracking	08.2010, Stockholm	Recording and visualizing an architecture of my daily mobility in public space due to the appliance of the gps technology	GPS wrist watch, software GPS visualizer	GPS files, Gpx, kml, image files, jpeg	Continuously when in a freely accessible public zone
Sound-tracking	05.2008, Stockholm	Recording and geo-tagging urban and natural sonic phenomena characteristic for the encountered locations	audio recorder, GPS wrist watch, photo camera	audio file, mp3 (30sec), text file, image file, jpeg	Each time when attracted by a situated sound source
Street-sampling	07.2010, Haifa	Constructing a collection of ephemeral soundscapes created by street musicians performing in public spaces	audio recorder, photo camera	audio file, mp3 (1min), image file, jpeg	Each time when encountering a street musician in the public space
Reflecting	11.2012, Stockholm	Recording thoughts, naive observations and judgments triggered by the very situation while taking public transport	smart phone, text editor, evernote	text file, txt, odt	Each time in the public transportation when inspired by a combination of circumstances
Traversing	11.2009, Krakow	Building an open-ended repository of photographs of objects found during a weekly-executed walk	photo camera	Image file, jpeg	Every 8th day until 7 objects are found.

Table 1. A list and description of the majority of the On-Going projects.

For instance, every single day since July 2010, each time when attracted by a particular sonic atmosphere, I have been recording at least one, sixty-second long audio sample. For this purpose I have been using a portable Zoom H2 audio recorder and a pair of binaural microphones worn as regular earphones. Even though I capture preferably only one minute each day, being aware of the continuous character of the On-Going project makes me pay attention to soundscapes throughout the entire day. As opposed to automatic capturing described in previous paragraphs, On-Going projects require a certain amount of conscious gestures and effort. In the case of Minuting, as I call the one minute recording practice, these gestures include for instance reaching to the fanny pack where I carry my recording equipment or remaining particularly focused and preferably still while recording. Just as all the

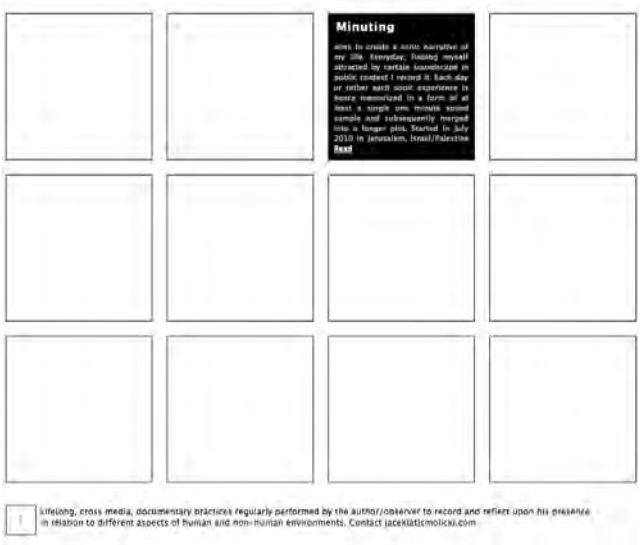

Figure 4 Screenshot of the self-developed website showcasing On-Going projects: www.on-going.net.

other practices within On-Going projects, I see Minuting as not being merely aimed at producing a record, a mediated impression for subsequent archivization, but primarily as a method of witnessing and being in the space more intensely. For instance while binaurally recording a minute I simultaneously listen to the amplified sounds of the surrounding. Through this technological amplification, my own sense of presence becomes amplified.

The On-Going projects are a highly idiosyncratic and subjective set of recording and archiving practices. This idiosyncrasy results from a highly personal array of conditions forming a unique kind of a conduct developed and applied by an individual to track, not all, but selected aspects of life. This idiosyncrasy of the digital record is also reinforced by the fact that the content is uploaded solely on a self-designed website which requires hard coding each time the data is being added [fig.4]. As both the front- and the back-end of the website are not inherited from any third party application or consumer-dedicated platform, the whole archive remains hardly informative and applicable for anyone else than the author. In other words, the possibility that the content becomes (ab-)used by some commercial entities, as it might easily happen with life-logs enabled by popular, consumer-dedicated online platforms and applications, in the case of the On-Going projects' website is drastically limited. While an important component of the content uploaded by people on popular social media is meta-data (contextual information assigned by the very users as well as the owners of the platforms controlling their back-ends and databases where users' data eventually end up), in On-Going projects the meta-data is often removed prior to the upload. For instance in a practice called Self-tracking I apply a GPS clock to record my daily itineraries. The watch is not connected to the cloud or any other external services. The data is downloaded locally and processed into graphical representations (a jpeg format). While for an external observer these representations most probably remain meaningless, for me perhaps not all, but many of them function as triggering images enabling a recall of particular moments and routes, as well as recognition of certain routines in my daily mobility [fig.5]. Thus, such a practice can be seen as a method of encrypting one's personal, bodily data in a way that it cannot be decrypted without the presence of the embedded memory of the very subject that generated the data in the first place.

The programmatic approach to documenting my life can be also seen as a way to counteract an excess of data produced through unstrained and undisciplined data collection practices characterizing modern of incorporating recording and archiving media into one's life.

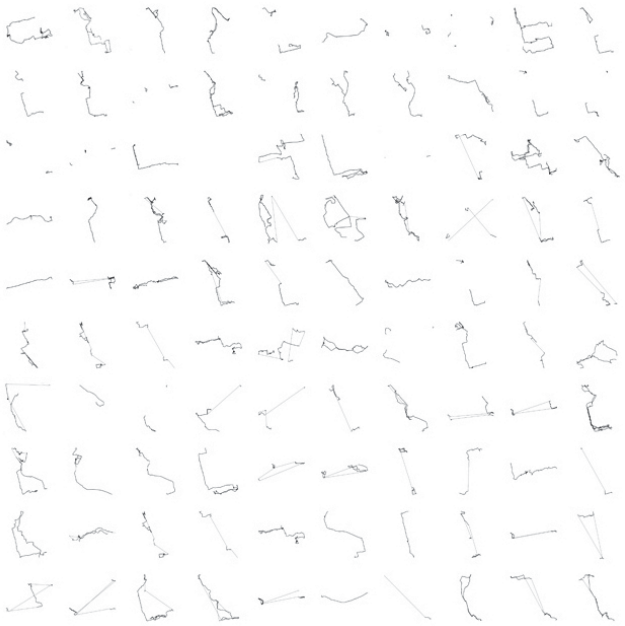

Figure 5 Self-tracking. A compilation visualizing one hundred days of GPS-tracked daily walks. The project has been initiated in August 21, 2010.

Summing up and concluding

Stiegler's study of memory, knowledge and their relation to technology as Mark Hansen suggests can be synthesized into an observation that "human evolves through exteriorizing itself in tools, artefacts, language and technical memory banks" [22]. The technology is not an autonomous addition to the human existence, but quite the opposite - it is its essential dimension. Human evolution does not happen merely in the biological sense, but rather above it, 'by means other than life'; in the dimension of exteriorized functions. In such light, the technology seen as exteriorisation of human functions does not interrupt or violate human evolution but rather intrinsically informs its progression. Similarly Flusser argues that since we rely more on learned than genetic information "the structure through which information is carried exerts a decisive influence on our lives"[23].

In this text I proposed a critical perspective on how we negotiate and articulate various grades of the entanglement with recording and archiving devices in the context of the latest proliferation of automated technologies of capture. As I argued, this very context requires critical, reflective and practical response, which I demonstrated by pointing at my own, life-long artistic project. I believe that the growing pessimism in relation to the direction that the development of media technologies seems to be taking (e.g. increasing data surveillance mechanisms, algorithmic analysis of human behaviours or increasing dominance over and colonization of the Internet conducted by ever fewer large corporations) can be addressed by recognizing, conceptualizing and shedding light on the potential that recording and archiving technologies might reveal if effortfully, attentively and reflectively entangled into individual tactics and practices. Seeing life as happening not *in* media or *through* media, but always already *with* media, let us avoid thinking of media as entrapping one into fixed and imposed relations. In contrast, extending and deepening the focus on *with*, both theoretically and practically, by for instance deploying artistic methodologies, allow more thorough and fruitful exploration of potentialities that reside in ever more easily accessible recording, tracking and archiving technologies of today.

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Author Biography

Jacek Smolicki is an artist, designer and researcher currently undertaking PhD studies at the School of Arts and Communication at Malmö University in Sweden. In his research Smolicki explores recording practices conducted by individuals who creatively, subversively and reflectively deploy recording technologies to construct personal and site-specific archives. His interest encompasses practices of sousveillance, lifelogging and field recording studied in the context of the changing nature of the archive. Since 2009 Smolicki himself has been conducting a number of self-tracking practices utilizing variety of available recording media technologies (www.on-going.net).

Smolicki holds his master degrees from the Design Department of Krakow Art Academy, Interdisciplinary Studies at Konstfack University of Arts, Craft and Design as well as Sound Art from Stockholm Academy of Dramatic Arts. He actively engages in exhibiting, conducting workshops and leading seminars (e.g Madrid, Budapest, Krakow and Stockholm). More info: www.smolicki.com

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Historical Residue, an Augmented Reality App and the Exploration of the Lost Town of New Philadelphia, Illinois

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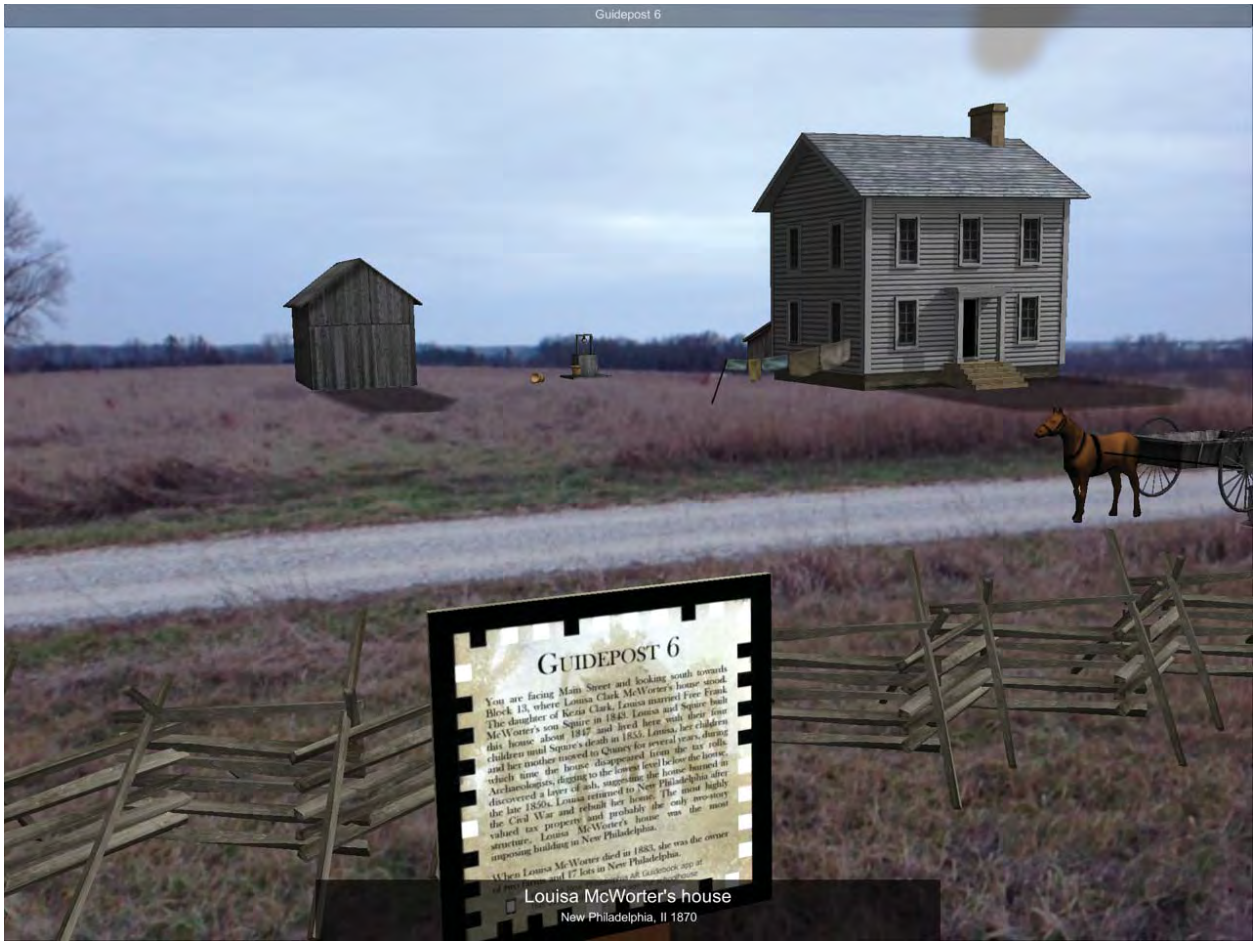
Abstract

The New Philadelphia AR Tour is an historical mobile app that uses Augmented Reality technology to present the lost 19th Century town of New Philadelphia, Illinois to visitors. New Philadelphia is a United States National Historic Landmark that is historically significant as the first town in the United States to be founded by an African American. After being abandoned in the early 20th Century, however, the site reverted to farmland. Today there are no visibly remaining buildings or artifacts. The app enables visitors to view 3D reconstructions of buildings overlaid onto the current landscape in their original locations. The historical buildings and artifacts are carefully reconstructed based on a collaboration between the author, the United States National Park Service's Network to Freedom Program and archaeologists from the Illinois State Museum. The project represents an innovative model for interpreting historical sites that have traditionally been challenging to interpret, particularly when there is an absence of remaining artifacts. The New Philadelphia AR Tour challenges the notion of what kind of historical site is worth interpreting and what value or historical residue remains when there seems to be little that visually remains. Moreover the project's use of Augmented Reality and its minimal footprint help to address the dilemma often faced by those managing historical sites of facilitating public access to a site at the risk of compromising site preservation.

Keywords

Augmented Reality, Virtual Reality, Games, History, 3D, New Philadelphia, United States National Park Service



Screenshot from mobile device during New Philadelphia App testing

Does an historical site lose its significance or become less worthy of interpretation if there are no surviving buildings? Can visual and multisensory representations give meaning to a bare landscape and ***disrupt*** our notion of which locations have historical value? As a serious game designer and Assistant Professor in Game Design at Fitchburg State University, I am seeking to address these questions through the medium of Augmented Reality in an ongoing project at the New Philadelphia National Historic site. The project involves a collaboration with the United States National Park Service's Network to Freedom Program, the Illinois State Museum and descendants of Free Frank McWorter to create an Augmented Reality app that allows visitors to walk through New Philadelphia, view reconstructed historical buildings placed in their original locations and learn about the history of a lost 19th Century American frontier community.

The story of New Philadelphia and its founder Free Frank McWorter is powerful, even biblical, in its narrative arc—encompassing major themes in United States history including slavery, the Underground Railroad, the American frontier and settlement of the West. In short, New Philadelphia is historically significant as the first town in the United States to be founded, platted and registered by an African American. The founder, Free Frank McWorter, was a slave who purchased his own freedom through money he had earned while being leased as a laborer. Free Frank moved west from Kentucky into Illinois and purchased land which he then surveyed and sold as lots, in the process founding the town of New Philadelphia. Free Frank used the proceeds from those lots to successively purchase the freedom of his wife and later his children and grandchildren, all of whom had remained enslaved in Kentucky.1 Over the course of the mid-19th century, New Philadelphia grew modestly in size as a multi-racial community of whites and blacks peaking around 1870, however, the town was eventually abandoned in the early 20th Century and reverted to farmland (Figure 1.).

The challenge today for historians and educators is how to interpret a site for visitors with little visibly remaining besides the landscape. As the developer of the New Philadelphia AR Tour, and in line with the ISEA Conference themes of ***Disruption*** and ***Residue***, I sought to leverage the historical ***residue*** in New Philadelphia--which in this case is the landscape and terrain. Visitors to present day New Philadelphia are confronted with an uninhabited landscape just as the community's first settler Free Frank. In many ways they are able to experience the site like Free Frank and imagine how they might build a new community. The app builds on that ***residue*** by reconstructing the town and presenting it virtually through Augmented Reality.

As an artist and designer who has dealt extensively with historical subject matter for museum installation-based exhibits (most recently for the Senator John Heinz History Center's semi-permanent exhibit *From Slavery to Freedom*), the New Philadelphia app was my first Augmented Reality project. The app builds on an emerging form of mobile app developed in the area of cultural heritage and digital humanities that enables visitors, to an historical landmark, to appreciate the existing environment while also accessing deeper location-specific historical and cultural information. A recent example of this includes *Ghosts in the Garden*, an audio and location-based interactive that presents the colorful social history of a Georgian Pleasure Garden in Bath, England.[2] Another example is *Jewish Time Jump: New York*, a mobile game that deals with Jewish labor activism in early 20th Century NY.[3] In both examples, users are able to explore both the location and information in a nonlinear manner. This was a feature that I planned to incorporate into the New Philadelphia app early on.

I created the app using the Unity Game Engine which affords all of the 3D interactive graphics capability of a 3D game. In addition, I used a Unity AR package called Vuforia by Qualcomm which enables the project's Augmented Reality feature through image recognition of precisely oriented marker signs. The app uses marker signs located at specific points within the site's visitor path to accurately place historical structures. When visitors view a sign through their mobile device, the app overlays 3D reconstructions of houses onto the current landscape (Figure 2.). The historical buildings and artifacts were carefully reconstructed based on a collaboration with archaeologists from the State Museum. Visitors also hear audio narration and sound effects which serve to recontextualize the existing landscape. A schoolhouse, for instance, echoes with the sound of children playing. As of May 2015, the app reconstructs half of the town and is in a testing phase. A beta version of the app is now available to the public for Android devices at Google Play[4]. An iOS version will be released in September of 2015.

The app also presents the site's less visible historical ***residue*** of archeological artifacts (many of which now reside at the Illinois State Museum in Springfield) buried or recently uncovered in excavations. Visitors can encounter virtual artifacts in the locations that they were found. These artifacts include a metal trivet, most likely created by one of the community's blacksmiths, a William Jennings Bryan campaign button, fragments of school slate boards and pencils, broken dolls and many other items.

One of the challenges in reconstructing a lost historical location like New Philadelphia for the purpose of historical interpretation, was in how to reimagine buildings and artifacts based on varying and limited information. Over the course of the project, I gained access to plat maps of property blocks and recent archeological survey maps (Figure 3.). The sources contained information on building locations and in some cases the building footprints. However, information on the buildings' exteriors varied from nonexistent to rough hand-sketches drawn from memory by previous inhabitants as was the case for case for the Louisa McWorter House (Figure 4.). As a result, in consultation with historians and archeologists from the Illinois State Museum, I

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decided to represent those buildings for which I had information on the exterior appearance in high detail. Other buildings that lacked information, but for which we knew existed in particular parcels, were represented with "graybox" house models. In this way, I devised a system for presenting historical artifacts in a way that reflected the veracity and degree of source information.

As an active archeological site, the New Philadelphia project seeks to address issues relating to historical preservation and interpretation that can apply to a number of other historically significant locations. For example, how can an historical site, in which archeological work is planned or ongoing be interpreted or presented to the public without damaging and compromising the site? The building of ghost structures (a proposal still being considered) has the potential to disturb the soil and destroy remaining artifacts. While sites like New Philadelphia can improve their funding prospects by expanding public access, the very means of historical interpretation can endanger or compromise the site itself. An augmented reality tour on the other hand can leave a minimal footprint as it requires small signs for positioning virtual buildings.

While New Philadelphia on the surface may appear to be an isolated rural landmark with limited appeal for visitors, it has the potential to connect 2 important historical sites--Hannibal, MO (the birthplace of Mark Twain) and Springfield, IL (the home of Abraham Lincoln). New Philadelphia is positioned between both locations on Illinois' Route 72. With adequate interpretation, New Philadelphia has the potential to help create a historical corridor for visitors both geographically and thematically given the significance of both Mark Twain and Abraham Lincoln to the African American experience.

Finally, as Frank McWorter's direct descendant Dr. Gerald McWorter, a Professor of African American Studies at the University of Illinois at Urbana–Champaign noted at a recent field test of the App, the history of New Philadelphia can serve as a beacon of hope for both African-Americans and Whites in its experience of peaceful co-existence and acceptance (Figure 5.). This is especially pertinent today in the wake of Michael Brown in Ferguson (less than a 2 hour drive away from the site) and Eric Garner in New York City.

For more information on the New Philadelphia AR Tour app visit:
http://studioamakawa.com/the-new-philadelphia-ar-tour-app/

Please note: below are links to short video clips of the first on-site field testing of the New Philadelphia app conducted by designer Jon Amakawa, New Philadelphia Association Board Members and Free Frank direct descendant Dr. Gerald McWorter on December 13, 2014.

https://www.youtube.com/watch?v=E4HzgbP2exE

https://www.youtube.com/watch?v=Jnz6dPC7IJo

Figure 1. New Philadelphia in June 2014. Photo by Jon Amakawa

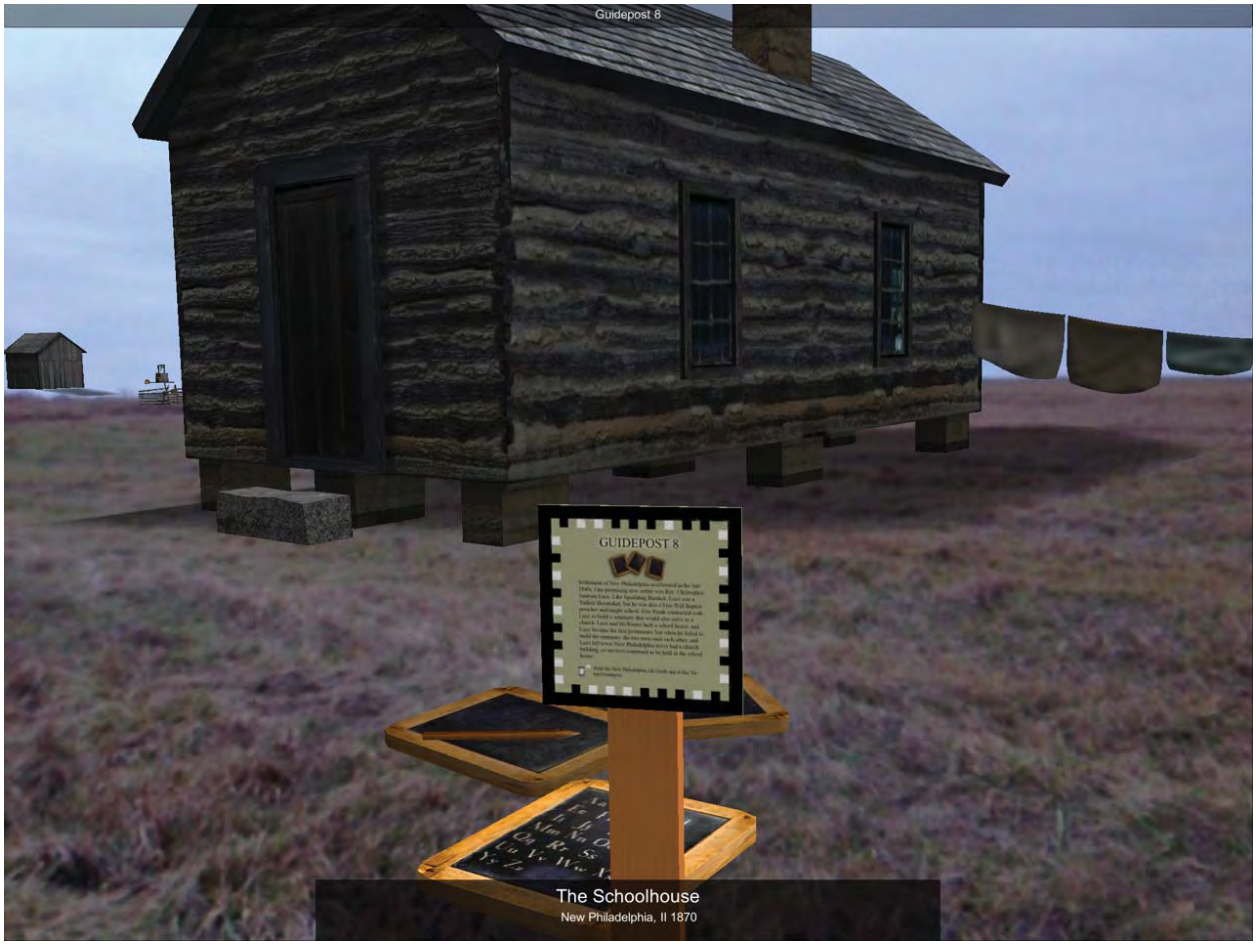

Figure 2. Screenshot from mobile device during New Philadelphia app testing

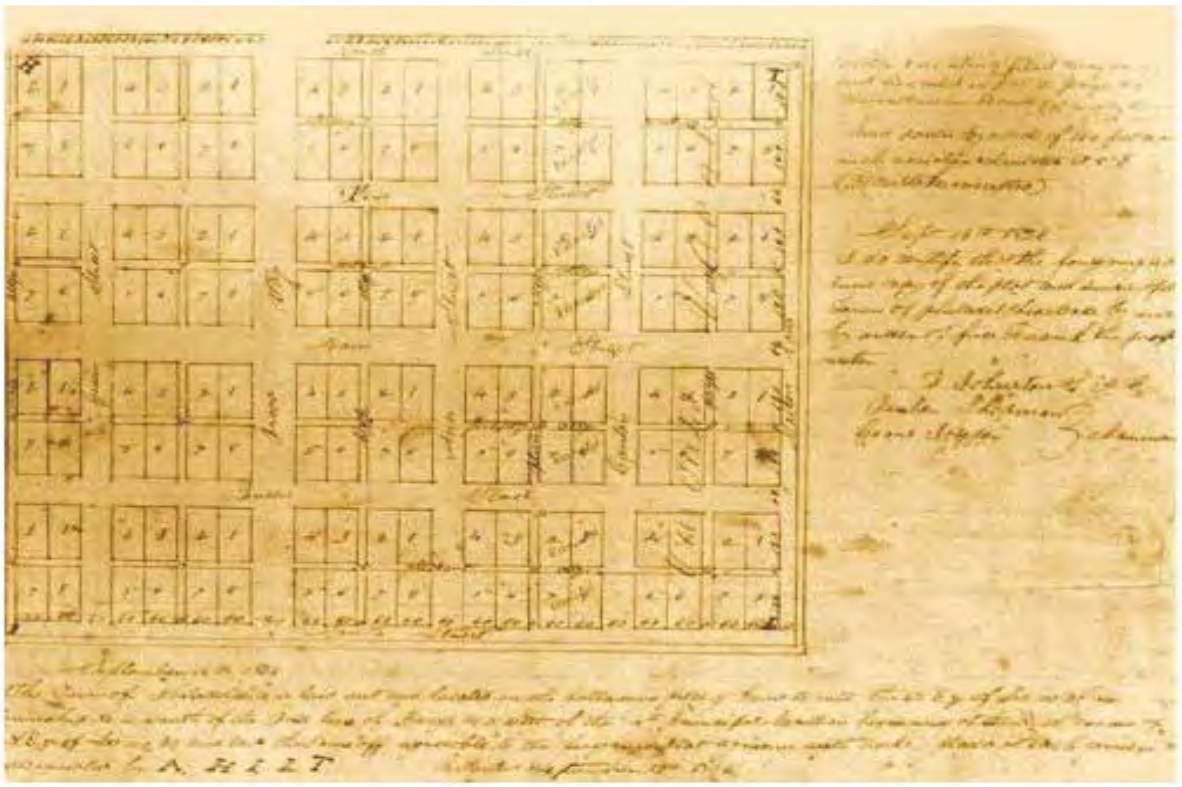

Figure 3. 1836 Plat Map of New Philadelphia

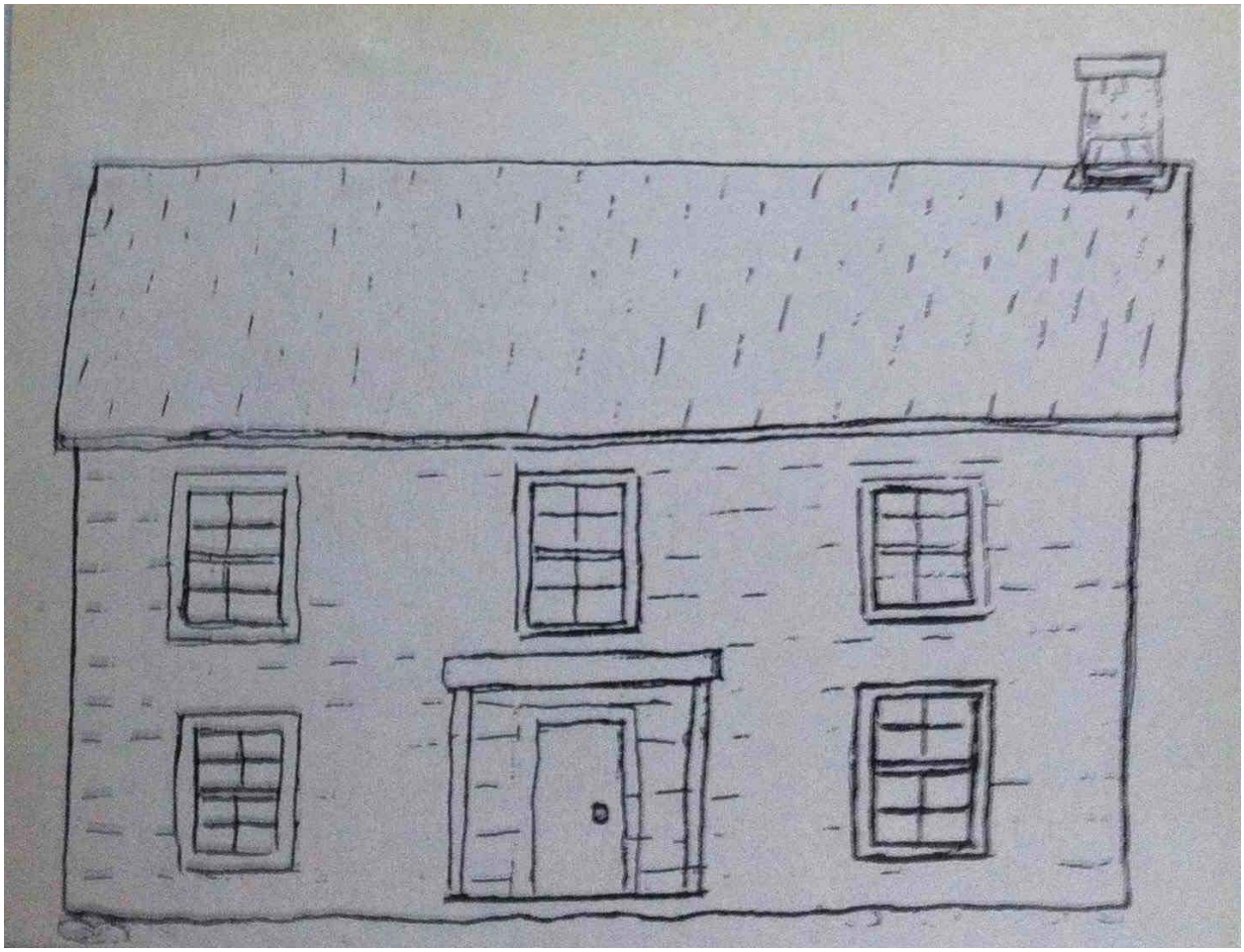

Figure 4. Sketch of the Louisa McWorter house by Lorraine “Larry” Burdick in the 1930s. Courtesy of the Pike County Historical Society

Figure 5. New Philadelphia Association Board members and Free Frank descendant Gerald McWorter field testing the app

Figure 6. Screenshot from mobile device during New Philadelphia app testing

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Producing New Media Ethnographies with a Multi-Sited Approach

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Abstract

Ethnography is an inductive methodology that generates its own object of study through a series of encounters, while laying bare the modes of construction that are used to do so along the way. The result, the ethnographic media text, serves as the canvas for a subjective reflection on culture, but it is also often its own art piece that can take the form of a literary work, an illustrated catalogue, a collection of photographs, a video or an installation. What happens when ethnographic works are made with electronic media or when they are interactive? Does the use of digital research tools disrupt the making of ethnographies or does it trigger the emergence of new possibilities for ethnographers? Are some methodologies better suited to addressing the new ontological conditions of emerging digital-material research tools? By presenting three new media ethnographies that have been produced with a multi-sited design approach, our article suggests that this particular methodology might offer significant advantages when conducting ethnographic research involving new media technology. These examples of practice aim to show how the affordances of electronic art can better support an object of study that is complex in scale, multi-dimensional, shifting, and multiply situated.

Keywords

Multi-sited ethnography; research-creation; inductive approaches; digital cultural heritage; intangible heritage; Aboriginal research.

Introduction

As Tyler remarks, *in lieu* of providing scientific insights or political understandings, ethnography is a form of writing that engages in a process of negotiating and renewing ethical visions of the world. [1] Ethnographers achieve this by using three rhetorical strategies: *descriptive* (by presenting subjective observations on people and cultures), *interpretive* (by highlighting the relationships between these observations), and *reflexive* (by exposing the constructed nature of the relationship between the observer and the observed).

Ethnography is an inductive methodology that generates its own object of study through a series of encounters, while laying bare the modes of construction that are used to do so along the way. This implies that it is, as often as not, an open-ended exploration which consists of carefully documenting, not only a set of observations, but also a research process that will itself be submitted to scrutiny.

In cultural anthropology, the ethnographic text serves as the canvas for a subjective reflection on culture, but it is also often an art piece that can take the form of a literary work, an illustrated catalogue, a collection of photographs, a video or an installation; it has the dual status of research outcome and cultural product – *the research-creation*. As such, it can go beyond describing, interpreting, and reflecting on a given understanding of culture to provide valuable knowledge on the material practices of art-making. This implies that there may be a body of ethnographic inquiry that undertakes similar research objectives and strategies as do some research-creation methodologies in the arts.

But what happens when ethnographic works are made with new media technologies or when they are interactive? What are the ethical implications of such forms of artistic production? What opportunities and challenges arise when ethnography is practiced within the parameters of technical culture? Does the use of digital research tools disrupt the making of ethnographies or does it trigger the emergence of new possibilities for ethnographers? Are some methodologies better suited to addressing the new ontological conditions of emerging digital-material research tools? How could they best support new media creative practices?

Based on the assumption that some ethnographic texts may also be understood as research-creation projects, this paper suggests that a multi-sited design approach to making culture might offer significant advantages when conducting ethnographic research involving interactive new media technology. To support this claim, the first part of this paper will expound multi-sited design ethnography as a methodological tool recently introduced to the study of human-computer interaction (HCI), while the second part will provide three examples of practice in new media. The paper will conclude with a discussion on multi-sitedness.

A Multi-Sited Design Approach to New Media

All the authors of this paper are affiliated with the media anthropology lab of a HCI design department in which researchers conduct multi-sited design ethnographic research by building and maintaining *epistemic relationships* with informants encountered during fieldwork. Multi-sited design is a methodology recently introduced to the field of HCI by Dourish and other practitioners. [2]

This emerging HCI constructionist methodology combines two approaches: first, the practice of multi-sited ethnography as theorized by Marcus, [3] second, the tradition of participatory design that originated in Scandinavia. [4]

Multi-Sited Ethnography

Multi-sited ethnography is an interdisciplinary critical approach conducted in multiple, distributed, and shifting (micro) locales to later be analyzed against the contours of these sites' overarching (macro) context. [5]

While traditional ethnography typically sees one or sometimes several ethnographers describe a single, well-circumscribed site, in a multi-sited approach, one or more researchers can be sent to observe each of the fields in which stakeholders might play a role in the creation, production, distribution, and reception of a social structure.

Practically speaking, this means that fieldwork is conducted in a distributed environment made up of multiple sites. By moving in and out of these sites, the ethnographer can come to know the actors, customs, routines, practices, and idiosyncrasies tied to each one of these locales. This means that rather than studying a single location as the product of global phenomena, in a multi-sited approach:

> "*the researcher travels to multiple sites, following various pathways in order to assemble a narrative [which] is intended not to give the ethnographer more cases…but to expand a single case beyond its immediate location."* [6]

By documenting observations, reviewing them, culling them, and drawing them together, one can get a sense of how an overall cultural structure functions. Because the mode of construction is to follow a single thread across multiple sites, multi-sited ethnography ostensibly produces "a distinctly different sense of 'doing research'." [7]

Participatory Design, Participatory Development

While Participatory Design (PD) is a set of methods used in HCI to engage people within a workplace, organization or community of practice in order to participate in the design of the computer systems they use in the everyday, the related approach of Participatory Development more broadly aims to "involve local stakeholders in development projects", notably in developing regions or countries. [8]

Perhaps these two distinct approaches point to what some authors refer to as a "drift in focus from participation as the means to a political agenda to participation, as a means to a smooth development and implementation, or sometimes as an end in itself." [9] What they have in common, however, is that both are inherently about the politics of design. Who participates in the design process?

Anthropologists tend to be familiar with collaborative approaches. For instance, collaborative ethnography aims to go beyond the solipsistic bias of participant observation, [10] while participant-generated ethnography takes a pragmatic stance towards the problem of gathering data in large-scale systems by actively involving informants. [11] As a result, many ethnographers using new media technology share a similar set of concerns as designers using PD.

New Tools, New Platforms, New Ethnographies, New Research-Creation Practices

The work that has laid the foundation for multi-sited design argues that the transnational character of everyday life in today's world system presents designers with unique challenges when making interactive media artifacts. [12] Multi-sited design is thus proposed as a tool that can effectively meet the conditions of contemporary life whereby "technologies are appropriated into local cultures and yet shaped by transnational politics and negotiations". [13]

It is for this reason that this emergent methodology has proved particularly well-adapted for our research. Multi-sited design allows us to each construct our research field as its own network of sites. This configuration can include physical, virtual, and imagined sites of representation. [14]

Practically, this means being able to relate and simultaneously explain phenomena, which occur within the new experiences of time and space enabled by connectivity and human-computer interaction. Whether events take place in real time or asynchronously, and whether they are situated in the hyperlocal or are mobile in global networks, multi-sited design offers ethnographers new tools to describe and interpret. Furthermore, the extant literature argues in favor of making the act of design part of the investigation: multi-sited design is thus a research-creation methodology:

> *"we attempt to build a multisited analytical framing in which design is central to both our research method and analysis, with a commitment to positioning design and ethnographic writing purposefully against exocitization or center-periphery binaries and toward empathetic connection"* [15]

Producing ethnographies with multi-sited design gives researchers the flexibility to follow an object of study that is complex in scale, multi-dimensional, shifting, and multiply situated. Because our ethnographic texts are produced with interactive digital technologies, it also allows us to make better use of new media's specific affordances.

Three New Media Ethnographies

The following sections present three examples of practice that demonstrate how the multi-sited design approach can be applied to the production of new media ethnographies.

While in some cases, the sites may be multiply situated in terms of their geographical locations, in other cases, their multi-dimensionality may be manifest in how they assemble physical, virtual, and imagined sites of representation. For this reason, each of the three new media ethnography is described according to its genesis, its contribution to knowledge, its methodology, and its specific sites.

Appalachian Punks: A Multi-Sited Ethnography of Changing Traditions in the Era of the Interactive Documentary (Rachel Ward)

While folklore studies of Appalachia have typically focused on the documentation and archiving of traditional music, the first example of practice presented in this paper explores the global permutations and transformations of "traditional" culture as facilitated by new access to digital archives of cultural heritage. In this research-creation project, ethnographic inquiry is conducted through the parti-

Figure 1. *Performance by Appalachian "punk" band*, 2013, Rachel Ward, photograph, ©2013RachelWard.

cipatory development of an interactive documentary that will be produced through research and collaboration with the Smithsonian Centre for Folklife and Cultural Heritage, Library of Congress, interactive documentary producers, Canadian scholars and musicians, and community stakeholders from the northern Appalachian regions, specifically Pennsylvania, West Virginia, Pittsburgh and Brooklyn.

Genesis of the Research

In 2013-2014, Rachel Ward traveled throughout northern Appalachia filming a documentary short entitled "Appalachian Punks: A Resurgence of Tradition." This film explored the renegotiation of traditional mountain music from a young, contemporary punk aesthetic. A key component of this work is the in-depth interview that was conducted with Lester McCumbers, one of the last living traditional Appalachian fiddle players. During this interview, he explained that over 30 years ago, a man from the Library of Congress came to record him, but neither he nor his family had since been able to locate the recordings.

The Appalachian Punks research-creation project begins with the digital return of this "lost song", by tracing its beginnings from the instruments of West Africa and ancient European folk songs, to the archives in Washington D.C., to tape, CD, MP3, to the punk bands that are now performing these songs in Brooklyn and uploading their videos to YouTube™ as seen in Figure 1.

Research Contribution

From a theoretical standpoint, this project builds on scholarship exploring the implications of recent developments in the field of interactive documentaries and the UNESCO 2003 Convention for the Safeguarding of Intangible Cultural Heritage. It poses the question: how do interactive documentary projects create access to collections and help (or hinder) safeguarding intangible cultural heritage?

Although there is significant research in the realm of digital cultural preservation and visual documentation of Appalachian music, there is a gap in the literature that explores the use of new interactive documentary forms as tools in the dissemination and preservation of culture, or in the making of a collaborative, "public anthropology". As a platform that is becoming integral to our understanding of the documentary as a genre, interactive documentaries utilize "action and choice, immersion and enacted perception as ways to construct the real, rather than represent it" [17]. Importantly, from an interdisciplinary perspective, this project addresses the call for the use of Marcus's multi-sited method applied to the field of human-computer interaction design research. [18]

Research Methodology

Following her fieldwork in the Appalachian region, where struggles with poverty, illiteracy, and unemployment are pervasive, Rachel's dual roles as field-researcher and collaborative media producer have allowed her to identify community desires related to heritage preservation, technological training, and education. The culmination of her background and training in anthropology, new media, and film, in combination with her community connections in this geographic region, have uniquely positioned her to undertake an original research-creation project that is both culturally appropriate and accessible in collaboration with folklore scholars, curators, archivists, musicians, documentarians, archaeologists, historians, and local leaders.

Rachel is tracing the historical, transnational, and virtual flow of this music across global and digital borders using multi-sited ethnography. This approach calls for the "tracking" of a single object, metaphor or allegory across sites of interest. [19] In the context of this project, the path of one song is "tracked" across Scotland, Ireland, France, England, West Africa (Mali and Senegal), Canada, and the United States via archives, communities, and virtual/hybrid spaces. This music exists in distinctive styles throughout North America: the "Scottish" tradition of Nova Scotia, "prairie style" of Saskatchewan, French-Canadian sounds of Quebec, as well as the traditional Appalachian and Francophone Cajun in the southern USA.

The project explores regional variations based on European settlement and the syncretic blending with First Nations and African American styles. For instance, the signature "Red River Jig" dance of the Aboriginal Métis (residing in Canada and the northern United States) is clearly traceable to the fiddle music introduced by French fur traders in the 1600's and the pow wow dance tradition. [20] This data is then published in a web-based, user-navigable interactive documentary, in which the viewer can trace the movement of a song from its African/Aboriginal/European origins to a live-stream of Brooklyn bands uploading their "punk" reinterpretations on YouTube™. The user can pause at specific interactive nodes for an in-depth exploration of multimedia sites containing film clips, audio, interviews, photographs, and archival materials.

Research Sites

This interactive documentary combines theory and praxis as a visual representation of transdisciplinary research related to globalization, digital repatriation, intangible cul-

tural heritage, traditional knowledge (TK) transmission, and participant production as a research method.

Through collaborative research, Lester's "lost song" is traced as a metaphor for cultural knowledge and globalization, while addressing important (yet little known) African, First Nations and multi-cultural contributions. Distinct from folklore studies that focus solely on documentation, here, music is utilized "as a tool of discovery to question value systems – not just the differences between genres or subjects, but how the divides themselves are constructed and negotiated". [21] At the local level, this research will make a significant contribution to the creation of a digital resource that attends to local needs by focusing on the "value of meaningful community participation in efforts to safeguard their digital cultural heritage". [22] This type of methodological advance in the field of digital, participatory, and interactive documentation will reinforce the development of visual, collaborative, and interactive methodologies as novel fields of scholarship.

New Media and Intangible Cultural Heritage: Digitization, Documentation, and Circulation of Uyghur Dastan (Aynur Kadir)

The second example of practice presented in this paper is a media archive co-produced by the Making Culture Lab, the Xinjiang Folklore Research Center, Uyghur folk artists in Khotan Village, Xinjiang, and youth participants from the Uyghur community. Dubbed the *Digital Uyghur Dastan Archive Prototype*, the end product is to be designed in collaboration with community members through a slow, ongoing iterative design process. The purpose of this research-creation project is to use digital media to give tangible form to an intangible cultural heritage in China, which is increasingly endangered.

Genesis of the Research

China's vast northwest region, Xinjiang Uyghur Autonomous Region, has a rich and colorful history and has long been a unique blend of cultural influences. For hundreds of years, it was a vital link in the famous Silk Road, the overland trade route that connected China with Europe through Central Asia. Xinjiang's Uyghur people represent the easternmost expression of Turkic Islamic culture.

One of the largest traditions among Uyghurs includes *Dastan*, epic oral narratives which use both poetry and prose to dramatically recount events from the past. Dastan embrace a wide range of themes: not only the Uyghurs' ancient "heroic age", but also religious tales, love stories, and historical events like farmer revolts. Uyghur folk Dastan are of great length and complex subject matter, and are musically and instrumentally demanding. Dastan are played and performed by *Dastanchi*, skilled and specialized folk artists. They display their talents on market days and during traditional festivals. Dastanchi accompany themselves on traditional Uyghur instruments like the *rawap*, *dutar*, and *tembur*, while simultaneously adopting the roles of numerous characters during poetic and narrative Dastan verses.

However, as modernization continues to transform Xinjiang, Uyghur Dastan are rapidly vanishing from public view. Dastanchi, nearly all of them elderly, are now facing significant challenges to the sustainability of their ancient craft. In the past decade, researchers and students from Xinjiang Folklore Research Center collected an archive of over one hundred magnetic audiotape recordings and more than fifty videotapes of different sizes and formats documenting the Dastan. This collection needs proper organization and archiving in order to be digitized and returned to the community.

This project is especially urgent since only a dozen Dastanchis are still alive and available to record the most recent Dastan versions and to determine ethical treatments and cultural protocols for digital archiving. As a result, important questions regarding representation, copyright, intellectual property, ownership, and control of documentation and circulation in digital form must be addressed immediately for this knowledge to be transferred across time and space, for the benefit of future generations and publics around the world.

Research Contribution

The need to safeguard intangible cultural heritage around the world has garnered international awareness in recent years as a growing number of traditions have been deemed endangered. [23] This research focuses on the blending of theoretical, practical, and ethical issues in the collaborative design of a digital archive for intangible cultural heritage in order to assist in the safeguarding of Dastan.

The development of digital media technology has facilitated new ways of preserving and protecting such cultures. [24] For example, digital archiving and participatory filmmaking are seen as important tools for the documentation and revitalization of Aboriginal languages and cultural practices. [25] This nexus of culture and technology must take into account local cultural protocols for ownership and circulation, and Indigenous curatorial approaches. [26]

A number of media-specific questions arise from this research-creation project: How can digital knowledge sharing be facilitated through multi-sited ethnography and participatory design? How do existing cultural protocols and social, national concerns shape access and control of traditional knowledge in virtual space? What are the current protocols in which Uyghurs preserve and transmit their cultural heritage? How can we apply these understandings to represent intangible cultural heritage in a digital world while utilizing community-based approaches? What kind of challenges and opportunities are associated with media production, and archiving within the Uyghur context? What are the possible categorizations, meta-data standards, and technical treatments for media materials in the archiving process? What are the most appropriate ethical frameworks for the circulation of Uyghur digital heritage?

This research aims to explore emergent theoretical and practical issues regarding ownership chronologies, continu-

ity of traditions, repatriation potentialities, and to collaboratively negotiate opportunities and challenges associated with the digitization and return of cultural heritage. The outcome and level of access will be determined through collaboration process and will highlight usage of cultural protocols and national concerns as defining features of an interactive system. This research will draw attention to the importance of understanding traditional protocols for the handling and care of intangible culture, and how these may be adapted for use in preserving digital versions of culture.

Finally, this study expounds on how traditional cultural gatekeepers think and have functioned in the past and how their role may evolve in the future. The archive development process – understanding what a digital archive means at the community level – will make a significant contribution to research by addressing a gap in this area of research and by providing a platform with the potential to connect later generations with their culture in a sustainable way.

Research Methodology

As a media maker and Uyghur community member, Aynur Kadir is uniquely situated to undertake a research-creation project that involves developing and critically analyzing a digital archive prototype for the audio-visual materials of Uyghur Dastan. Her research plan begins with an investigation of the discourse surrounding the mobilization of Uyghur identity. It is to be conducted within the context of her role in the design and development of a community-based, sustainable web-based digital heritage prototype for and in collaboration with the Uyghur community.

The Digital Uyghur Dastan archive prototype is then to be designed through an iterative design process with community members using multi-sited ethnography and collaborative participatory design methods. These research strategies are needed because a single-sited ethnographic approach would not be a suitable tool to effectively produce and evaluate this collaborative digital archive system.

The reason for this is multifold. First, Aynur intends to conduct traditional anthropological fieldwork in different villages of Xinjiang region with collaboration with folk artists. Second, she will also categorize and organize physical/material archives in Xinjiang Folklore Research Center, China. And third, the post-production and media producing will take place in the Making Culture Lab, Canada.

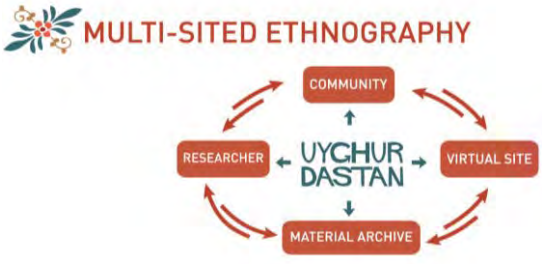

Figure 2. Diagram of the multi-sited design research model used in *Digital Uyghur Dastan Archive Prototype*, ©2013AynurKadir.

During the collaborative process, Aynur will create the digital archive virtual site, which is open to community and researchers to add continuous data/metadata of latest related Dastan materials. This virtual site will be another important "field site" that will be used to reproduce/represent traditional cultural knowledge. As represented in Figure 2, in this project, Uyghur Dastan is therefore the key location that connects different geographical communities, research labs, and virtual sites created by researchers and community together.

The interdisciplinary practice of multi-sited ethnography will allow Aynur to mobilize her cultural and academic identities and responsibilities during the research and production of this digital media research-creation project. In her quest to find answers to the ethical, practical, and theoretical questions raised by her research, she will also "follow" the Uyghur Dastan in different sites.

Based on collaborative participatory design experience and multi-sited ethnographic fieldwork, Aynur will trace representation, ownership, and intellectual property issues surrounding Uyghur digital cultural heritage. Not only will attention be drawn to the important role of digital technologies in the preservation and revitalization of culture but questions and concerns about how to best represent intangible expression in digital space and intellectual property issues in cultural heritage will also be explored. In summary, Aynur will set out to investigate both global and local theoretical, ethical, technical, and practical considerations for the Uyghur digital archive context.

ʔeləẃkʷ – Belongings: A Tangible Table in *c̓əsnaʔəm, the city before the city* at the Museum of Anthropology (Reese Muntean)

ʔeləẃkʷ – Belongings is an interactive tangible tabletop activating replicas of Musqueam belongings excavated from the *c̓əsnaʔəm* archaeological site along the banks of the Fraser River in what is now known as Vancouver, British Columbia. These ancestral belongings, along with contemporary objects of significance in Musqueam life, are placed on the tangible table to access cultural knowledge and stories about the First Nation's long history of fishing as well as its practice today. The table was designed by faculty and students at Simon Fraser University's School of Interactive Arts and Technology's Making Culture Lab and Tangible Computing Lab along with curators from the Museum of Anthropology (MOA). The table was installed in MOA as part of *c̓əsnaʔəm, the city before the city*, an exhibition hosted by three institutions (Musqueam Indian Band, the Museum of Vancouver, and MOA) in an exploration of one of largest ancient village sites on which Vancouver was built.

Genesis of the Research

Building on an existing research relationship with the Museum of Anthropology, The Making Culture Lab approached *c̓əsnaʔəm, the city before the city* curators Jordan Wilson and Sue Rowley about the possibility of contrib-

uting an interactive media-focused project to the exhibition. After consultation with the curators and representatives of the Musqueam Indian Band, an interest was confirmed in developing a tangible computing application to convey the complex significance of belongings—known by archaeologists as artifacts—for contemporary Musqueam people and their continuity with ongoing everyday practices. Making Culture Lab Researchers partnered with Dr. Alissa Antle's Tangible Computing Lab to begin an iterative co-design process with curators Rowley and Wilson that would merge interaction design research with critical museological approaches to representing archaeological collections and their contemporary lives as 'belongings'.

Research Contribution

This research builds on the movement of repatriation and digitization of cultural objects as well as the reviving, archiving, and again, digitizing, of intangible heritage. Processes and protocols are developing for sharing traditional knowledge digitally within a community while retaining the cultural customs around such knowledge, and institutions are opening their own archives for input and annotation from community members and local experts. [27] *ʔeləẃkʷ – Belongings* was similarly developed using values-led participatory design methods to highlight Musqueam values and voices along with the goals of the museum curators in the creation process. [28] This work further explores how interaction design and tangible user interfaces can be used to share cultural objects and intangible heritage with museum visitors as seen in Figure 3.

Research Methodology

ʔeləẃkʷ — Belongings represents a multi-sited approach to the collaborative design of an interactive media installation for a major Canadian museum. Reese Muntean from the Making Culture Lab was involved in the development of the tangible table as the project manager. By taking notes, documenting meetings, and overseeing the collaboration, she was able to observe the design process of the tangible table. From the overall goals of the project as expressed by the individual team members at the onset to the installation of the table in the exhibition, Reese was able to witness the entire design and document much of its process.

Reese is now part of a team who is studying the table in the museum and its reception by museum visitors. Visitor interviews and observations are being conducted to access the use of the tangible table technology in the museum setting and whether or not the visitors received the messages that the curators intended.

Research Sites

Reese's research sites can be understood as sites of "Belings" and sites of "Knowledge" (although these concepts are inseparable from one another). We begin by describing "Belonging Sites". *ʔeləẃkʷ — Belongings* uses physical replicas of both ancient belongings from the burial site at c̓əsnaʔəm as well as contemporary belongings to teach

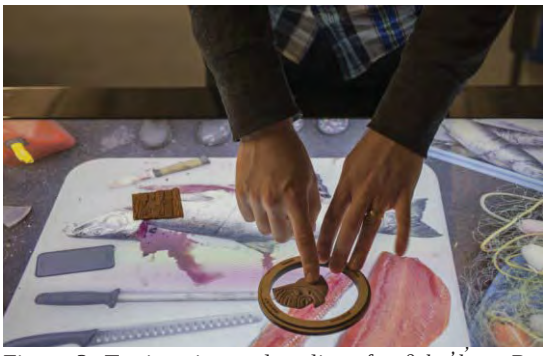

Figure 3. Testing ring and replicas for *ʔeləẃkʷ – Belongings*, 2014, Reese Muntean, Digital Photograph, ©2014ReeseMuntean.

museum visitors about the technological and traditional knowledge from Musqueam history and how that knowledge persists as part of the culture and day-to-day life.

The belongings embody a long history. For example, one of the replicas is cast from an original net weight housed in MOA as part of the Lab of Archeology's (LOA) collection from c̓əsnaʔəm. The net weight was originally used over one thousand years ago to place fishing nets. Excavations beginning in the late 1880s removed human remains and cultural objects from the village's burial site, and this net weight was one such item – along with hundreds of net weights – that ended up in the museum.

In 2010 MOA, Musqueam Indian Band, Stó:lō Nation/ Stó:lō Tribal Council, and U'mista Cultural Society launched the Reciprocal Research Network (RRN), partnering with other cultural institutions to bring the net weight and artifacts online and accessible to the community as well as researchers. Using the RRN website, collaborators can work together on projects, viewing, tagging, and commenting on items held by the partner institutions. The designer and curators of the tangible table used the RNN to access information about the net weight and other belongings, build prototypes, download images, and select final belongings from which to create molds for the replicas.

After viewing the original belongings in MOA and receiving permission from Musqueam, molds of the belongings were then made. Lastly, each belonging exists in the code of the table, and when museum visitors place the replicas on the table, that information is shared.

Other research sites can be called "Knowledge Sites". The traditional knowledge and intangible cultural heritage transmitted though the table was relayed to the design team from the Musqueam Indian Band through the MOA curators. Throughout the process, the designers made every attempt to implement and imbed the cultural values, as the designers understood them, into the design of the table, into the activity of designing the table, and all related documentation. Examples include the use of the term belong-

ing, earning knowledge, and the documentation and implementation of Musqueam's hən̓q̓əmin̓əm̓ language.

The term *belonging* was applied to all of the artifacts from c̓əsnaʔəm, as the Musqueam people still see the ownership of these items as remaining with the people who originally created them; these are the belongings of their ancestors. The term has been adopted by the design team and used in all discussions, meetings, and project-related writing and research.

Another example is the idea of earning knowledge. This concept was incorporated into the activity design of the table. For each of the twelve belongings, a visitor must learn about different aspects of the belonging, including basic information (what it is, what it does, and the name in hən̓q̓əmin̓əm̓), how it connects to Musqueam fishing technologies (incorporating the fish preparation image that is displayed on the table), and how it relates to contemporary issues in Musqeaum culture (which matches the ancient belonging to a contemporary).

Lastly, designers took care to ensure hən̓q̓əmin̓əm̓ terms and Musqueam language preferences were translated correctly into the digital form of the project and documentation. hən̓q̓əmin̓əm̓, traditionally a spoken language, uses the North American Phonetic Alphabet for writing which is often difficult to render properly on computers since many fonts do not include the necessary glyphs. Musqueam approved an abbreviation of c̓əsnaʔəm, which was used in standardizing file names for the digital archive of the project documents as well as in the code written by the tangible table programmer.

This constellation of sites – physical and virtual representations of belongings and knowledge – articulate the multi-sited collaborative interaction design process and its reception in a major cultural heritage institution.

Conclusion

After having expounded multi-sited design ethnography as a new methodology in HCI research, this article presented three new media ethnographic works that serve as contemporary explorations of multi-sited design. Each of them was described as its own research-creation process, which begins with a clear intention that becomes the trackable thread of the project and expands into multiple research sites. By doing so, this article set out to show that multi-sited ethnographers craft their sites as they go, guided by the encounters they make along the way. Tracing their object of study becomes a means to make and express the relationships between who and what they encounter.

In Rachel's ethnography, the multi-sited approach allowed her to describe the interplay between situated physical sites and online virtual sites of representation. In Aynur's project, since the archive has not yet been created and may never be created for political reasons, the sites are physical, virtual, and imagined; one could say the archive is a latent site. And finally, in Reese's work, the sites are both tangible (belonging sites) and intangible (knowledge sites). Here, the multi-sited design approach supports knowledge transfer by connecting these sites to one another, as well as through interactions between stakeholders.

All three of these projects highlight how multi-sited design uses digital-material research tools to engage in a narrative mode of knowledge production that experiments with today's augmented configurations of time and space. At a moment in which the majority of ethnographic documentation and representations are born digital and take on multiple lives and forms in virtual spaces [29], we view multi-sited design as a promising methodological direction for the creation and evaluation of these works. Further, as digital forms of ethnographic representation are increasingly intersecting with art and design initiatives – for example, see the work of the curatorial collective *Ethnographic Terminalia* [30] [31] – we aim to make a contribution to a growing movement in anthropology that values research-creation as scholarly praxis.

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Dr. Kate Hennessy is an Assistant Professor specializing in Media Anthropology at Simon Fraser University's School of Interactive Arts and Technology (SIAT). Her research explores the role of digital technology in the documentation and safeguarding of cultural heritage, and its representation and exhibition in new forms. She is the Director of the Making Culture Lab at SIAT, where she oversees the research of the four graduate students who have co-authored this paper.

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[Session 6]

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Augmented Asbury Park: Disrupting the Present with Remnants of History in Augmented Reality

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Abstract

Augmented Asbury Park is a free mobile experience created by the authors and their collaborative team, which involves the reconstructions of key historic landmarks in augmented reality on the Asbury Park boardwalk in Asbury Park, New Jersey, USA and off-site. The project invites people to disrupt their present experience by using their own mobile devices and locations to interact with digital representations of historic structures. *Augmented Asbury Park* superimposes interactive 3-D history on the present using augmented reality (AR) technologies, including both geolocation-based and vision-based technologies.

Keywords

Augmented reality, mobile technologies, GPS, locative media, community mapping, digital three-dimensional design, interactive design, virtual architectures, psychogeography, memory

Project Summary

How many times have you seen someone gesture at an empty space like a parking lot as a means to describe what was once there? *Augmented Asbury Park* is a free mobile experience involving the reconstructions of key historic landmarks in augmented reality (AR) on the Asbury Park boardwalk in New Jersey and off-site. The project empowers people to disrupt their present experience and connect it with the past by seeing digital 3-D models of past structures and buildings overlaid on top of their mobile device's camera screen. Frequent visitors to the boardwalk remember the old sites and have the opportunity to share their memories with new visitors. And new visitors have an innovative way of interacting with the history of the site.

One example of this is the digital 3-D model of the wreckage of S.S. Morro Castle from 1934 seen in Figure 1, which we reconstructed in a 3-D modeling environment using photographs provided to us from the archives of the Asbury Park Public Library. We used geolocation-based augmented reality to place the model where the wreckage was roughly located.

Asbury Park was one of the most prominent Jersey shore resorts from the late 1800s to the 1960s. It was a hub for Boardwalk entertainment and hundreds of hotels were frequently filled to capacity. All of this started to fade through 1970s leading to closure and dismantling of the majority of sites in the late 1990s and early 2000s, including two famous carousels. Guided by the community's sense of cultural loss and because we believed that, "AR can serve as a historic documentation…a reminder of people and culture of the past," we developed this collaborative project in 2013 with the intent of showing people what the Asbury Park boardwalk used to look like. [1]

We began by doing research on the history of the most famous locations by making connections with local historians and the Asbury Park public library.

Figure 1. Still image from camera of mobile device showing digital 3-D model of wreckage of S.S. Morro Castle from 1934 placed near Asbury Park beach in geolocation-based augmented reality.

After showcasing our initial explorations at World Maker Faire New York 2013, we ran a successful Kickstarter campaign. [2] Subsequently, we did more research, constructed and textured digital 3-D models with collected photographs, and using AR, we put a digital reconstruction of the boardwalk carousel back in the carousel house.

From the initial project success, we were invited to give a talk about the project at TEDxNavesink 2014. [3] Following the talk, we finished placing our digital 3-D assets on the Asbury Park boardwalk using geolocation-based AR. In addition, we provided on-site free tours over the summer of 2014 where people were able to experience these models through their mobile devices. The project is now available for free on-site and on the project website at www.augmentedasburypark.com. [4]

Figure 2. Photograph of *Augmented Asbury Park* tour during July 2014.

Inspiration

In today's society, there is a pervasive sense of cultural and historical loss. Our cities are sites of constant change. In the world where bottom-line seems to dictate what history and culture remains preserved, people often experience a sense of longing for what once was. In our interaction with Asbury Park residents and visitors, we listened to how important these places were to their collective memories.

We began by asking ourselves, "How can we help preserve these memories? And how can we use AR as a form of historic documentation that is directly related to the physical sites in which those memories were created?" As Dan Collins points out in his ISEA 2013 paper, "[Locative media] technology enables experiential mapping and geospatial annotation to produce online applications that support geographically 'located' communities." [5] Later in his paper, Collins states, "The strategy [of community mapping] can reveal the stories of a place that remain invisible to the casual observer." [6] We decided to explore using AR technologies and locative media, because of their abilities to disrupt the present by connecting people with meaningful information both spatially and geographically on a personal level.

Research Process

To begin our research, we drove to Hatfield, Pennsylvania to visit the Philadelphia Toboggan Company (PTC), the original manufacturer of Carousel No. 87, which has become known as the Asbury Park Casino Carousel. In 1932, PTC produced and delivered the carousel to the new Asbury Park Carousel House. The Carousel House was built between 1929 and 1930 as a part of a larger boardwalk redevelopment after the two devastating fires of 1927 and 1928. Warren and Wetmore, the two New York architects known for designing Grand Central Station, designed the Carousel House. [7] Built to fit exactly within Warren and Wetmore's new building, the PTC carousel was graced with masterfully carved wooden horses. In further research, we discovered that the Asbury Park Casino Carousel was moved from Asbury Park to Myrtle Beach, South Carolina in 1992. It is now in a small amusement park called "Family Kingdom." We drove to Myrtle Beach to shoot many photographs of the carousel, seen in Figure 3.

Figure 3. Photograph of Carousel No. 87 at Family Kingdom in Myrtle Beach, South Carolina.

Subsequently, our collaborative team constructed digital 3-D models of the carousel in a 3-D modeling environment and textured the models with the photographs collected from that trip as seen below. Each digital 3-D asset was

Figure 4. Image of digital 3-D model development of the Asbury Park Casino Carousel.

created in a very similar manner to a 3-D game design asset; each model consists of a series of triangulated polygons. We focused on reducing polygon count in order to decrease the load time of the experience on mobile devices. Also, we optimized the images that were applied to the 3-D models to decrease load time as well.

As seen in Figure 5, we placed a digital reconstruction of the Asbury Park Casino Carousel back inside the Carousel House using geolocation-based AR. Anyone with a smartphone and the free mobile app Junaio, created by software developer Metaio, can walk up to the Carousel House and see the model of the carousel in the space.

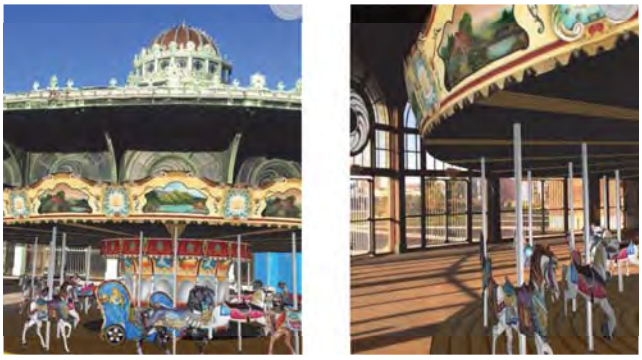

Figure 5. Images of digital 3-D model of Asbury Park Casino Carousel placed inside the Carousel House using AR.

With the help of the Asbury Park Public Library, we learned more about several other historic buildings and structures and were able to collect a large amount of visual references from the library's postcard collections. We created several other digital 3-D models of other buildings and structures on the Asbury Park boardwalk, and we placed those back on the boardwalk using AR as well.

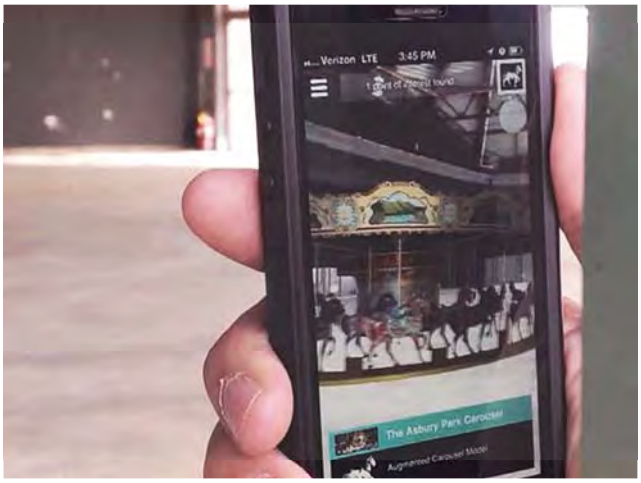

Figure 6. Photograph of camera phone interacting with the digital 3-D model of Asbury Park Casino Carousel placed inside the Carousel House using geolocation-based AR.

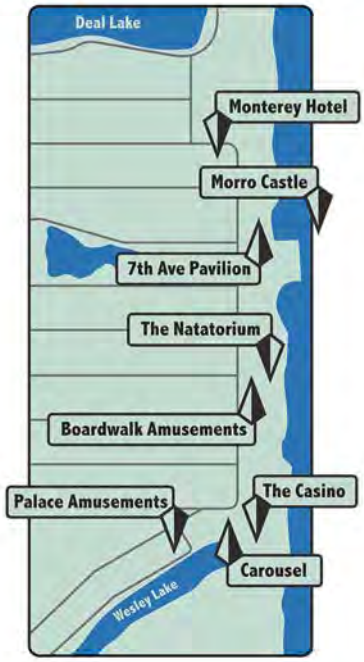

Figure 7. Map of AR assets on the Asbury Park boardwalk.

Here is a list of the completed assets from top to bottom:

- Monterey Hotel, built in 1912, demolished 1963
- Wreckage of S.S. Morro Castle, beached in 1934
- 7th Avenue Pavilion, built in 1905
- Original Boardwalk Casino, built 1903, destroyed by fire in 1928
- Natatorium, first built in 1912
- Skyride and Boardwalk Amusements
- New Boardwalk Casino, built in early 1930's and partially demolished in 2006
- Boardwalk Carousel, built in 1932 and dismantled and sold in 1992
- Palace Amusements, originally built in 1888, demolished in 2004

In addition to geolocation-based AR, we also used vision-based AR. This technology enabled our team to tag each model to a corresponding AR-enabled poster. We designed posters with illustrations and historical information about each building or structure. Now, when people scan one of the posters with their mobile devices, the digital 3-D content appears in front of the poster.

Project Impact

As we led our tours each Sunday in July, the significance of our project became clear. These tours coupled with the on-site AR content engaged the local community and provided opportunities for people to share their experiences and memories. On a perceptual level, it disrupted expected reality and activated it with superimposed, meaningful content. On a social level, the tours disrupted the expected

experience of casual beachgoers who decided to join in on the tour. People stopped and became engaged.

There are now permanent AR markers for visitors to experience on the Asbury Park boardwalk. Also, our project website provides free off-site methods for sharing and experiencing the project content. We are excited to continue offering these experiences and to find ways of growing these kinds of meaningful disruptions.

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Michael Richison is a Specialist Professor in the Department of Art and Design at Monmouth University. He is a multimedia artist who utilizes a variety of media and approaches including graphic design, video, sculpture, printmaking, drawing and installation. At Monmouth, he teaches Motion Graphics, History of Graphic Design and Typography. He has exhibited and performed at venues in New York, Philadelphia, Boston, Detroit, Los Angeles, and London. Richison has received multiple Grant-in-Aid for Creativity awards from Monmouth University.

Dr. Marina Vujnovic is an Associate Professor in the Department of Communication at Monmouth University. Vujnovic studies participatory journalism and new media, media history and gender, and political economy and cultural studies. Her interests focus on international communication and global flow of information, journalism studies and oral history; explorations of the historical, political-economic and cultural impact on media; gender, ethnicity, and media. In 2009, she published a book about Croatia’s first female journalist, and she frequently contributes to books dealing with journalism and media.

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Cart(ont)ology: Mapping Self-as-Network in Three Carts

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Abstract

We live in a networked world to which we find ourselves entirely ill-adapted, clinging to outdated means of perceiving and understanding our environment. Part art intervention, part philosophical project, cart(ont)ology proposes the convergence of cartographic and ontological approaches to the question of being/becoming. It seeks to account for both individual entity and its networked presence in a single discursive movement. Through the development of three interwoven artworks – a pushcart, inventory-qua-cart, and PCBs-qua-cart – the author explores how we might engender a network sensibility in ourselves which encompasses our relations with not only people but also machines and objects, and which renders us better adapted to act within our networked existence. Embodied across these three scales, the physical carts created serve as abstractions through which to understand networked relations from the local context outwards. They are also a performative investigation into how we might engage in a radically active receptivity as a means of network-oriented perception, encounter, and exchange.

Keywords

research-creation, performance, complex systems, networks, semiotics, intervention, assemblage, ontology

A Crisis of Networks

Networks aren't what they used to be. Despite decades of post-structuralist semiotics, we remain uncomfortable with the privileging of process over object, and networks have been co-opted from the notion of a mutable set of relations to nothing more than a large and interconnected but fundamentally stable structure. Christopher Kelty writes:

> "At the time, the word network [...] clearly meant a series of transformations [...] which could not be captured by any of the traditional terms of social theory. With the new popularization of the network it now means transport without deformation, an instantaneous, unmediated access to every piece of information. That is exactly the opposite of what we meant." [1]

Of course this doesn't prevent us from living in them, and living in them seemingly well. We are not ignorant of the value of networks; rather, in the words of theorist Anna Munster, we suffer from "network anesthesia – a numbing of our perception that turns us away from their unevenness and from the varying qualities of their relationality." [2] We ignore the ever-changing forming and reforming of relations which make networks dynamic entities. [3] Above all, we neglect to address this dual-edged notion: it is the activity of their individual nodes that keeps networks in constant flux, and yet if the network around us is constantly changing, so must we be by extension, however still any of individually may be standing.

In her work Munster proposes how we might understand networks differently. My project is similar, but ontological in another sense as well: I suggest that to better understand and live within networks we also have to change how we think about and exist within ourselves. True we are already astute navigators of networks, albeit in particular of other human nodes within networks, and we are keen theorists of the powerful potentials of complex systems and networked life. Yet we recognize only insufficiently how deeply and perhaps existentially we are affected by our networks, and ignore how a network-level perception might radically change the scope of human and human-object relations. Our day-to-day encounters and existence are marked by the stilted continuation of a worldview in which there is us and then there is our surrounding network and environment of people and objects and machines, to be used or modified or displaced or engaged with as we see fit.

Towards a Cart Ontology

As a counterpoint to this state of affairs I propose a cart ontology: or, what it means to be a cart. Make no mistake: remove three letters (the "ont" of the individual, according to cell biology) and it serves as a kind of cartology, as well, an emphasis on what realities about larger systems might be expressed through the local; a complementary conceptual tool to deterritorialization. Cart(ont)ology as its awkward formulation suggests is a site of slippage between the well-traversed ideas of cartology and ontology.

Mine is as much philosophical project as it is performative experiment. I suspect that we are all carts of a sort – more likely we are several all at once – and research (surveyed briefly below) in genetics, parasite ecologies, and psychology is suggesting much the same thing.

So what is a cart? Well it is mobile. Carts are meant to move through space and time, and thus in our terminology, easily enter into and out of different assemblages and relations. Carts also exist, in-the-world, as a site of contact among people and objects. In contemporary art and architecture one must never take for granted the notion of something physically existing. This material existence is

crucial as well because it prohibits us from collapsing the notion of a cart into that of a vector, or some other immaterial means of transmission.

Yet more than most things we encounter, carts are defined by their relations. Just ask Google to show you a "shopping" versus a "gypsy" cart. At what point these relations become so central as to become part of the very identity of the cart is more than a question of worthwhile debate. It is the very crux of this project.

The premise of cart(ont)ology is not that we exist both as physical and networked individuals but rather that we exist simultaneously as both individuals and networks. It is an attempt to engender an understanding of this nature as concrete, experienced reality, not merely conceptually.

This is not just about the shopping and gypsy carts, of course. Everything and everyone may be characterized by a cart(ont)ology. Carts themselves – carrying pretzels or shawarma or medical equipment or toys or people – are the most basic exemplar and the abstraction through which we can begin conceptualizing this. As the capacities of an entity increase beyond those of carts as we typically know them, through sentience to movement to decision-making, the cartology of any network in any given instant becomes more complex. But this project exists especially for human beings in all their sentient, moving, desiring decision-making, as part of an equally desirous wish to better adapt us to our own networked existence.

Why Cart(ont)ology

In what ways can we be said to *be* (synonymous with our) networks? Deleuze and Guattari have already proposed multiplicity and molecular becoming as alternative ontologies; this project theorizes a similar understanding via our networked relations. Such a multiply defined existence is not a matter of conjecture; it is not even new, although its landscape is being shaped by contemporary technologies, surveillance tactics, and biological research.

Take for example the fact that researchers have found they can identify 95% of cellphone users based on four sole instances annually of knowing a user's location at a given time. [5]. Or the alarming accuracy to which our identities can be constructed and even future life events predicted as circumscribed by no more than Amazon purchase records, Google searches, online activity rhythms: in a word, datapoints, many of them, of all kinds. [6] Are these examples of our identity being externally assayed based on our networks, or ways in which our networked self is becoming equally or more our "actual" self?

What about research into how seasonal weather modifies human gene expression? [7] The way colour, sound, and sunlight almost universally affect our eating habits? [8] How parasites and bacteria alter animal behaviour? [9] How famine turns grasshoppers into locusts? [10]

What cart(ont)ology contributes to the theorizing of ontology is a reflexive gesture: remapping the self-as-network back onto the self-as-entity. It presumes that there is a direct relationship among nodes in an assemblage or network (insofar as the existence of relations is likely the criteria that compelled us to define some set of entities as a network to begin with). Let us also postulate that a network is characterized exclusively by the positioning of its nodes, albeit not necessarily their geographic or spatial positioning but rather any descriptor of its edges and relations that makes sense to apply. For our purposes there need not be any history to a network, other than the latent history which led to this configuration being precisely as it is now. The networks' possible future states are informed by its current configuration and the relatively imperceptible (virtual) capacities of each and every node.

From here, the experiential component of cart(ont)ology suggests that it is possible for each node, by virtue of its immediate access to its surroundings, to literally perceive, feel, or absorb information about the network's state, at potentially higher levels of abstraction than we traditionally attribute to perception (but ones which a few examples will show we do not typically exclude from it, either). This is perception, as Anna Munster describes it, as "a making of the world and of sensing itself, as we go." [11]. Anything existent within the immediate network is available to be perceived or acted upon, informing the actors' actions and the network's future. Likely much of it is already doing so, without the actor's realization, which is precisely why I suggest that beyond simply being in-a-network, a given entity *is*, in some ways, its network.

Also, because networks overlap, this perception may effectively extend beyond the immediate network insofar as each individual node exists at once as individual actor and an expression of (its own) network conditions.

It is crucial to note that cart(ont)ology is not restricted to human actors: networks conceived in this sense necessarily include people, objects, plants, machines, bacteria, etc. The individual-as-network aspect of cart(ont)ology is influenced by Jane Bennett's object vitalism, wherein "the concept of *agency* [...] becomes distributed across an ontologically heterogenous field, rather than being a capacity localized in a human body." [12]

At least in many circumstances, human nodes' capacities for action tend to outnumber those of their non-human network neighbors. Humans are also the only ones who might be reading this essay. Thus cart(ont)ology, despite urging a network-level perception and process of decision-making, is fundamentally human-centric in situating its impetus upon human actors. It inquires how we might act upon this object-oriented understanding to engender in ourselves alternative perceptive approaches that render us better adapted to life as networked beings. What precisely this might look like is the subject of my artistic research.

The Cart(s)

And so I am building a cart. Not one, but several carts! With a post-structuralist wolf in each. Many networks – and all self-organized critical systems – have the mathematical property of being scale-free, following a power law irrespective of their size or accretion. Well so do carts! Or, better said, so does the abstraction of a cart:

so does a cart ontology. To arbitrarily adopt the metric system as a means of illustration, entities that I would argue function like a cart at different scales might include:

- meteorites (kilocart)
- spaceships, urban plans (hectocarts)
- caravans and markets, airplanes (decacarts)
- my cabinet-of-curiosities street peddler cart (base)
- inventory (decicart)
- printed circuit boards (centicarts)
- altered genes (millicarts)

I am building three of these, from the street cart down. The contribution of my carts as physical objects is in the vein of art as research practice, as elaborated upon by Graeme Sullivan among others. [13] As such my philosophy of cart(ont)ology is still very much in process. At the time of writing I believe that each of these three objects already highlights different elements of cart(ont)ology; several rules will make these ramshackle real carts further exemplary of their cart abstraction.

First, the large street peddler cart (which houses the others) will not "know" or broadcast its location. This is an aesthetic not obligatory decision. It provides a space through which the networked reality of the cart can be emphasized over its physical one, since the latter of these is not about to be missed anytime soon, measuring about five feet long and three feet wide and set on rather prominent wheels. Furthermore, unlike its shop, food cart, and gallery brethren (especially mobile ones) it lacks an online presence of its own authorship and so can be experienced only through some degree of directly networked relations: through what I or its visitors have to say or show of it. There is also a mythology regarding the cart's inability to know its own location.

Speaking of which: fictions are an important aspect of my project because they expand one's understanding of the potentialities present in a given context. In the words of critic Steven Shaviro, writing on the philosophy of Alfred North Whitehead:

> "Whether true or false, delicious or repugnant, a proposition points to a *potentiality*. That is to say, propositions are neither actual nor fictive; they are 'the tales that might be told about particular actualities.'" [14]

In network terms, propositions (of which mythologies and fictions are instantiations) expand the (virtual) capacities to action of the node which has encountered them. How this affects and may be understood through cart(ont)ology is among the questions I will be exploring.

Second among my rules, the cart inventory must be continually updated, to the point of absurdity if possible. Everything *is* in fact always changing. If it is impossible enough to keep track of amidst our many trillion cells and surrounding molecules, it becomes downright inconceivable as soon as we remember we are an open not closed system and part of networks whose other components are also always changing. The absurdity of the inventory highlights the relative reasonableness of the proposition I am making: that we actively absorb these changes not through conscious observation and recording but rather as perceptions and affects, which may be acted upon through lived experienced.

Printed circuit boards, the centi-scale of the project, are already exemplary of a cart(ont)ology for the ways in which they house a regulated system but are designed to interface with the local environment through the input or output of signals. Their cart nature will be enhanced by making them mobile, by activating them atop small robots and through their sale as products.

Technically what else is on the cart makes little difference for my performative experiment, and indeed the most important feature is that these contents can change from day to day or even minute to minute. Nonetheless I have chosen the first collection of works quite specifically to highlight tensions between the physical and networked (virtual) body, whether these be of humans, objects, or locations. This is for two primary reasons. One, since I am situating this cart not only in the world but also in the context of "art", for the latter's sake the objects onboard might as well reflect the project's larger concept in the meta- approach of which contemporary art is so fond (and perhaps this also gives it a certain elegance). Two, I think I believe in cart(ont)ology and yet in my everyday existence I typically fail to feel like a cart. By exploring the tensions across the tripartite existence of biological/physical being, that of self-as-node-in-networks, and that of self-as-network, I hope to engender in myself the approach to networked existence I am propounding here.

One side of this largest of my carts is thus devoted to a project which collects breaths: both their forms, generated as a 3D model from sensor data, and then saved or 3D printed in ceramic, and the expired air, collected in small vials and labeled with name and mood data when granted. On the other side several works more directly juxtapose physical and virtual or networked bodies. Among these is a set of vessels, composed partially of local clays, whose shapes reflect the horizon line of the landscape where the material was collected. A separate series of prints compares the actual location of an entity (usually myself) to the location that would have been interpolated based on a triangulation of related data points. And so on.

Cartology Through Radical Receptivity

Thus far I have elaborated on the ways in which these three (or more) actualized cart forms represent and allow me to further investigate the idea of cart(ont)ology. They are all meant to change over time, to move or be moved to different settings, and to be encountered by different people: changing circumstances which I undertake as experiments into the nature of carts.

In addition to describing contemporary states of being/becoming, however, cart(ont)ology should propose an alternative means of being-in-the-world which takes optimal advantage of the peculiarities of the networked multiple self. The conceptual crux of cart(ont)ology as lived experience is a notion I refer to as radical receptivity. It owes much to Alfred North Whitehead's philosophy in

its conceptualization, again encapsulated here by Shaviro:

> "Activity, no less than passivity, is a dimension of receptivity itself. Every experience, every feeling, is at one and the same time an 'inheritance' from the past and a fresh creation. And both of these dimensions are contained within an open affectivity." [15]

Radical receptivity involves opening oneself to the network aspect of being. It urges us to recognize that we are constantly being affected by everything with which we are in direct contact whether the chemicals in our blood, the knickknacks on our desk, or the people we're communicating with. As suggested above, by extending this notion out through several degrees of overlapping networked relations, we may be said to be more or less directly affected by even non-local conditions.

Radical receptivity is necessary because complex circumstances increasingly render linear thinking and other historically useful approaches inadequate. This is an ontological problem, not one of a lack of data. Manuel DeLanda elaborates:

> "The reason why the properties of a whole cannot be reduced to those of its parts is that they are the result not of an aggregation of the components' own properties but of the actual exercise of their capacities." [16]

Capacities which are always in flux, whose precise outcome can never be known, merely statistically estimated. This may be sounding familiar. After all, a very basic observation of complex systems is that even deep knowledge about the workings of individual components is insufficient information to be able to predict the emergent properties of the system as a whole.

The privileging of man and his ability to impose his will on his environment is part of a distinctly western philosophy and worldview, if not also part homeostatic drive. [17] Yet now more than ever, man finds himself caught in the throes of enormous networks where it would be impossible to know all of the individual actors and nodes in most cases, let alone the landscape of an entire system. As non-omniscient human beings moreover with our own constellations of vested interests, we cannot effectively assess these systems in the ways heretofore favoured, much less make predictions about their futures or our futures within them. And yet much of human society is dedicated directly to these efforts. Cart(ont)ology and radical receptivity seek a way out by encompassing within ourselves our surrounding networks, in all their flux.

What does radical receptivity look like in action? This is where the philosophical project ends and the art-as-research-process begins. The streetcart I am constructing is a traveling incubator full of objects and fictions. As I reinvent the mythologies of the cart and objects onboard, as my collection of archived breaths grows, as I engage with the public about these projects and ideas, as I move to diverse locations: the introspectively performative aspect of my project is that I will be actively attempting all the while to engage in a praxis of radical receptivity. I hope to explore its contours, define its practice, map its limits, and suggest its potentials for a concretely networked existence.

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Case Study: White Night Melbourne in 2013 and 2014 Disruption or Contribution Toward the Socially Engaged Public (Art)?

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Abstract

The purpose of this case study is to analyze the White Night arts festival as a form of public art using the frameworks of art as experience, art practice as cooperation and social objects. In 2013, Melbourne hosted more than 300,000 participants at its first White Night and in 2014 the number increased to 550,000. [1] The White Night started in Paris, 2002 influenced by the origin of Nuit Blanche, and is now held in more than 23 cities globally. [2] The various White Night events share a common objective, which is to celebrate and transform the city, as art and entertainment [3], into a free cultural event. The White Night festival features traditional and new media art in public spaces that promote social interaction and participation amongst large public groups. Three artworks are discussed as case studies using the conceptual frameworks to highlight the potential of the festival to build socially engaging and interactive public artworks. The case studies also reveal areas of focus that are unique to the festival, which could be leveraged to greater effect.

Keywords

Public Space, Public Art, White Night Melbourne, New Media Art, Social Objects, Audience Interaction, Participation, Cooperation, Co-creativity, Socially Engaged Art

Introduction

In 2013 and 2014 the White Night transformed part of the urban public environment in Melbourne, Australia into a cultural playground. Audience interaction and participation are significant components of the festival, and it brings digital media art projects directly into public view. Although the festival has a growing number of visitors and meaningful goals, it also raises questions of how the audience perceives the event and its larger influence on the urban environment in the city. Observers have viewed it as both a public disruption and contribution, suggesting lessons that can be learnt from the festival for exploring how digital media can provide a socially engaging and interactive experience for its audience.

As well as increased attendance, from 2013 to 2014 the White Night festival saw increased facilities for visitors and larger, more diverse area of involvement including the city center, railway stations, galleries, museums and laneways.

The White Night represents a growing international development that has brought public art to large audiences. The festival brings a concentrated collection of artworks and a unique scale of public involvement, making it a valuable event to analyze for its approach to public art. In this study the White Night is considered using established frameworks for interpreting public art projects, to find lessons that can be taken from the festival and also provide criticisms that can be used to develop it with increased social engagement and interactivity.

Methodology

Participatory new media installations in public spaces struggle in the intersection of political, cultural, social, educational, entertainment and economic fields. The fields have different operational logic and techniques that impose different demands for audience participation so the desired outcomes of public art in urban environments are diverse and sometimes conflicting.

This study is less concerned with political, educational and market aspects of the public art experience and focuses instead on experimental practices in new media participatory public art that has greater potential to build social interaction and participation. Art as experience, artifacts as social objects and art practice as cooperation are concepts that are relevant to the White Night festival and point to a discussion on how to develop socially engaged and interactive art practice. The concept of co-creativity forms the basis of an extension of this discussion.

Art as a tool for social transformation is not a new concept. It has a long history from religious paintings to new media participatory public art. However, recently the term ‘socially engaged art’ has arisen in many academic seminars and public discussions about contemporary art practices that focus on site-specificity [4], ‘new genre public art’ [5], participation [6], community [4, 5] and audience interaction, experience and cooperation. [7, 8]

The definition of ‘socially engaged art’ is ever evolving and has different connotations depending on context. This paper focuses on the underexplored potential that engaging the wider public as co-creators of interactive digital

experiences has to act as a catalyst for social awareness and change through positive experiences of cooperation.

Conceptual Frameworks

Social spaces can be defined by their physical properties, but also by conceptual properties. Public parks, shops, social networking sites and online games have their own social functions. Henri Lefebvre argues that space requires human social interaction and a cultural dimension of represented space. He states that all "space is social" and emphasizes the designing and planning of social space through the use of a 'social object', stating that "social space has thus always been a social product."[9]

Jyri Engestrom defines 'social objects', a concept he framed in 2005, as "the objects that mediate the ties between people" in the context of social networks and argued its fundamental basis to spark social interactions and build connections between users, leading to the success of the social network. [9] Karin Knorr Cetina had elaborated the concept more generally as 'Objectual Practice' four years earlier. [10]

This framework has been applied in different environments, such as the development of the iPhone, marketing and games. Nina Simon also applied it to museums. [11] These applications focus on elevating social objects as strong connections that bind people together, a connection of having something in common and new. These cases are based on social objects outside the social media paradigm.

Social objects can be everyday objects used in art or public works that result in human-human interactions. When a baby or animal is the centerpiece of a new interaction on the street, the baby or animal can be considered as social objects that play the role of promoting a new connection between people in a public environment.

One of the main objectives of the White Night festival is [re]connectivity between audiences through engaging in and with public environments such as Fiqure2. Dance Now. If an audience can identify new art objects that are social, transformative and playful in the White Night event it could lead to increased social interaction and participation, building a 'we-together' concept between social objects and audiences.

The concept of art as experience considers the way the viewer experiences the physical surroundings and other people when viewing art. The experience will differ from viewing the art alone at home, in an exhibitions or museums. The environment plays an important factor in facilitating active engagement, interaction and participation. By encouraging social engagement through artworks that require the audiences to interact with each other, a deeper experience can be created that is more dynamic and playful. [12]

The concept of co-creativity in art process and design is to have creative inputs from multiple individuals with shared goals in the output. This includes collective interaction and expressing shared values in public spaces. The artists and designers at White Night can facilitate audience members to participate and to become co-creators with positive social outcomes. White Night has a large audience and with it the potential to affect positive social change as a collective and cooperative movement.

Discussion

The reason for visiting White Night was to experience the art works as well as to explore Melbourne's laneways, which had been transformed by the event. White Night is as much an exploration of creativity as it is of the city and its people. People were as interested in the air of festivities as they were in the actual art works, but many visitors were there to witness the creativity and artistic expressions.

Some of the events were based on audience interaction. One particular event, "Dance Now", encouraged the participants to burst into a dance routine as soon as some music starts playing. This was a true example of playful participation and audience engagement and an embrace of art as experience.

Figure 1. *Dance Now*. Photo used with permission from Photographer Wayne Hawkins 2014.

The most notable displays involving new media were seen in Melbourne's Federation Square. The architectural light projections were vivid and stunning, as described by many viewers. These clearly highlighted peoples' interest in visually appealing media and the transformation of public spaces and architecture. The festival could build on the audiences' shared interest by accompanying visually engaging objects with viewing areas that encourage conversation amongst the viewers.

Figure 2. *Wonderland*. Photo by Yun Tae Nam 2014.

Socially Engaged Art Projects

Vladmaster is a handmade View-Master experience designed by Valadimir: A View-Master is a device to look at 3D color picture. It was widely used as a children's toy and for viewing tourist attractions. Viewmasters were in common use from the 1920s to the 1960s. It was interesting to see them in use during a contemporary arts festival, focussed on using the latest technologies. The physical interaction design was particularly interesting. An analogue touch based mechanism to navigate to the next scene with a pre-recorded narration. This unique involvement of a haptic (touch based) mechanism inspires design that encourages physical interaction and play.

Figure 3. *Vladmaster* performance at ACMI.
Photo by Yun Tae Nam 2014.

Purple Rain is an installation that uses sound and visual artwork to create an immersive experience. The name is a direct reference to the music of, and film featuring the performer Prince. It embraces the all night theme of White Night by using bright purple lights and showers of water to create a deep glowing effect that echoes the 1980s period that the film and music were made in. Audiences are given clear umbrellas so that they can get in underneath the artificial rain and see the light effects from various angles and music accompanies transitions in the light.

Figure 4. *Purple Rain*. Photo used with permission from
Photographer James Pang 2014.

This installation provides the audience with a unique sensory experience, not only through the effective use of visual content and sounds but also the audience engagements that create a starting point for interesting social interactions between audience-members in the installation environment. Taking pictures with each other or recording videos while the 'rain' is pouring down builds the feeling that they are sharing a common experience together. Smiling with each other, posing for the best pictures. They can also share the contents through social media as digital social objects that include the environment and audience interaction and participation as content.

The audiences are really participants and content generators because they also create sounds and scenes within the purple world. While holding umbrellas, or even without them, they freely play with the rain and generate sounds from their wet bodies. The combination of play and sharing a new world with other people can create an emotional experience and create new happy memories for the participants.

Bouquet Final 2 is a large metal structure that towers several meters high. From the top of the structure, liquid bubble foam begins to pour down and envelop the whole structure. The effect is temporary as the bubbles burst and the liquid drains down to the bottom of the structure. The artwork appears to grow and decay like an organic object.

The installation gives the audience a visual and haptic experience at the same time. The generated bubble foam creates an unpredictable sculpture in real time and the shapes are unique in every moment of time. Unlike many sculptures in a museum environment that are not permitted to be touched, *Bouquet Final 2* is a haptic experience. Audiences can freely touch and feel the foam which gives them a new experience they cannot typically find in galleries and museums. Audience members could be seen putting foam onto each other and laughing and playing with the bubbles like they might have done in their early childhood. This experience has the potential to induce a sense of nostalgia of happy childhood memories.

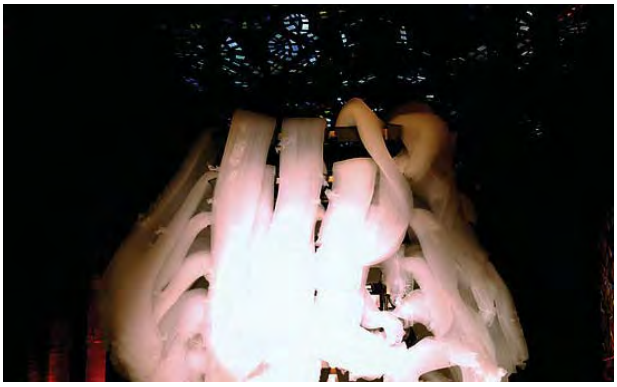

Figure 5. *Bouquet Final 2*. Photo by Yun Tae Nam 2013.

These three examples show successful applications of some of the conceptual frameworks of social objects, art as experience and art practice as cooperation. By embracing the freedoms of a short festival inside a public space, interesting experiences were created that facilitated play

and physical and social interactions. By having environments that can be enjoyed as a shared experience, participants were also inclined to take photos, which could act as social objects, expanding the reach and effect of the festival beyond its physical boundaries. Further exploration of these concepts at the White Night festival could continue to build the social function of the event and provide inspiration for public art in general.

Limitations

There were limitations in compiling a review of writings on the White Night in Melbourne.

- Lack of reviews by art critics and new media experts
- Limited sources of literature documenting specific individual events

Conclusion

At White Night in Melbourne there have been diverse artistic expressions using old and new media artworks. Each artwork has its own forms of interaction and meaning for socially engagement. They enabled social interactions and participation via multimedia installation forms that showed the potential of socially engaging because much of the presented works have been focused on participants-led. Art practices in public space such as the White Night are valuable events for seeing how the public perceives public art.

People often follow social conventions to guide their use of public spaces. Interactive digital technologies allow them to make non-destructive but stimulating visual, audial and tactile experiences of their own design. The new use and conceptual image of that space changes their personal and social experience. By using frameworks that consider both artist-led and participant-led artwork that embrace co-creativity, a unique, socially engaging experience can be created that has ongoing social effects.

Many artists, organizers and community groups are trying to encourage social transformation through events that run for even just one night, such as White Night, by temporarily transforming the city into a part of art and entertainment. This event can be considered as a social-cultural playground with further potential for the pubic to experience art in a meaningful way for our society.

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Disrupting Conventional Boundaries of Public Art In Urban Space

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Abstract

In contrast to the spectacle of large-scale projections onto urban architecture, digital eco-art offers intimate experiences in reciprocity with the largeness of the sensorial realm of nature. Digital eco-artists position work in natural settings for the exhibition of interactive computer generative sound and visual installation works. In doing so, they push traditional boundaries of urban public art to be more socially interactive, immersive, and inclusive of place they offer a means for re-visioning urban natural green space.

Keywords

LocoMotoArt, place, digital eco-art, technologically mediated experiences, urban environment

Introduction

"Space and place" are components of the living world, which have biological connections that can be mapped, measured, calculated, and used via the experiential. Within this concept of space and place, we find that both resonate multiple qualities, meanings and mediated symbolism, which we often take for granted. [1] We can also consider that space is a "sphere" consisting of multiple trajectories, more specifically that the sphere is comprised of "coexisting heterogentity…without space, no multiplicity and without multiplicity no space." [2] In this point of view, there is an inseparable character of space and place. Sampson reminds us, "a meaningful sense of place has four primary dimensions – emotional/affective, spatial/geographic, ecological/interconnection and temporal/historical. A true sense of place includes the intertwining of all four." [3] Lefebvre defined the concept of 'representational space' as spaces of imagination, complex embodiment and coded symbolism. A conceptual triad, representational space is considered the "most evocative" and according to Lefebvre, linked to "the underground side of social life as also to art," which he referred to as a "code of representational space." [4]

Use of space embraces a multitude of competing trajectories, which are interrelated. Contributing to these intertwined boundaries, we find that physical space and place are deeply embedded with technology and thus, electronic space and place is as much a part of space and place as buildings, parks and plazas. As Amen and Thrift note this has "crucial consequences" because "the technical is not seen as separate from the social or the natural," [5]. I consider space and place to be intertwined, ever changing, steeped in complex fluctuating intricacies and temporal changes.

In response to the awareness of the oscillation between physical and electronic space and place, electronic artists seek to interrupt the everyday and transplant human activities through the ubiquitous and sensorial aspects of digital technologies. These artists move towards unconventional use and repurposing of urban natural space. In doing so, a means for local place making and exhibiting public art emerges that disrupts conventional and traditional boundaries of the space and appeals to the imagination more intimately. Traditionally outdoor spaces are used for concerts in parks, parades, street parties, and festivals. Digital eco-art, emphasizes electronic and physical space and place by oscillating between perceived realms.

In "Digital eco-art: transformative possibilities," co-author Philippe Pasquier and I observe, "We must consider that there are many interactional experiences and relationships that exist in both natural settings and digital technology. It is generally understood that our ability to connect with nature is accomplished by way of direct sensuous engagement. Because digital devices and sensor technologies provide enhanced experience by augmenting human sensorial awareness within auditory, visual and haptic experiences, we can also be sensuously and immediately engaged through such technologies. By combining these multisensory augmentations with the experience of natural setting, the two blend, resurrecting our cultural connection to the natural realm…" [6]

Digital eco-artists use this sense of oscillation to push traditional boundaries of urban public art to be more socially interactive, immersive, and inclusive of place as a vehicle for re-visioning of urban natural green space. Drawing upon five years of arts based research and the work of LocoMotoArt, a multi-disciplinary media arts group, I report on a digital eco-art event, *LocoMotoArt @ Queen Elizabeth Park* in Vancouver, British Columbia. This paper does not provide the opportunity for lengthy discussion, therefore I describe briefly some of the works from the exhibition which played upon the oscillation of place, space, locale, memory, the uncanny, fusions of nature myths, the geological history and the convergence of the colonial ramifications found within Nature, cultural traditions and society as related to this specific urban space and place.

Disrupting Conventional Boundaries

A more traditional use of urban space by electronic artists involves the creation and exhibition of works for spectators to experience a distanced *engrandized* representation with sensations engendered by the sheer largeness of the spectacle of urban projection. During the 1980s and 1990s the "provocative spectacle" emerged as seen in the work of artist Krzysztof Wodiczko, who in the mid-1980s projected gigantic "40 foot" images of objects and body parts onto the facades of public buildings and monuments. In her paper *Urban Disturbances,* Ewa Lajer-Burcharth concluded that Wodicczko's projections, "…indicate and use the contradictions of specific social space … and in doing so open them to reinterpretation." [7] Large-scale projection utilizes architecture for screening surfaces, for staging striking visual displays for immense crowds of people who are assembled together in an urban area. It is axiomatic that urban ecological sounds, (sirens, horns, motorized traffic, air and land), as well as metaphors and symbols of human history and the architecture used, begin to merge into the viewing experience.

In contrast, digital eco-art engages the spectator with the interaction and intimate experience of both nature and technology. Digital eco-artists strive to use all attributes of natural settings such as forests, beaches, caves, lakes, or stream banks for example. Screening surfaces are found within the contours of the landscape, and incorporate natural aspects such as steep inclines, uneven ground, sand, or rocks. Another contributing aspect is that of existing ecological soundscapes, such as waves, birdsong, or wind. These add to the artist's work in ways that differ from large-scale urban projection or indoor gallery settings. Digital eco-art is the temporary occupation of natural urban place; it is small-scale and positioned in dialogue with natural settings, or as specific intervention. It engenders a sense of intimate connection to and the understanding of natural environment and its restorative properties. [8]

Aesthetics of Digital Eco-Art

The term aesthetics is commonly associated with the senses, art, and the value of appreciation of the beauty of art. The etymology of the term is "to perceive with the senses", so it is possible to consider "all experience as fundamentally aesthetic." [9] When considering the aesthetics of digital eco-art, we must acknowledge that we are corporeally connected to landscape, and that our senses hearken back millennia to a time when the experience of interconnectedness was synonymous with survival and our understanding of the world. Humans were so deeply embedded within a sustenance relationship that a sense of reciprocity with the natural world was embedded in human existence and culture.

Electronic space, or virtual space, is similar to natural spaces in that sensuous qualities such as texture, form, colour, light, scale and movement, sensation of sound may also be present. When we consider digital eco-art placed in natural settings, we must also consider interconnected aspects of these. Digital technologies provide multiple sensory and interactive experiences and augment the senses in ways that could be considered similar to the sense of arousal one can experience in nature settings. Within the human sensory-perceptual system we have the capacity to interpret, or internalize cognitively that, which is perceived. Internal and external perceptions are produced at the same time, and they are not separate; "in our experience we never find them disjoined" [10]

Re-visioning Urban Natural Space

As an emerging genre, digital eco-art provides an intimate, heightened sense of aesthetic engagement among humans, technology and nature, and disrupts pre-conceived cultural notions of the separation of the three. Similar to the influence of Joseph Beuys on social sculpture and environmental art, digital eco-art and its use of public natural space, history and memory also responds to the need for generating discourse related to ecological issues. These types of "art agendas" involve traditional as well as activist practices, and all have a role in raising awareness of ecological issues. The ubiquity of digital media in our lives can make them seem at times more familiar than nature. Digital eco-art re-visions the park or natural green areas of a city and provides a means for the repatriation of the inhabitant with his or her environment. As electronic space interacts with the physical urban public space, it becomes a transformative experience. [11]

Social Interaction and Digital Eco-Art

During five years of field study with LocoMotoArt, spectators repeatedly commented that the sense of stimulation provided by the experience of digital eco-art led to feelings that were "pleasant," arousing a sense of "being in love", or "uncontrolled excitement," or "intense uncontrolled curiosity" when experiencing electronic art installations *in situ*. Several spectators commented they had feelings of a sense of "intimacy" and that the technology and art all felt "absorbed" "connected" and not separate. In further findings participants spoke of feeling a momentary sense of human, technology, nature interconnectedness. This moment of bridging of the lacuna of the separation of all three – human, technology, and nature awareness – and the experience that all three are absorbed as one – the HTN Triad Relationship – may act as a conduit, or a potential sensorial pathway (intermediate agent). [12] Pursuant to research studies, there are associated cognitive and health benefits related to exposure to nature as well as "technological nature." [13][14] For complete details related to the research study, I refer the reader to "LocoMotoArt: Digital Art in Natural Settings," published in Volume 10 Issue 1 of the *International Journal of New Media, Technology and the Arts*, and other references listed related to LocoMotoArt.

LocoMotoArt

The multi-disciplined group of electronic artists also

called LocoMotoArt, re-vision natural settings for use in performance, participatory walk-based GPS enabled works, and interactive and computer generative sound and video installations. They are currently artists-in- residence with the Vancouver Park Board Arts, Culture and Engagement Division with studio space at the historic Aberthau Mansion in West Point Grey (2013-2016). It is the vision of the group to address the importance of our environment by offering audiences collaborative new forms of engagement through digital multi-media works comprised of sound, live movement, performance, storytelling, and participatory interaction with outdoor natural settings. [15]

LocoMotoArt @ Queen Elizabeth Park

Queen Elizabeth Park is a large world famous arboretum with a vista point from where tourists come and view the City of Vancouver. The park itself is an extinct volcano, and ex-industrial site. The former crater, previously a rock quarry, is now a showcase garden. Primarily a daytime park, at night the lower quarry garden is closed to the public. The garden became the site for the exhibition of twelve sound, visual and interactive installations created by artists: Jamie Griffiths, Miles Thorogood, Sebnem Ozpeta, Rob Scharein, Dave Leith, Laura Lee Coles, Merlyn Chipman, Mark Nazemi, Maryam Mobini, Wynne Palmer, Bobbi Kozinuk and an excerpt from *Coyote X* by the late First Nation media artist Terry Haines, presented by Aaron Rice.

Over 500 participants of varying ages, cultures and backgrounds enjoyed a rare opportunity to be a part of using the park in a non-traditional way during an untraditional time. To enter the installation area they had to descend a series of dimly lit stairways. Once at the bottom, the installations were viewed by walking the entire pathway, which snaked about through various levels encircling the large garden. The artworks could be experienced from afar, or up close – "in" the installation itself.

The members of LocomotoArt dedicated the exhibition to the memory of multi-disciplinary artist Terry Haines, of *Secwepemc*, Welsh, French and and *Tsilhquot'n* ancestry. A short segment of the late Haines' monumental four-channel video installation, *Coyote X,* was screened on the large rock face situated next to a fast moving waterfall that dropped forty feet over a granite rock wall. Viewers had to reach this area by walking over a bridge and pond. They could first see glimpses of the movement of light, with splashes of red, blue, turquoise, purple and patterns through the trees, but once at a designated place, they gazed upon the single channel video by standing next to the falls witnessing the Coyote emerging in and out of the brick poetry of *graffiti*. Haines wrote of his work that *Coyote X* mirrors human actions of adaptation and survival, "Standing like us in the shadow of a dominant society, amid urban sprawls, colonial ramifications and realities of expansion…[T]he contingent environment Coyote inhabits echoes our society's precarious tense on occupied traditional territories. The serene forest, Coyote's sanctum, has become a place of chaotic discord and unimaginable transition." [16].

beginning re-creation, was a multi-channel soundscape installation reminiscent of the former rock quarry of 1911. Presented by Miles Thorogood, whose work encompasses memory and imagination; the soundscape was generated using the *Audio Metaphor* system developed by Thorogood and Pasquier. "The composition module creates a layered two-channel soundscape composition by processing and combining classified audio segments. Each layer in the composition consists of processed background, foreground, and background with foreground sound recordings."[17] Thorogood placed eight small hand-made speakers into the landscape, challenging the participant to enter a dimly lit secluded path off the main walkway, surrounded by lush greenery on each side. As the participant explored this environment, they walked up several stairs to reach the top of a 20-foot lava rock mound. As they traversed this steep incline they experienced sounds of the derelict quarry, shifting back and forth with sounds from current place and time, that is, sounds recorded from the current botanical garden's acoustic ecology. To get closer to the final sound zone, the viewer had to step close to the edge of the 20-foot drop. The tension further augmented the participant's sense of memory, place and space as they heard clicking of metal tools and grinding of mechanized quarry work oscillate with the natural sounds of birds.

Vancouver based media artist Sarah Shamash presented her dual projection video installation *"D" for Diorama."* Shamash projected images of animals (tigers, gorillas, zebras, and rhinos) she photographed of the New York Natural Museum dioramas and alternated them with moving images of animals she videotaped at the Bronx Zoo. The installation was projected onto an 8-foot tall by 18-foot wide manicured Yew hedge. The alternation of uncanny dioramas with that of living animals that have been captured and removed from their natural settings – animals who in real life would never be found roaming the garden – invited the viewer to deliberate on the complex relationships among the animal kingdom, nature, and technology.

Interdisciplinary artist Jamie Griffiths employed a small-scale video pico projection accompanied by amplified audio for an isolated rock located off the main pathway, and found up a more secluded path with a slight incline. *BOTANICUS* discretely offered the visuals and sounds of people walking through Kew Gardens in London, UK (established in 1759 by British Royalty) and transplanted them into a public garden in Vancouver, BC. As the viewer climbed the small incline, the soundscape of Kews oscillated with the sounds of the present botanical garden. Through this alternating sense of presence of place, this meshing of locale, the conversations and species sounds intertwined to the point where sense of location was disrupted.

Conveyance[S] by Laura Lee Coles drew upon the geological history of the site known locally as "Little Mountain". Coles used the symbolism of fire to stimulate thoughts of the primordial beginning, *Conveyance[S]* invited viewers to reflect on the presence and absence of the former volcano by experiencing different forms and pat-

terns of flowing molten lava. Projected onto the rock face of hardened volcanic rock and framed by hanging tree branches, viewers glimpsed into the past made present, as if an eye or a ball of fire existed in the corner of the site looking back at them

Conclusion

In contrast to large-scale urban projection, the digital eco-art genre re-defines the role of technology and at the same time is reshaping public sphere *because it intervenes and exists* between experiences of electronic space/place and physical place/space *intimately*. As artists utilize the intimacy of the multi-sensorial realm of work *in situ* in natural spaces, meaningful implications may be observed for contemporary society as the work provides for shared social interaction and personalizes the sensorial connection with place and technology. The practice also changes the art experience from a contemplative one to a living experience by stimulating the human pre-disposition for affinity with natural space known as "biophilia", or "topophilia." [18] [19].

It is through lived and living experience that socio, cultural and ecological processes, the human connections to natural places, are both transformed and reinforced. There is great value in the re-visioning of public natural space through associations of cultural and environmental aesthetics, which reinforce connection and in turn may lead to enhanced aesthetic appreciation for the environment. [20] "The more hi-tech we become, the more nature we need." [21]

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Disruptive Strategies in the Post-Digital City

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Abstract

The development of the sociotechnical apparatus shaping our Post-Digital space and culture ran simultaneously with the conception of a relational and processual reality and the development of computation and networks, which are becoming ubiquitous. These technologies have embedded in our physical space, giving birth to a fuzzy system that struggles between the opportunities for collective engagement, offered by the networked communication, and the capacity of control of a pervasive and opaque system. Art has been experimenting with these new technologies from its inception thus assuming the aesthetical and political commitment to develop strategies capable of disrupting the codes of domination and promoting a collective and constructive appropriation of space. These strategies refer to practices of embodiment and encounter, capable of promoting new assemblages towards the accomplishment of the Right to the City, the new citizenship proposed in the theories by Lefebvre and the actions of the Situationists.

Keywords

Post-Digital Space, Right to the City, Hardware Criticism, Appropriation.

Introduction

The city is the place of togetherness. It is the space of sociability and politics, as well as the ecological environment of our affordances and a collectively constructed form. This space is practiced and conceived according to an apparatus that codifies it the set of relations, discourses, institutions, laws, police measures and philosophical propositions supported by certain forms of knowledge and supporting the relations of power a space dominated and segregated in static functional parts. 1 However, at the same time it is the lived space, appropriated by its inhabitants and the rhythms of their moving bodies. 2 The body is not a substance but a producer of differences, that becomes understandable only when is considered conjointly with its medium. It became engaged with the reality around, interchanging information, starting new rhythms that produce resonances able to create new assemblages. Deleuze identifies this poetic activity with the ecological capacity of art. 3 The capacity to render the space expressive and give birth to the territory or inhabited space, where the process of subjectivation is possible. There is not subjectivation without the production of an appropriated space. It is a continual revolutionary activity, deterritorializing the codified towards the production of new assemblages.

The ongoing of capitalism and gentrification leads to a homogenization and fragmentation of space. The places of experience and identity vanish and the Dissolving City only endures as a museum or spectacle. 4 Later on, Castells attributes this dissolution of places to the rising of the space of fluxes. 5 The space of power, that organizes production in a global space thanks to the use of networked media. Territorialization and subjectivation become impossible in the fluid space and a new way of delocalized and diffused control appears. The Control Society, where individuals are always objects of information but never subjects of communication. 6 However, in his recent study about networked social movements Castells points to the possibility of appropriating the networks. 7 The net could become a place for encounter, a public sphere, where new social movements can begin. These movements are able to reach the street and produce social and spatial changes.

Lefebvre identifies the appropriation of the space with the “jouissance”, a way of enjoyment not related to non-work more than to productivism, to excess rather than to accumulation, to gift rather than to exchange. 8 In terms of space, it relates to the use as usufruct, the right to benefit from, use and enjoy something that is held in common ownership, as long as it is not damaged or destroyed common space that Agamben proposes as a result of the profanation, it being a way to challenge the apparatus that produces the dominated space, a form of use freed of goals, able to liberate the mediums, to return the spaces confiscated by power, and open it to the creative energies of the collective. 9 Both concepts refer to practices of embodiment and encounter, producers of disruptive situations where a liberated body moves and acts across the common space and oversteps the borders that fragments it in functional divisions. The appropriation is a poetic practice that renders the space intensive, where molecular bodies capture the noise and indeterminacy to start new interactions, the activation of non-actualized intensities capable of resonating towards the creation of new assemblages and territories.

The commitment to the aesthetic and political appropriation of the virtual and physical space has led to the development of strategies that materializes, firstly, as building blueprints then, as spatialized metaphors on the net, and finally, as embodied practices in the Post-Digital space. These are

raised from different fields that share a critical and productive attitude, increasing the capacities of the collective to interact and actualize the intensive matter and which applied to the common space are able to activate its collective production, the Right to the City.

The Architecture of "jouissance" or the mechanization of leisure: New Babylon vs Fun Palace

The playful appropriation of the space proposed by Lefebvre was practiced by the Situationists giving birth to practices such as the *dérive* (drifting), and the construction of situations. These are poetic actions involving the construction of environments that must be both the products and the instruments of new forms of behavior directed to revolutionize everyday life. New Babylon (1959-74) by Constant Nieuwenhuys was the project aiming to be the architectural space of these practices. 10 Conceived as a social space with movable articulations it was the playground of Homo Ludens, the new citizen with energy for becoming involved in the creative construction of a new environment and way of life after being liberated from work. It was an intensive space where physical dimensions were shaped by the actions of its inhabitants, made intensive by the use of technology as a tool for realizing experimental collectivism, by means of the promotion of communication. This labyrinthine city was never constructed Babylon must be the work of New Babylonians, for their creators it was only a model of reflection and play, an instrument to develop a new conception of social space.

In 1964, the architect Cedric Price, commissioned by Joan Littlewood and advised by a cybernetic committee directed by Gordon Pask, started another unrealized project. Fun Palace had to be a transformable building that emerged as a conversational process of the interactions among its occupants. 11 This building-sized transformable machine abandons the Situationist revolutionary goal of transforming life to become a space for leisure and the education of the masses. The authors of this building-toy responded to a different concept of human nature. The Homo Ludens is considered as a subject of learning and control, leisure is no more a chance for the freedom of creativity but an opportunity to educate the new specialized workers of the industrial era. Contrasting with the participatory architecture, the space collectively created by the inhabitants of New Babylon, Fun Palace is a responsive architecture, where technology is not an intensification of space, but a cybernetic machine that tracks and calculates the spontaneous movements and behaviors of its occupants an interactive construct that responds to the actions of the people within it while at the same time shaping them and their behavior. The architect becomes the engineer of social space, and their creation a concrete machine for techno-social construction.

International City Stand: Dematerialized metaphor on the Net

In 1990, Internet became accessible to humans through the interface, a virtual environment that spatializes information following familiar metaphors. This new medium for networked communication was soon considered as a new public sphere the anonymous, open, Agora, not hierarchized and freely accessible for the making of a new democracy. Amsterdam City was one of the first experiments for the collective appropriation of this new medium. It appeared as a free services provider in 1993, and was shaped as a city.

The Digital City was an interface built around the notion of square. In it, the city was used as a metaphor to show the culture-in-the-making resulting from the interaction between complex community spaces and the conceptual diversity and assembly that we can find in an open medium for general-purpose. 12 The Digital City closed in 2003. Nowadays social networks have substituted these services.

Social Networks are platforms for sharing and self-promoting driven by software, a social space where the architecture of participation encounters with algorithmic control. In it, our behavior leaves traces, data, retrieved and processed by the algorithms of artificial intelligence. The self-aware collective creation of space that characterized new Babylon shifts to the control driven by the non-transparent processes of a modular system that shapes our relations, a space where our choices are computed to capture our desire.

Software is not a neutral tool it shapes our relations and processes of involvement and determines ways of seeing and knowing. Software becomes a producer of culture and space. Matthew Fuller analyses how software criticism can foster disruptive interventions in the modular and in continuous variation control systems that are shaping our society, strategies that arise looking behind the software events. These are interpretive and reductive operations carried out according to the implicit politics of the dominant apparatus and with aesthetic capacities towards forms of control and production. Software criticism analyzes the indeterminacy of these events to propose new couplings towards unexpected results. 13

Fuller points to three strategies observed in different projects. Critical Software, consisting of the creation of pieces of software designed to open the black box of computerized processes, making explicit the protocols, statements dynamics and sequences of normalized software. Social Software, software produced, changed and developed as a result of an ongoing sociability between users and programmers. Free-software creates its own culture. Finally, Speculative Software, which takes advantage of the abstraction of hardware resources led by the process of virtualization to explore the potentiality of all possibilities, introducing creation and the possibility of change. It explores the capacity of software to foster transversal forms of connection, encounter the noise, and make the ordering of data categories or subjects spam out of control, leading to the possibility of a mutant epistemology and creative intervention.

The Post-Digital Space

Nowadays, computation is becoming ubiquitous. It is embedding the algorithmic processes of software into physical reality and reaching all the fields of our daily lives. The information becomes pervasive and the networked devices of the internet of things become new mediators of our relations with our world, which reduces everything to data, everything becomes normalized, stored, processed and retrieved towards a traceable and responsive space.

Post-Digital research is involved in the study of the development of this new responsive space. It is a reflexive criticism addressed to understanding the epistemology and ontology that this situation is producing towards a productive engagement with the new non-human agents that are populating our environment. Considering urbanism, it concerns the construction of the programmable space, not as unrooted, homogenized and fragmented no-where, jeopardized by the fuzzy relational systems of an imperceptible apparatus, but as a transactional environment populated by human and non-human agents, a space rooted in the specifics of the local and able to embrace difference a space populated by open systems that foster participation, empowering citizens, that can be appropriated for new uses and where everybody can be engaged in its social production.

Disruptive Strategies in the Post-Digital City

Post-Digital strategies challenge the Apparatus that produces and maintains our contemporary space. These strategies start in a reflexive analysis encompassing not only the devices and their functioning but also the processes, social relations and politics in which they are merged. With this aim, their practitioners refuse general standardized solutions to focus on situated issues arising from local communities. They do not accept information as a fact to be consumed passively and appropriate the spaces of knowledge and production for the common space. These strategies arise from research as production and are aimed at producing things that embody information and its processes, objects capable of invading the public space producing unexpected results and transforming the programmable space in writable information, where it becomes an interpretative experience open for creative intervention.

These strategies will be presented in three differentiated groups. The first are strategies making information tangible, directed at challenging the models implied on the production of cartographies of our space. The second considers the strategies that embody new social relations fostering new ways of social gathering and participation inherited from the traditions of FLOSS and DI . The third includes strategies directed at the intensification of space and the speculative production, introducing new non-human agents on the space able of promoting new intensities and affects towards the production of new assemblages exploring new possibilities.

Embodied interfaces

All our actions in the urban space are tracked producing data that are gathered and mined without our knowledge. The processing of all this data has led to a new form of cartography showed in well-known projects such as the Senseable City Lab's Real-Time Rome, Preemptive Media's Air, or Stamets' Crimespotting. Real-time visualizations that are aggregated in complex models, interactive dashboards as the IBM's City Forward. These models are used to redesign our environment towards an increasing efficiency and sustainability. However, they operate at an abstract level, disembodied from the reality that produces this data they normalize people, reduce differences, discriminate parts of the reality, and support concrete institutional frameworks and kinds of knowledge. Opposing these models we can find projects that produce new ways of interfacing information, making it tangible towards an increasing of our awareness and literacy of the communication process we are immersed in.

The projects produced by Julian Oliver consist of new objects produced to disrupt the automated systems and communication infrastructures producing our environment, thus resulting in the extension of our knowledge and capacity of intervention in these systems. In this way, the Transparency Grenade (2012-14) detonates leaking the information around. It captures all the traffic at the site and securely and anonymously streams it to a dedicated server where it is mined for information. Border Bumping (2012) is a work of dislocative media, an app that situates cellular telecommunication infrastructures and redraws national borders according to the disparities between virtual and political territories. 14

Embodiment of new social processes

Following the tradition of Free and Open Source Software, we find collective projects that engage people in the remixing, production and sharing of things. The open hardware connects with social processes such as the Do it oursSelf and Do it with Others, fostering new ways of sociability and reuniting people around the experimentation with the engineered objects interfacing our reality. These new local communities emerge in places such as Hacker spaces and City Labs confronting situational issues and the collective management of them. Projects such as Pachube are digitally-enabled places for the encounter of these communities. These are platforms allowing people to collect their own data that are shared in an open public network, free to interpret and reuse. 15 Other related projects extend towards the production of their own devices for data sourcing. This is the case of the Sense your City or the Data Citizen Driven City. 16 17 When people produce their own sensing devices in a shared and open way, they promote the awareness of how things work and how to engage in the production of the ecologies where they interact. They boost new epistemologies engaged in the appropriation of the spaces of knowledge and production towards a collective production and engagement in our environment.

Intensive space and speculative production

Finally, we find projects that use technologies to make the space intensive, by means of exploring the capacity of virtualization to create encounters between different realities.

Speculative production consists of the exploration of all the possibilities of space. It produces new things with new powers of assembly, where the noise produced by the playful actions of people is transformed into signals interacting in an open communication system towards the emergence of unexpected assemblages a poetics of connectivity that occupies the space with ephemeral or more stable unexpected structures. As an example, the DI City 0.01a (2012) is a prototype for a future mass-participation performance. In the project, the very streets themselves, and the buildings that look upon them, become the canvas for an urban-scale three-dimensional projection, a graphical environmental wiki that gathers the desires and expectations of a collective towards the production of urban space. 18

Conclusion

In our Post-Digital situation, the apparatus mediating our relations and producing our space have become a pervasive system where the mechanized processes of computation are reaching all the fields of our existence. They are determining forms of knowledge and production towards a functionalized reality in which we are immersed without being real users. For an effective territorialization of this reality that allows the process of subjectivation, an appropriation of these technologies is needed that allows information to become experienced in a public space. The examples studied here, are proposals that engage people in the participative production of the things mediating our reality. This playful appropriation increases our knowledge and awareness of the process producing our lived space, allowing our intervention and productive engagement. It boosts the profanation that challenges the dominated space of control producing a space open for productive disruptions towards an increment of our affordances. These practices are fostering new ways of collective engagement in the production of space, proposals that germinate new productive forms to the accomplishment of the Right to the City.

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O'megaville: Excursions in Planetary Urbanism

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Abstract

Four decades ago Henri Lefebvre anticipated the complete urbanization of the planet, which no longer sounds so strange. Radical shifts seem to appear in our experience of the city, through dislocations of self and body, the World and the Earth. This paper explores a range of concerns underpinning a media performance project – *O'megaVille* – using Google Street View as a platform for critical approaches to planetary urbanism. This has involved dance workshops in Mexico, mobile media actions and video installation in Montreal and New York, and a performance-lecture in Toronto, amongst other events.

In this paper I'll use Google Street View (GSV) to think about how media assemblages play an enactive role in the speculative nature of experience. How may GSV be seen to illustrate what I see as an emerging urban condition that is simultaneously planetary and embodied? What may be at stake here for bodies (broadly defined) that operate within a distributed field of forces – in part nonhuman, often inhuman? And how may these disruptions in the fabric of experience call for a speculative response? Linked to a separate Artist Poster session at ISEA, this paper offers a series of conceptual and theoretical sketches for surveying the ruptured cohesion of Google Street View.

Keywords

Planetary Urbanism, Google Street View, Infrathin, Mondialisation, Cine-philosophy, User navigation, Faciality, Algorithmic intelligence, Image flatness

Introduction

It's not my intention to give an Artist talk here, for this occurs elsewhere, but rather to explore the broader conceptual implications of the project, so these might shift across conference formats in ways that invite disruption. It's also not my intention to comment on the work of other Artists who use Google Street View. Many of these reframe documentary photography in new ways – notably the work of Doug Rickard, Jon Rafman, Michael Wolf, and Mishka Henner. Others offer performative reconstructions of GSV, such as Ben Kinsley and Robin Hewletts' *Street With a View*, or Paolo Cirio's *Street Ghosts*. I'm interested in a more speculative approach for this paper, sketching a broad set of concerns that may find critical and poetic refraction in looking through the lens of Google Street View as a planetary image machine.

I'll focus on several features within GSV user navigation: first, finding three anomalies, or what I call a Stretch of the Imagination. These will be seen to offer a speculative reading for the future of planetary urbanism, drawing on Marcel Duchamp's concept of the infrathin, Jean Luc Nancy's approach to mondialisation, and Gilles Deleuze's cinephilosophy. Here I hope to locate a grey area for entering the Earth through a geological turn of the image. I'll go on to find what I call three Sites of Dis/Appearance, where Street View feels like the naked stumbling of early cinema, towards something new – taking us through cracks of continuity and smudgings of the subject, to become orbital in orientation. I'll conclude with a speculative proposition for excursions in planetary urbanism, with reference to my Poster session at ISEA where I offer a disruption for entering *O'megaVille*.

A Stretch of the Imagination

Extensive Surface: Google Street View gives us an image of the world as an extensive surface that seems to stretch and tear as we move across it, with each click smudging us further along our way. It's as if the stretch continues to the ends of the earth, or at least a kind of planetary continuation given by the image database. Even though incomplete in reach, it gives us the schema of a terrestrial flattening into the beyond – a stretch of the imagination.

If as Spinoza suggests, the imagination concerns affections of the body implicated with external bodies, present to us as images of things, [1] the question may become, how do digital geographies of this kind effect the way we situate ourselves in the world?

Geo-Presence: there is a sense of 'being there' enacted by Street View user-navigation, through the flattening and repetition of territory in the continuation of surfaces. A new Flat Earth phenomenon appears – especially when we use Street View to arrive somewhere physically, as if falling off the edge through a strange schism.

Historical Displacement: the feeling of geo-presence is nonetheless not quite Now, only until the last update on the image database. In some places we find local anomalies like this village in Sendai, Japan (Figure 1) – not updated since July 2011, soon after the Tohoku Tsunami. A few hundred meters away – on all sides – the reconstruction of

the region is virtually complete in a 2013 update.

Figure 1. Google Street View: Sendai, Japan. © Google

It's an historical displacement that feels somehow continuous with the movement of the world via the flat earth effect of GSV. (Or where the History View function also allows users to move back in time). These disruptions are especially uncanny here in Sendai as an echo of the devastation that was felt at the time – with the sweeping helicopter shots on News media and the invisible catastrophe that followed with Fukushima; to be felt everywhere as something planetary and embodied at an inexplicable rupture of scale.

An Infinite Now: for the purposes of user navigation its as if captured time becomes an enacted moment that repeats itself endlessly, giving us a fractured duration held somewhere between the image database and the act of arriving. A real place and a singular moment, but always there, pregiven and extensive, both untimely and enactive.

Planetary Urbanism

This inexplicable folding of a planetary surface opens in real terms to the kind of space-time disruptions we may see occurring in the experiential fabric of the City. In the 1960's Henri Lefebvre foretold the total urbanization of the planet. [2] But was this ever going to proceed as an even wave? Contemporary permutations of planetary urbanism are characterized by an uneven totality – a full datum of singular events within a complex whole, one in which the social tissue of experience is mutually affected by the built fabric and its surface distributions.

Black Hole Cities: Lets take Moscow for example. Moscow journalist, Ellen Barry, explores the involution of rural areas towards the urban metropolis. She says:

> "…the death of a village is a slow process. A geographer, Tatiana Nefyodova, calls them "black holes," and estimates that they make up 70 to 80 percent of Russia's northwest, where Moscow and St. Petersburg act as giant vacuum cleaners, sucking people and capital from the rest of the country" [3]

Or is it Moscow that's the black hole – a dynamic collapsing mass that pulls everything into its event horizon? And then at its core we pass into a parallel universe shared by Global cities the world over, where territorial abstractions acquire the floating density of integrated capitalism. It's as if we were to suddenly pop out the other side to find ourselves in New York, Tokyo or London, more so than any native country.

Topological Density: There are limits to the metaphor. But perhaps we can say that all are drawn along a strange horizon where uneven urban densities are distributed across the surface of the earth, subjecting all entities at whatever scale or category of existence to disruptions of an experiential fabric as much as a built one. An uneven topological field unfolding in and upon itself, through the systemic self-regulation of cities and their effects on all entities invested in the urban milieu.

We can see it in the trans-local evolution of global cities, transnational corporations and consumer products; we see it in the folding of reverse migration, or the donut effects of gentrification and economic polarization. We can almost feel it as a change in atmosphere as we move through the city. What I'm proposing here is that these contemporary permutations of planetary urbanism articulate an affective area beyond or further to normal space-time parameters, at a level that is simultaneously worldwide and embodied.

Entering the Infrathin

So how can we imagine such an area? Marcel Duchamp offers a useful conceptual figure for thinking about such a space – the infrathin. Not an actual space *per se*, but more of an abstract relation wedged in the concreteness of things. Donald Kunze defines the infrathin as "any delay between a conventional meaning and a further-on meaning." [4] Duchamp refused its definition, preferring to give examples: "The thickness of a shadow, the difference between two objects cast in the same mold..." [5] In Landscape Design Mary Kate O'Brien sees it in "...the thinness that separates artifact and site, the frame from the view, surface from depth, the distance between one moment and the next." [6]

These are all very instructive for GSV. The infrathin is that moment of the stretch, delimited by an extensive planetary surface; between navigation and being there; or of something having been there, now here. It's the strange fringe horizon of historical displacement, geopresence, and an infinite now; shifting points of disruption subtended by the full datum.

A World Without Another: If the infrathin helps to locate an image for this abstract relation, what is at stake here for planetary bodies, including our own, and how do we proceed? With globalization the World seems to have reached a territorial limit, to fold back through many black hole

scenarios, expanding and contracting, inventing new spaces for occupation. How do we renew our belief in the World when it brings us to a point of exhaustion?

As Jean Luc Nancy suggests, the World reaches an external limit as a transcendent ideal following historical vectors – Church, State, God, Empire, even Capital. [7] To find a 'world without another' we become earthbound, mondial or worldwide – in the sense of relating to or involving the whole World at once. We have already fallen off the edge of that other World - to find that this edge is in fact a crack taking us into a different flatness; a continuous surface where differential limits fold and spike across ruptures of scale.

A Different Flatness

There are always infrathin areas that escape capture, when we take time to pause, veer off and zoom into the fabric, to find an enactive depth within an event.

Figure 2. Google Street View: Moscow, Russia. © Google

There's something quite cinematic about Street View, when we reselect what has been randomly captured. Returning to Moscow, here's a young man walking down the street (Figure 2). Zooming in we find a different navigation and a different flatness – off track, at the limit of the image. Here depth-of-field is so shallow that everything seems to sit on the same plane – intersecting lines, dissolving colors, bleeding contours and textural artifacts – all coexisting on the surface with a painterly flatness. Then there's the way this young man raises his foot or holds his head with a pensive quality at the point of capture. It all indicates a life in motion – held for a moment – not just his life, or even a human one, but a life of intersection; an event ecology. The still image becomes cinematic in the way it singularizes a world, delimiting an expanded field of relations.

Cinematic Singularities: In his Cinema books Gilles Deleuze finds something unbearable in the World – in the limit of thought and the weight of time, where microintervals of experience shift within a given milieu. [8] In Cinema he also finds reasons for believing in the World once more, in its singular construction of 'a' world. Two useful concepts here are 'camera consciousness' and a 'filmic subject'. The way the camera moves around a scene gives us a nonhuman or more-than-human perception, letting us see and feel things beyond selective consciousness and subjective perception. The kind of subject this enables is not just one of human agency, but the film itself as a broader process of individuation.

Cinema constructs a singular world without another, while making possible modes of perception that may take on the World all at once. Movement and time enter disruptive delays and relays, through circuits of perception, affection and relation, giving the image an enactive plasticity in the event. We see this for example in the suture of cinematic montage, with the fullness or fracture that results when Film directors manipulate gaps and elisions, to elicit affective shifts in the spectator.

Google Street View has its own scopic specificity, but cinematic parallels become useful for the way these contemporary permutations of planetary urbanism may generate disruptive and productive contrasts with singular aesthetic worlds. As we've seen, strange hybrids of movement and time appear in the Street View image – geo-presence, historical displacement, the infinite now – mediated as a full datum. (Or at least, via the scopic assemblage of user navigation, image database, algorithmic intelligence, and satellite array).

Sites of Dis/Appearance

Moving towards a kind of Conclusion, I'd like to revisit a Stretch of the Imagination by locating what I call Sites of Dis/Appearance; where people seem to fall into the Earth – through the image – at the limit of the World.

Differential Flatness: The first of these is our young guy in Moscow, where a world appears just as the subject disappears into it – a different flatness becoming differential at its limit.

Scene: In terms of montage, there are about 4 or 5 image captures taken by the 9-Eyed camera of the Google car before it moves on. If we follow our guy we get a sense of moving around a scene, like a series of jump cuts, with all the gaps in continuity dropping us into a wider plenitude: the machinic vision of a planetary assemblage.

Stitch & Fray: As we move around the scene, the stretch from point to point reveals the way it's all stitched together. People seem to disappear when we try to follow the thread of the montage, especially at traffic intersections. This is because the Google car follows an economy of movement, cutting the city grid in lines – this way and that. On the database the temporal disjunction is stitched together to give the illusion of spatial continuity. At intersections you will often pass through these temporal dislocations, where people seem to appear and disappear as if through a crack.

Blur: Yet another flatness, and this time where the subject really disappears – into the scopic assemblage and out to a different milieu. Our man in Moscow has his face blurred to satisfy privacy concerns, as does everyone in the Street View world. It's a neat paradox – privacy is protected just as the public is privatized. Google owns the image, as if removing us from public space in a twofold pincer move. Or perhaps this is just another fold in the surface of planetary urbanism. Our faces are erased rather than identified – but the effect is the same, through face recognition software. In a reciprocal overcoding of power and overdetermination of desire we allow ourselves to be profiled, simultaneously fixing and mobilizing the subject within the computational agency of self-as-world.

Smudge: White Wall / Black Hole

For Deleuze and Guattari the notion of faciality operates as a grid of power - the White Wall of the face and its Black Hole orifices become a machinic configuration of signifiance and subjectification. [9] Street View blurs the two in a single smudge, making something inhuman of the face, and beyond it something strangely nonhuman.

An algorithmic intelligence saturates the scene, extending the smudge of signifiance and subjectification across each and every locale – including linguistic identifiers such as street signs and number plates. Anexact in measure, it accidently overreaches its protocol to find faciality traits in the pattern of leaves on a tree, or an arrangement of trash. It de/faces each location to excess, just to be sure, so all sorts of things get caught up in the strange horizon of the White Wall / Black Hole system.

Gridlock: Face recognition software calculates variations on a grid – mouth-line and eye-line across the bridge of the nose. Its not much of a stretch to see how the Grid as a primary urban condition allows an extensive surface for the White Wall, with all its ruptures of scale through the Black Holes of planetary urbanism; more-or-less human / more-AND-less human.

But lets not fall into an easy dystopian critique. Deleuze and Guattari saw the potential for defacializing the face with the notion of Probe Heads – the invention of new Black Hole / White Wall configurations; faciality machines that multiply and transform traits, becoming abstract to excess – something animal, botanical, architectural perhaps.

Conclusion: A Proposition

For *O'megaVille* I'm interested in tracing a migration of faciality traits within a given location, plunging through the face to find other smudgings across the scene. Here I aim to take this paper through a speculative segue as a practice-based research project. I'm also presenting an ISEA Poster session using a Google Cardboard VR headpiece for building Probe Heads out of things found on the street. I'm curious as to how Cardboard VR recalls early 3D Cinema glasses taken into the mobile-media space, where the flatness of Street View may acquire an orbital dimension for the cinematic futurity of planetary urbanism.

I want to hang this out there as a teaser, offering it as a proposition rather than a conclusion. Where this paper cross-links may be an opportunity for disruption, and for further excursions into planetary urbanism. I invite you to join these forays, from the flatness of this paper to embodied dislocations in the orientation of theory and practice.

For more information, see: michaelhornblow.com/omegaville

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[Session 7]

Communities: Public Art

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3x4: Exploring metaspace platforms for inclusive future cities

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Abstract

In megacities such as Delhi and Mumbai - and within one of the fastest growing cities within the world, Ahmedabad - more than 50% of the population live in informal urban settlements. 3x4 metres is the plot size seen to be provided in some resettlement colonies, a government initiative which relocates people within informal inner-city settlements to vacant land on the periphery. In a collaboration between Professor Paul Sermon at the University of Brighton, Dr Claire McAndrew at The Bartlett, UCL, Swati Janu a Delhi-based Architect and photographer Vivek Muthuramalingam from Bangalore, 3x4 looks at informal settlements differently where informality is not viewed as a problem, but a promising new model of urbanism for the global south. 3x4 uses an immersive telematic networked environment to provide a playful, sensorial exploration of new hybrids of digital space. Merging two 3x4 metre room installations in Delhi and London through mixed-reality, this transnational dialogue intends to set an aspiration for developing metaspace platforms in megacities of the global south. It builds upon practice-based research conducted as UnBox LABS 2014 Fellows in Ahmedabad, India; which used an immersive installation to explore the qualities and values built through self-organised communities that are lost in the resettlement process.

Keywords

Informality, metaspace, telematic, resettlement, communities, videoconference, urbanism, population, India, cities.

Introduction to UnBox LABS

3x4 is an AHRC funded research project that seeks to identify a future cities *metaspace*, with a view to connecting communities and contributing to dialogue on informality in the global south; 'informality' in the context of this project refers to anything that does not fall within the purview and planning of the civic authorities. It is the component of the city that is not formal i.e. organized and planned, and consequently considered illegal. The project offers an alternative way of seeing informal settlements that prefaces their ingenuity in the face of adversity, over their illegitimate status. Such a perspective becomes necessary as informality gives rise to a new type of urbanism, one that is fuelling the growth of megacities in the global south and redefining temporal narratives of progress.

With an interdisciplinary team of researchers and creative practitioners, 3x4 seeks to embrace the informality of the global south and re-imagine new hybrid platforms. Through creative practice we have used the 3x4 metre resettlement plot size as an interface to identify an alternative *metaspace* platform. This initial 3x4 project concept was arrived at through our collaborative participation at the UnBox LABS Future Cities workshop at the National Institute of Design in Ahmedabad, March 2014. [1] Our interdisciplinary range of subject specialisms and practices were first brought together and explored in a scoping project that culminated in the development of a prototype video installation, consisting of a 3x4 metre muslin-covered bamboo structure (see fig. 1) exhibited at UnBox LABS. [2] This installation incorporated video projections of images and quotes sourced directly from informal settlements and their inhabitants, focusing on the role of networked technologies within these communities. The combination of the 3x4 plot size and verbatim comments clarified an opportune sense of informality and signalled the need to further explore new systems of communication within future cities of the global south.

Figure 1. Bamboo structure for 3x4 scoping project installation at UnBox LABS 2014. ©Sermon, P., McAndrew, C., Janu, S.

3x4 Research Context

We now stand at the fulcrum of urbanisation with 55% of India's population expected to be living in cities by 2050. [3] Millions in the global south are leaving their rural homes in a mass movement toward the cities as they hope for a better life. [4] As cities swell under this surge of migration, informal settlements are proliferating to accommodate for the large numbers that are unable to find affordable housing. Viewing them as eyesores without

understanding the predicament of the inhabitants, the civic authorities have been seen to raze such settlements, sometimes leaving thousands homeless overnight. [5]

In a drive for 'beautification' of the city, those that are evicted are forced to resettlement colonies at the periphery of the city, with little or no infrastructure and in plots of land as small as 3x4 metres. Fast-tracking the creation of 'slum-free' cities and without addressing the larger issues at hand, the authorities in Delhi have started relocating people into high-rise buildings within the city. [6] The failure of such experiments in the West are many, from the Pruitt Igoe housing in St. Louis to the Aylesbury Estate in London. Without learning from the mistakes of the global north, Indian cities, like many other cities in the global south, aspire to be 'world class' cities such as New York or Dubai, overriding the requirements of a majority of their populations.

What is lost in this process is the strong sense of community and qualities that make informal settlements a productive and integral part of the city. These settlements need not be viewed as eyesores or problems within a city, but as self-made solutions by communities. It is arguably the DIY nature of such settlements that have helped communities survive in the face of government apathy. This iterative quality of informal urban settlements is necessary for empowering people to make their rightful claim to the city and bring about development. It seems the global north has much to gain from dialogue with its southern counterparts, with the conceptual development of 3x4 metre solutions as a sustainable and affordable solution to UK housing. [7] 3x4 provides a new way of viewing informality and our relationship to megacities as we envision the Future City.

Figure 2. Chroma-keying process used in 3x4 installation to composite images from Delhi and London together with computer generated background. ©Sermon, P., McAndrew, C., Janu, S.

3x4 Research Project

This next iteration of 3x4 contributed to the UnBox Festival in Delhi, 12 to 14 December 2014. [8] Using a live telematic videoconference connection, the installation functioned between two geographically distant audiences located in separate 3x4 metre blue-box room installations at Khoj International Artists Association in Delhi and Southbank Centre, London. The audience groups in these two blue-box spaces were captured on camera and brought together through a system of live chroma-keying (see fig. 2) and were placed onto a computer-generated background image. The complete composited image was then displayed simultaneously on large LCD video screens in both locations. As the merged audiences started to explore this shared telepresent space they encountered the digital background environment they now both coexisted within. These background scenes were co-created by online participants in London, Delhi and across the globe via a 3x4 project web portal and shared Google drive. [9] By uploading an image or downloading other people's contributions and using elements of them in their own, they created the environments displayed within these rooms, whatever they imagine that to be, directly referencing their combined social setting, ranging from informal settlement dwellings and Delhi environments to contemporary compact interior designs, micro living solutions and virtual worlds; asking what does a co-created 3x4 metre London/Delhi living space look like? In addition to occupying digital 3D models and photographed living spaces audiences were provided with chroma-key blue fabric and invited to bring objects and props into the 3x4 room to further explore their telepresent coexistence in this new *metaspace* platform.

The 3x4 installation in Delhi was located in Khirkee urban village at Khoj International Artists Association and opened directly onto a busy street (see fig. 3) within reach of a broad audience demographic, providing equal access to all local community participants, ranging from the inhabitants of informal settlements and urban villages to residential home owners and commercial businesses. The connected 3x4 installation at Southbank Centre London was equally situated in a public space, located in Festival Village at street level it also encountered a broad cross-section of public that inhabit and pass through the space daily. Spanning five time zones, the installation was connected six hours a day from 10.00am to 4.00pm in London and 3.30pm to 9.30pm in Delhi, combining two cities not just spatially but temporally, from the start of one person's day to the end of another's. The opportunity for the audience participants in Delhi to decorate and customise the interior of their 3x4 space played a pivotal role within the installation. Items of furniture, domestic objects and a means of self-construction were introduced and made available to explore how subjective design interventions influence the user experience and their creation of multidimensional spaces.

The networked convergence of these two physical 3x4 metre structures and their urban locations allowed these diverse public audiences the opportunity to explore networked spaces as new mixed-reality hybrid environments. It made it possible to experience, not only the presence of geographically distant participants, but also

a sense of coexistence with them. Using the embodied platform of open interaction as an alternative networked communications protocol, enabled them to define the context and narrative of what followed. Both audiences responded enthusiastically through their interactions with the installation, particularly in Delhi, with over 500 participants and return visits over three days the intervention made a significant and memorable impact on the community.

Figure 3. 3x4 at Khoj Studios, Khirkee village, Delhi. Dec 2014. ©Sermon, P., McAndrew, C., Janu, S., Muthuramalingam, V.

Through the design of 3x4, its methods of connection and representation, the layering of London over New Delhi provided comment on the domination of the global north and rising of the global south. And yet, the co-creation of built and imagined landscapes offered opportunity to redefine collective futures, a critical visual commentary on living spaces, racial segregation, informality, underground culture and contemplative fantasies. Occupying a part-demolished building via 3x4, took the matters of informalising architecture, contested space and merciless destruction to a global audience (see fig. 4). Not just imaginings, 3x4 also morphed into a playground of spontaneous and undirected play. Children, for whom the street and the objects it contain form a recreational landscape, shifted their space of play to this metaspace. Using their bodies as an interface, they even shared a digital chair – emblematic perhaps, of this approaching inversion and shared digital future. 'Playing the city' it seems, can bring built and imagined spaces closer together, creating new typologies of architectural space that shape lived experience in novel ways.

Play is in the eye of the beholder

3x4 is a temporal and spatial timecode; reduced to its ephemeral elements it consists of 18 hours of memories and reflections in the minds and collective recollections of those who participated in it, played out over three days on 12, 13 and 14 December 2014 from 10:00-16:00 GMT / 15:30-21:30 IST daily. Ultimately what remains as its legacy is a story told in and between two cities consisting of human encounters and events that unfolded in a state of flux between London and Delhi. Whilst every effort was made to document this transitory happening through photographs and video footage the single most important recording was from the line out video feed (see fig. 4); the final composited or chroma-keyed image of the audience participants displayed within the installation itself. When watching this recording we are taking up the position of the persons within it; we are looking directly at the very same image that caused the effect we are now contemplating for ourselves.

From beginning to end, the entire recording represents a 1080-minute data stream upon which we can now study and apply our own minute-by-minute layer of metadata based on observations, reflections and analysis, as we look the participant in the eye through this 'two-way mirror' recording. This video contains memorable moments upon which we can now reflect, such as when a young boy in Delhi enters the space and initially waves to participants in London, staying for over an hour perfecting his interactions and gestures as he invents and plays new games. Or when three ladies in Delhi enter with two babies greeted by participants in London eager to hold and play with them, who appear to be memorized by this lacanian moment of realization as the babies stare into the screen (mirror) [10].


Figure 4. Video still from line out recording of interaction in 3x4 installation. Dec 2014. ©Sermon, P., McAndrew, C., Janu, S.

Impact and Legacy

This public legacy represents a pathway to future cultural, social and economic impact that goes beyond its academic context, and has the opportunity to help shape the future cities of the global south. This legacy pathway draws on an analogy with other examples of significant research impact that have helped create the networked communities and technology industries of the United States west coast. This impact has resulted from the legacy of pioneering interactive media artworks and public interventions from the 1970s and 80s. Including seminal artworks such as *Hole-in-Space* by Kit Galloway and Sherrie Rabinowitz from 1980 [11] that linked live public

audiences in Los Angeles and New York, the *WELL* (Whole Earth 'Lectronic Link, 1985) network which was one of the earliest independent virtual communities based in San Francisco, [12] and pioneering projects such as *Send/Receive* by Liza Bear and Sharon Grace in 1977 involving public participation in some of the first interactive satellite art events. [13] These are among many examples of networked interventions and happenings that are often cited as the beginnings of the Internet and set a stage for the continued influence of the United States west coast today. In the same way, the 3x4 installation in Delhi and London aims to capture the collective imagination of its public audience to create its own legacy and similar level of impact albeit in relation to the inclusive needs of future cities in the global south.

In the context of informal settlements in megacities of the global south, the 3x4 installation provided many public participants with their first encounter of a networked platform. Through this unique engagement public audiences acquire new knowledge through their lived experiences that present a possible vision of a future city *metaspace*. These first time encounters and experiences can be used by the participants to influence future projects, define methods for using this new knowledge to inform themselves, who in turn tell their family, friends and colleagues of this new experience, motivating others to engage in similar experiences in future projects. The intention of this legacy is to inform a critical public community that impact on future network protocols appropriate to the needs and requirements of a future cities *metaspace*. At the same time it seeks to identify its relevance in the global north. The dialogue between Delhi and London is a critical pathway in connecting communities and contributing to dialogue on informality in the global south and its symbiotic relation to future cities in the global north.

The success of the 3x4 has led to the Southbank Centre London inviting the installation back for inclusion in Alchemy Festival from 15 to 25 May 2015 and Web We Want Festival from 28 to 31 May 2015, linking the Royal Festival Hall in London and India Habitat Centre in Delhi.

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Authors Biographies

Paul Sermon (http://www.paulsermon.org) is Professor of Visual Communication at the University of Brighton. He has worked for over twenty years as an active academic researcher and creative practitioner, primarily in the field of telematic arts. Having worked under the visionary cybernetic artist Professor Roy Ascott as an undergraduate Fine Art student, Paul Sermon went on to establish himself as a leading pioneer of interactive media art, winning the prestigious Prix Ars Electronica Golden Nica in Linz, Austria, shortly after completing his MFA at the University of Reading in 1991. An accolade that took Paul to Finland in the early 1990s to develop one of the most groundbreaking works of his career Telematic Dreaming in 1992.

Dr Claire McAndrew is a Research Associate and Chartered Psychologist (CPsychol) at the Institute for Environmental Design and Engineering, The Bartlett UCL's Faculty of the Built Environment. Combining social science insight with design-led thinking, she is interested in the possibilities of design and digital technologies to facilitate connections between people through urban space for transformative effect. Her research since 2008 has focused on the embedding of design interventions in public spaces to shape cognition and behavior in the contexts of human wellbeing, security and resilience, and future workplaces as they extend beyond buildings into the fabric of the city.

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Designing Interfaces to Experience Interactive Installations Together

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Abstract

Researchers at the *Making Culture Lab* use ethnographic methods to study how interactive technology supports digital practices in diverse cultural environments. This paper reports on how certain design aspects of display systems implemented in public space can induce social encounters and awareness. Field observations made since 2012 show that interface design may be a key factor in structuring such shared experiences. In 2014, HCI researchers introduced the Social Natural User Interfaces (Social NUIs) analytical framework to help HCI practitioners design interfaces that better support collaboration and cooperation in co-located multi-user interaction scenarios. This study describes four interactive media façades deployed in Montréal's Quartier des Spectacles to suggest that electronic artists intuitively anticipated the Social NUIs relational approach to interface design. Analyses highlight how the artists used crossmodal interfaces – also based on intuitive modes of interaction such as gesture, touch, and speech – to design interactive installations that engage people beyond the ubiquitous single-user "social cocooning" interaction scenario. The aim of this research is to illustrate how artistic architectural-scale digital public display installations has the potential to parallel, drive, and contribute to, socially concerned design thinking.

Keywords

Interface design; interactive displays; crossmodality; natural user interfaces (NUIs); Social NUIs; public space; urban interventions.

Introduction

While Huhtamo traces the history of public media displays to Ancient Rome, he further claims that it is the invention of electricity that saw dynamic displays and media façades make their appearance in public outdoor space. As far back as the nineteenth century, incandescent bulbs were used to illuminate advertising billboards while magic lanterns were used to project images on screen surfaces, walls, and public monuments. [1] Although today, these media platforms are electronically engineered, they often tend to serve similar purposes; typically, they are used to publicize commercial content, news, and location-relevant information.

Likewise, Manovich argues that digital technology has borrowed from older traditional forms – such as print and cinema – to remediate new media objects into *cultural interfaces*, a concept he defines as computerized screens that encode culture in digital form. [2] Because digital screens can now be used to mediate action and control, the design of cultural interfaces presents significant challenges with all new implications that reach far beyond issues of representation. [3] A case in point is how unleashing their interactive potential at the scale of the built environment might redefine people's everyday experience of the city.

Relatedly, contemporary artists are using the *crossmodal* properties of new media to experiment with large display installations as a media platform that can transform perceptions from one sensory modality to another. [4] For instance, *MindWind* uses ambient traffic noise (audio input) to trigger movement in an architectural-scale video projection (visual output). [5] The artist's stated intention is to use "elements that are part of our everyday environment to reconnect people to their sense of place." [6] Mediating one sense-impression into another also evokes an invisible link between the natural world and the transcendental.

Since 2012, the *Making Culture Lab* has been investigating such creative uses of dynamic digital displays in public space with a focus on understanding how new media artists are harnessing the interactive medium-specific potentials of screen-based systems to induce new forms of encounters and awareness. Field findings show that interface design may be a key factor in structuring such shared experiences.

Recently, the *Social Natural User Interfaces* (Social NUIs) analytical framework was introduced to the field of human-computer interaction (HCI) to help practitioners design interfaces that better support collaboration and cooperation in co-located multi-user interaction scenarios. [7] Social NUIs support a relational approach to interface design against the deeply ingrained technocentric orientations that have largely driven this research in past decades.

This case study describes four interactive media façades deployed in Montréal's Quartier des Spectacles to suggest that new media artists anticipated the Social NUIs relational approach to interface design in their screen-based artwork. In so doing, they may have paralleled, driven, and contributed to socially concerned design thinking by conceiving crossmodal interfaces that invite and engage people to experience interactive installations together.

Qualitative Field Study

Since 2012, we have been applying a multi-sited approach to the study of interactive media in public space with a focus on investigating the creative uses of dynamic digital displays. Our objective is to gather field data that will help

generate design knowledge on interactive display-centric technology deployed in urban environments. The following describes the research methods applied in this field study.

Methodology: Multi-Sited Design

The research methods used in this empirical study are derived from multi-sited design, an approach that draws from HCI, the social sciences, and the humanities. This emerging constructionist methodology is rooted in Scandinavian practices of participatory design as well as in multi-sited ethnography. [8] Participatory Design is a set of methods used in HCI to engage people in collectively participating in the design of the computer systems they use in the everyday. [9] Multi-sited ethnography is an interdisciplinary critical approach, which consists in conducting research in multiple, distributed, and shifting (micro) locales to later be analyzed against the contours of the overarching (macro) context that comprises all of the sites under study. [10]

Multi-sited design is a research strategy that can support thinking through making within the rapidly shifting socio-economic global context in which art and technology are being produced today. While traditional ethnography typically sees one or sometimes several ethnographers describe a single, well-circumscribed site, in a multi-sited approach, many researchers can be sent to collect data in multiple sites. [11] These sites are not only defined by their physical locations. They can be events, artifacts, narratives or even stakeholders. Further, such a method can allow researchers to compare the shifting and multiple virtual sites of representation that exist in online environments to situated sites.

By triangulating this data, a researcher sets out to sketch a broad picture or narrative, which exposes the web of complex relationships needed to create conditions conducive to the emergence of artistic creations or advances in art, science, and technology. In our research, the sites under study were made up of four art installations analyzed as situated events, which served as the locus of interactions between concerned stakeholders. By tracing connections between these sites, we attempted to identify design trends.

In this particular field study, data was collected while conducting non-participant observations of several interactive art installations deployed on some of the nine media façades of Montréal's Quartier des Spectacles, including first-hand field observations and notes, interviews with stakeholders involved in these projects; and a survey of the audio-visual materials that documented these artworks. In its broader context, this study was the exploratory phase of a latitudinous research that relied on participant observation and involved other places, stakeholders, artifacts, and events unified under a common thread: design knowledge.

Meta-Site: Montréal's Quartier des Spectacles

The past decades has seen major urban renewal projects undertaken all around the world to potentiate the new knowledge economy's "creative cities" by rebranding them as attractive and innovative cultural metropoles. [12] It is in this context that Montréal's Quartier des Spectacles came to operate nine media façades, wired connections, and a free wireless network within the boundaries of their one square-kilometer district. This permanent digital infrastructure enables artists to explore ways to catalyse public interaction and showcase their interactive public art pieces.

The deployment of such electronic artifacts is facilitated by ten kilometers of fiber-optic cables laid out underground to connect the master control room to strategic emplacements throughout the Quartier des Spectacles. Because this robust setup can support the real time transfer of massive data flows, it ostensibly encourages artistic experimentations in public space. Indeed, the Quartier des Spectacles announced in 2014 their intention to activate their nine outdoor media façades as a *digital urban laboratory*. [13]

Our field study considers some of the more interesting innovations that took place around the first instantiation of the *Digital Pathway*, a digital arts event during which interactive display artifacts were simultaneously deployed on some of the Quartier des Spectacles's nine media façades.

Key Approaches to Interface Design

While the last part of this study presents a detailed description of each of the four architectural-scale electronic art installations selected for analysis, the following section expounds the theory that guided our *post hoc* analysis of these artworks. Accordingly, it offers a selective overview of HCI approaches and concepts related to interface design to inform our discussion on interfacing devices used in digital art installations that include public media displays.

Crossmodal Experiences and the Digital Arts

While it can be said that each media technology offers its own ways to extend or compress the way we perceive, experience, and act within the matrix of time and space, it remains that today's screen technology comes with an unprecedented affordance. [14] Because it takes the form of digital data, it is now possible to transform media content into other media types, forms, and sensory modalities. [15]

Rendered possible by electrons – the very substance that digital information is made up of – this phenomenon is known as *transduction*, a three-step process which consists of, first, capturing raw data in the form of input; second, processing this data according to a set of prescribed protocols; and third, outputting it into an altered state. [16] Insofar as this characteristic of new media enables the conversion of one sense impression into another, digital art can be said to be a medium that supports crossmodal interaction.

But is this crossing over of sensory perception a novel phenomenon in people's experience of art? Merleau-Ponty claimed that everyone has a "synaesthetic perception" of their environment [17]. Notwithstanding that at any given moment, some sensory impression may overpower others, he purported that perception occurs through a "phenomenal field" in which different sensory modalities intermingle and mutually resonate with one another as sensory impres-

sions are experienced. [18] For instance, we can feel the softness of a fabric without touching it or hear the thump of a falling body even when it is observed without sound.

Many works of art defy Aristotle's concept of sensory discreteness, which suggests that we perceive an object according to the sum of the discrete sensory modalities it stimulates: its edges appeal to our sense of vision *and* its sound to our sense of hearing, *and* its texture to our sense of touch. [19] Not only does the experience of art tend to confound sensory modalities, but many artists have learned to use materials, colors, forms, and aesthetic strategies to produce artwork that stimulate perception across several senses or indirectly awaken one sense through another as when a sound is heard, or imagined to be heard, in response to a visual stimulus. With most media, this effect is achieved by association, metaphors, and evocative designs.

Artists working in new media, however, can use the principle of transduction to draw attention to how sensory impressions mutate into one another or trigger percepts across modalities. In fact, the science of electronics allows today's artist to expose this process in material form. In this sense, digital media lays bare the mysterious connection between the intangible and the tangible, the invisible and the visible, or the imagined and the experienced. Insofar as new media interfaces can make manifest how senses interact with one another, creating crossmodal interactions can become a means to expose these poetic relationships.

Further, because new media makes it possible to hypostasize crossmodality in works of art and because electronic artworks are conceived around this affordance, one could say that transduction constitutes a medium-specific property of digital art. [20] Indeed, most of the large-scale display installations described in this study proposed interactive experiences that remediated inputs across sensory modalities. In truth, this design feature has become so pervasive in the objects we use in everyday life that we rarely give it a second thought. Seeing, hearing, and feeling are now routinely combined in one of the world's most ubiquitous devices: the portable phone. [21] This becomes evident when it lights up, plays a tune or vibrates to alert users that there is an incoming call or a given location is close. [22]

This not only suggests that input and output are to digital art what brushstroke, color, and surface are to painting, or what light and contrast are to photography, it also implies that *interface design* constitutes a key factor in how new media objects shape aesthetic experiences. Interfacing devices are the membrane through which input and output are expressed and modulated – and although sensor and actuator technologies make up their nuts and bolts, in the end, user experiences are structured by interfacing strategies.

The field research we conducted on interactive display installations in Montréal's Quartier des Spectacles suggests that electronic artists often accidentally stumble upon unusual and innovative interfacing strategies in their creative work. Our review of the literature also shows that as far back as the early seventies, artists such as Peter Campus, Vito Acconci, and Bruce Nauman pioneered large-screen interfacing strategies by experimenting with human-scale video art installations. [23] The work of these legends and many lesser known artists arguably anticipated interface design thinking. The next section examines scientific trends in this area. This overview of the literature will be used to frame our discussion on examples of practice in art.

Natural User Interfaces (NUIs)

One of the major research trends in HCI is driven by the concept of *Natural User Interfaces* (NUIs), which proposes to rethink interface devices so they are responsive to "more natural forms of interaction such as touch, speech, gestures, handwriting, and vision" [24]. The assumption that underlies this approach to interaction design is that NUIs are said to be more intuitive and usable because they are arguably better adapted to everyday human actions, and thus more natural and easier to use. NUI advocates believe that developing interactions around a wider range of input modalities will enhance interactants' sense of power, offer better opportunities to design new forms of interactions, and more holistically blend users' actions with technology.

Because every new human-computer interface typically presents its own set of challenges and learning curves, Norman argues that natural user interfaces are not inherently natural, but certainly useful in enriching the existing repertoire of interaction techniques by adding more touch-based, gesture-based, and speech-based interaction to the existing arsenal. [25] In the same line of thinking, Wigdor and Wixon argue that adopting a NUI approach effectively multiplies expressive capabilities. [26] These remarks speak to the fact that interface design is not only a determining factor in what is *vs.* was is not possible in the realm of human-computer interaction, but also in that of art.

Design Approaches for Large Display Interfaces

In relation to screen technology in particular, Müller et al. offer a detailed taxonomy of design factors that support interaction including cognitive factors, interaction phases, interaction modalities, and mental models such as conceiving public displays either as posters, mirrors, windows or overlays. [27] Others metaphors that have been proposed to conceptualize the design of interactive public displays include *public notice areas* [28]; *community gardens* [29]; *theatrical stages* [30]; and *digital soapboxes* [31].

Beyond these dimensions, there are two aspects of large public displays that define them as a distinct type of interface: first, they can and are often used by more than one person, and second, they are deployed in a public context. Accordingly, design concepts and frameworks that place an emphasis on these seem particularly well-suited to developing the interactive potential of displays. This is the case, for instance, with the concept of *Shared Encounters* defined as spontaneous forms of communication and interaction that can take place in public places through technology [32]. More to the point, *shareability* is a concept that proves useful in operationalizing interaction in terms of entry points and access points in multi-user interfaces. [33]

The past few years, however, have seen a new approach emerge that is premised on this very idea of shareability in conjunction with that of natural user interfaces. Known under the moniker of *Social NUI*, it aims to facilitate thinking about multi-user interface design at an abstract level.

Social NUIs

Several HCI researchers have been concerned with the idea that NUIs are too focused on the single user's relationship with the interface and by extension, the system. Many of the researchers that have developed this framework are from the field of computer-supported cooperative work (CSCW), which is concerned with how people use technological systems to communicate, collaborate, and coordinate their activities. [34] Some felt that the concept of NUIs needed to be reframed into a model that could support these interactions. They describe Social NUIs as interfaces that "facilitate new forms of social interaction, participation and collaboration – how we communicate with each other, play together, learn together, and collaboratively work together through these technologies." [35]

Social NUIs place the focus on the relational aspects rather than the mechanics of interfacing devices. For this reason, it is an approach that arguably places greater focus on meaning and values because it encourages designers to:

> *"…extend the broader set of analytical concerns around NUI technologies to consider the meaning and values of these technologies as they are enacted in context..."* [36]

Given that most large interactive media displays are deployed in a public context, this study contends that the Social NUIs framework may be well-suited for this type of platform. To illustrate the forms Social NUIs could take in relation to dynamic digital displays, the following looks at four digital artworks that relied on custom-made interfaces specifically designed to engage users to experience the installations together as interactants *or* audience members.

Field Study: Four Interactive Art Installations

For a number of years and until recently, many of the HCI practitioners developing applications to interact with digital public displays used small, ubiquitous, portable devices such as cell phones or smartphones as their interface of choice. Although this trend was largely spearheaded by engineers, many artists followed suit by using this interaction strategy to conceive their own digital art installation. Figure 1, for instance, shows Yan Breuleux's *Tempêtes*, a media façade deployed in the Quartier des Spectacles that allowed people to post comments using text messaging.

Interface Size Matters: The *TRAME* Project

Our first case study offers a better example of how interaction with a media façade can afford greater shareability. Like the interactive video projection in Figure 1, *TRAME* sourced user input from people's personal portable devices, but its application called for more screen real estate.

TRAME is an interactive architectural lighting installation

Figure 1. *Tempêtes*, 2012, Yan Breuleux, video projection. ©2012MartineDoyon.

deployed in February 2011 on the media façade of a church located next to the downtown campus of Université du Québec à Montréal (UQAM). Born of an initiative instigated by NFB Interactive, the Rendez-vous du Cinéma Québécois and the Quartier des Spectacles Partnership, it was produced by Antoine Goudreault in collaboration with undergraduate students from l'*École des medias interactifs*.

In 2010, the Quartier des Spectacles hired the Montréal-based *VYV* firm to create detailed architectural mappings of their permanent media façades targeted by video projectors. VYV's signature *Photon* software has since been used by many artists to design media façades on the site. Given that each mapping carefully integrates the specific architectural elements of every building's façade, it becomes a tool that can be used to produce site-specific content that takes into account a media façade's peculiar shapes and textures.

TRAME was one of the first art projects to make use of VYV's custom-made software, which provided artists with a precise template of the intricate projection areas of UQAM's bell tower. Its video projections were made up of "episodes" each based on celebrated NFB animation films made by local artists in the past 75 year. Each episode paid homage to a key figure in the history of film animation.

In 2010-2011, UQAM students spent over seven months designing an application that could run on an iPod Touch, any smart phone, or an electronic tablet of variable size. During the deployment, anyone with a personal mobile device could download this application from the *TRAME* website to interact with an episode projected on the bell tower while it was being rendered live. Through simple touch screen commands, people could affect the music, and the speed or designs of dynamic visual motifs in real time.

Although the size of the input interface depended on whether people used their smart phone or a tablet, it would significantly change how people interacted. While smart phone screen size tends to encourage social cocooning, the increased visibility afforded by the oversized screen real estate of tablets made it possible for more than one person to watch a touch-based interaction. By including observers in the input process, here, interface size created conditions for socializing and thus for being involved in interactions.

Figure 2. *By Means of a Sigh*, 2012, Jean Dubois and Chloé Lefebvre, interactive video art installation. ©2012MartineDoyon.

Rewarding Group Interaction *By Means of a Sigh*

Another interactive display-based artwork that relied on the use of personal mobile devices for input is Jean Dubois and Chloé Lefebvre's *By Means of a Sigh*. Featured in the context of the first edition of the Quartier des Spectacles's *Digital Pathway* urban interventions in Spring 2012, this interactive video was showcased on an oversized digital display located outside the Place des Arts building on Ste-Catherine Street, near Jeanne-Mance. This was one of the rare *Digital Pathway* deployments designed for an actual LED screen rather than for a video projection on a façade.

Dubois has often used an anemometer to design interactions around his art installations. These devices measure the force emitted by wind or air pressure to generate data. In Dubois's *Brainstorm*, for instance, when someone blows into the anemometer, the words projected on the screen begin to move faster and away from one another, creating the illusion that one's breathing can disperse them.

By Means of a Sigh similarly uses breathing as the input signal that triggers interactivity. Filmed and edited prior to deployment, this artwork simply consists of a video loop of a lateral view of a woman and a man facing each other as they each blow bubble gum. As the size of their bubble increases, their thinning walls touch and eventually burst.

Interactants can help blow the bubbles by calling a telephone number that connects them to the screen. Figure 2 shows how they can then gather around the screen and exhale into their mobile phone to move the video projection forward at a speed consistent with the intensity of their breathing. If no one blows air into their mobile phone, the playback slows down or almost stalls, creating the impression that the balloon is deflating. If many people blow intensely and steadily, the balloon inflates fast until it bursts, causing the video to loop back to the beginning again.

Practically, this means that when people work together, they can synergetically influence the outcome. Although the input interface is small in that it is typically the size of a mobile phone, the application has been fine-tuned so that when the number of people who blow increases, the interaction appears more effective, and thus visually rewarding.

The artists's stated intention was to tie the intimacy of embodied experience to the art installation [37]:

> *"Being able to use one's breath to modify a big image, much larger in scale than one's own body, is a sensory experience that can give people a feeling of personal empowerment. We were concerned with finding ways of making interactive works that include interactants' bodies as part of the art piece because when we interact with an artwork, we become a part of it. Interactive public art is a tool that can activate public space and create conditions that connect people to it and each other".*

Although here, the art seems to be more about a process than an object, the physical and conceptual design of the interface determines the experience and value of the interactions. In this sense, the artwork attends to similar goals as Social NUIs by refocusing interactions on collaboration, play and meaning: it takes a village to burst these bubbles.

Interfacing Around a Campfire for *Bla Bla*

A few streets away, in front of a media façade deployed outside the Saint-Laurent subway station, an input interface that rekindled the age-old campfire metaphor offers yet a third perspective on how new media artists have been anticipating Social NUIs. Custom-designed for a public space installation that was co-produced by the National Film Board of Canada and the Quartier des Spectacles, the luminous podium seen in Figure 3 was the interactive portal of entry into the world of Vincent Morisset's *Bla Bla*.

Originally only available online, this interactive hand-drawn animation film was transformed into an interactive human-scale media façade on the occasion of the *Digital Pathway* in spring 2012. As was the case with the previous examples of practice, crossmodal interaction was triggered by touch-based input. Here, however, personal portable devices were replaced by a simple trackpad mounted on top of the stationary luminous plinth seen in Figure 3.

The input interface functioned much like the standard trackpads found on most laptop computers today. Indeed, hidden beneath the clean modernist lines and illuminated surfaces of the projecting base was a MACBOOK PRO™ connected to the fiber-optic cable infrastructure that leads

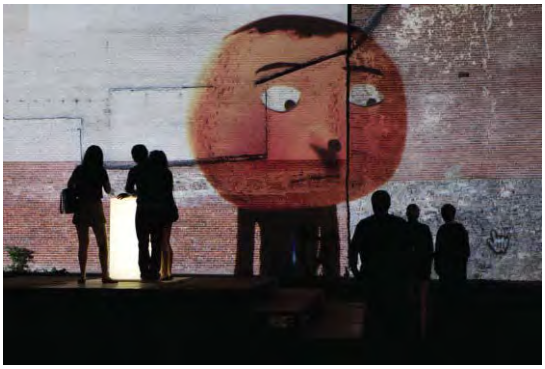

Figure 3. *Bla Bla*, 2012, Vincent Morisset, interactive animated video projection. ©2012MartineDoyon.

Figure 4. *Twenty-One Swings*, 2012, Daily Tous Les Jours. ©2012MartineDoyon.

Figure 5. *Twenty-One Obstacles* powered by *21 Swings*, 2012, Daily Tous Les Jours. ©2012MartineDoyon.

to the Quartier des Spectacles's master control-room. This economic lo-fi setup was, in effect, all that was needed to run *Bla Bla*'s entire interactive program every day from 9 pm to 2 am for the full eighteen nights of the deployment.

Although the basic interaction script consisted of interventions upon the animated images projected on the media façade, it is noteworthy that the device used to achieve this also responded to user input: the luminous intensity and color schemes of the plinth varied and flickered in response to how users touched the trackpad. As a result, *Bla Bla* highlights two interactive objects: the video projection and a site-specifically designed new media urban furniture.

Further, three form factors of this artifact evoke a campfire scene. First, the fact that the luminous plinth is fixed means that users must go to it, rather than freely move around as one would when using a mobile phone to interact. Second, its shape and size, not only enable, but also invite people to gather around it. Third, its luminosity is an entry point since it captures attention and draws us in. [38]

This leads us to say that *Bla Bla*'s input interface creates favorable conditions for people to socially interact and possibly eventually cooperate as well. As a kind of electronic campfire, it has much in common with Social NUIs.

Twenty-One Obstacles Set in Motion by *21 Swings*

Using accent lighting to single out the input interface of a display-based installation was a design strategy also used in the *21 Swings* luminous seats seen in Figures 4 and 5. Conceived by two Montréal-based interaction designers, Daily Tous les Jours's Mouna Andraos and Melissa Mongiat, this project is arguably one of the Quartier des Spectacles's most popular deployments. Located in front of the Place-des-Arts subway station public transportation hub, the swings were often used by people waiting for the bus.

Each swing was programmed to emit its own distinctive note. Whenever more than one swing was being used, different notes would be generated to create layers of sound. As a result, unique musical compositions would be produced each time there were multiple users. Further, if the vertical coordinates of at least two of the swings perfectly synchronized, a special tune would play over the musical composition to reward interactants for swinging together.

When the *21 Swings* were deployed during the *Digital Pathway* in 2012, the designers connected them to the monumental *21 Obstacles* media façade in order to provide more possibilities for human-computer interaction: swing motion would then generate both audio output (music) and visual output (moving objects on the façade). Much like with a pinball machine, the colorful, geometric obstacles could be seen to chaotically collide into one other on the monumental media façade of UQAM's President-Kennedy building when graphics were powered by people's swinging. At times harmonious and at times cacophonic, *21 Swings* was a musical instrument that provoked and proposed new forms of social intercourse in public space.

Interactants seldom talked, but they did collaboratively make music together. Once, we observed a homeless man swinging next to young people; he was enjoying himself so much that he began to enthusiastically improvise his own melody over the musical notes played by the swings. He sang completely out-of-tune with the melody played by the installation. People lining up for the bus seemed bemused, but there was a sense of civic life, of people sharing a space and a moment that was just about being there and being part of something together. Something that was what it was. If interactive public space technology could enable more playful and respectful public interaction, might we see changes in how people relate to one another socially? Might the relational qualities of these works even play a role in meaningful social change beyond this public space?

Towards a Social Affordances Framework

These four examples of practice trace the evolution of some of the interfacing devices that supported interaction with artistic architectural-scale digital public display installations deployed within the perimeter of the Quartier des Spectacles from 2011 to 2012. In doing so, it highlights the idea that interactive installations deployed in outdoor settings might call for new frameworks that rethink interface design in terms of the peculiar context of public space.

On the face of it, the Social NUI framework seems to be addressing this challenge, but in fact, it is not specific to public space. Researchers have applied it to many domains that have been indoors or outdoors, private or public, and across domestic, leisure or work environments. Indeed, it was first developed around scenarios where technology was used to interact around the dining table at home; in surgical settings that required sterile practices; in relation to MOOCs and educational purposes; in family gaming events designed around brain-computer interactions; and to support cooperation and socializing in the workplace. [39]

There are other conceptual frameworks that – much like the Social NUI approach – could be applied to interaction in public space or with large display-based systems. However, none of them are specific to the former *and* the latter. For instance, Greenberg's *proxemics interaction* and Vogel and Balakrishnan's *spatial interaction* framework for ambient displays are display specific, but they are mainly applicable to spatial engineering in the context of a lab setting. [40] In the past, we published two frameworks that attempt to bridge the challenges of designing interactions for public space with those of designing for display-based systems, but neither placed social concerns at its core. [41]

Based on our field findings in the Quartier des Spectacles, it seems clear that the social dimension of public space should be a fundamental principle in any framework that aims to inform interface design for interactive public displays. While it appears that our study focuses on ergonomic design factors such as the screen real estate size of an interface, its location within an installation, its ability to entice and accommodate as many users as possible, and how this interface rewards co-locatedness and cooperation, it is, in fact, human factors – such as the public context of these interfaces and the relationship between people that results from this – that structure these physical affordances.

As far back as 2003, a study by Brignull and Rogers proposed a *public interaction flow model* and two concepts that have become foundational to our research on displays, namely *public interaction* and *social affordances*. [42]

> *"For public interaction to become a more acceptable mode of social activity requires the purpose behind it and how it is manifested around and at the display to have strong physical and social affordances, that people can easily and unambiguously pick up on."* [43]

While Brignull and Rogers set out to achieve this by focusing on ways of reducing social embarrassment, raising awareness, and encouraging people to engage with displays in semi-private setting such as parties and intimate gatherings, our research embraces a social perspective that focuses its lens on relational aspects in public space. [44] In this sense, it straddles their model, the Social NUI approach, and prior work referenced above. What this study found is that interactive public installations by electronic artists often intuitively anticipate, and even paramount, social interface design thinking. For this reason, we believe that they might be regarded as best-practice examples in this area of study, suggesting that still today, blending art and science may provide more fertile grounds for research.

Conclusion

Using a multi-sited design approach, this qualitative field study investigated locations, events, artifacts, and stakeholders as distinct sites of representation to produce design knowledge in relation to interactive digital public displays. By presenting examples of practice, we aimed to show that ergonomic form factors can serve as entry points and social affordances that invite encounters and collaborations around an input interface. We also highlighted how new media artists use touch-based and gesture-based input, as well as crossmodal interaction to bring to bear the relationship between the digital and the material, the intangible and the tangible, the invisible and the visible world.

Like Social NUI advocates, we believe that by developing interfaces from a relational perspective that takes into account collaboration, meaning, value, and context, other ways can be found to design interactive digital public displays that might foster more rewarding forms of civic interactions, and possibly propose unprecedented manners of public interaction – itself a concept that, with smart cities on the radar, will likely gain traction in the years to come.

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Occupy the Screen: A case study of open artworks for urban screens

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Abstract

This paper examines the cultural and political implications of and for the proliferation of public urban screens appearing in cities around the world. Through a contextual and cultural study of cities and urban communities, informed by the work of Richard Sennett, Lucy Lippard and Scott McQuire et al., the paper asks what the opportunities are for creativity, intervention and public cohesion through these screens? This paper presents a case study of the authors/artist's practice-based research project "Occupy the Screen" 2014 for Connecting Cities Berlin and Riga 2014 European Capital of Culture. Using a practice-based methodology the authors utilise a method which maps the five elements of play, as defined by Hans Scheuerl in 1965 to measure open and closed systems in order to develop a framework for artists and curators to maximise engagement with public audiences through play.

Keywords

Telematic, urban-screen, intervention, ludic, participatory art, play telepresent, performance, interaction, networked.

Introduction

Our cities are networked; the screen allows the constant transmission of the latest information and communication. We are connected to a global digital infrastructure with mobile devices, GPS, Internet. Observed by surveillance cameras, our personal data can be stored and tracked, as can our geographical movements. Urban Screens take many formats to include large urban screens, handheld devices and architectural facades; they can be DIY, temporary, or part of the permanent architecture of the city. Urban Screens have been used to relay news, information sport and advertising, as well as cultural events and transmit 24hrs a day across cities globally. Through this practice-based research project we look at how artists can harness this digital network to offer audience agency, using Browning's definition (Browning 1964) as opportunity for creativity and making real choices, to promote sociability and play through participatory art works.

Networked Cities

Today's media cities are made up of many communities, which are multicultural, multilingual, and multi-faith, a multiple of strangers are brought together at close proximity. Richard Sennett sites Aristotle as the first to identify the city as a "synoikismos" or made up of diverse tribes and identifies contemporary cities as sharing a similarly tribal composition, arguing that it is important to respect these cultural complexities. Sennett promotes the idea of engaging beyond the divisive "us" and "them" attitude of a society defined by difference towards a "skilled co-operation" working together through craft skills. (Sennett, R. 2013, p4) The idea of multiplicity as beneficial to a community adding to the cultural richness, was shared by Georg Simmel a century earlier, in his 1903 essay on the city where he identified the demographics of a cultural mix as more enriching than the small close-knit communities of "Germeinschaft". (Sennett, R. 2013, p38) Richard Sennett suggests that contemporary society necessarily involves flux and shift in demographics. (Sennett, R. 2013 p4)

Through this research project we explore the historical and cultural context of our telematic artwork "Occupy the Screen" (Sermon, P. Gould, C. 2014) and the role it can play in connecting communities; to engage with the public and to offer audiences opportunity for agency and sociability through play, creating new narratives establishing new legacies, through public accounts stories and memories, grounded in the media arts context. Scott McQuire argues that artistic practice and research can potentially change and enhance the way that we experience the urban environment and the way that we relate to each other. (McQuire, S. 2008)

Community

Richard Sennett promotes the idea that sociability and community engagement need to be actively worked upon, and do not happen automatically. In a multicultural society, difference defines us and Sennett proposes that the aim should be a sociability that embraces tolerance as opposed to attempts to achieve consensus. In a contemporary society in which religion and material production play a reduced role in everyday life, Sennett advocates craft and ritual as well as informal discussion and social groupings as potential methods to bring people together as a support network, promoting empathy and tolerance as opposed to sympathy and condescension. He highlights the importance of all participants taking an active role in forging

institutions or community groups as opposed to an impinged "top down" approach. From this perspective the passive audience observes the spectacle promoting the idea that proactive engagement with culture is empowering to the public.

"…when ritual turns into spectacle something happens to communities and to individuals. Spectacle turns community into a hierarchy in which those at the bottom observe and serve but do not participate as individuals with self-standing worth". (Sennett, R. 2013, p108)

This image of a contemporary city as increasingly characterised by marginalisation and isolation is reflected in Robert Putman's study on social cohesion. He found that people keep away from those who are different, that passive participation now marks civic society. (Putman, R. 2001) George Simmel (1858-1918) had identified the inhabitants of the city of the early twentieth century as suffering from "stranger shock". He identified a universal pleasure in pursuing other's company in German known as "geselligkeit" and was optimistic about the opportunities posed by the larger urban communities as promoting "sociality".

Urban Screens

Urban Screens have been set up across the globe, including in twenty-two cities in the UK often used for news, information and sport, some exclusively for cultural purposes such as in Linz and São Paulo. The position of the screens offers huge opportunity for potential to engage with a broad demographic. Freud documents an early experience of an urban screen, in a letter to his family in 1907 from a Piazza in Rome in which he describes being transfixed by the repetition of images and isolated from the crowd. This passive consumption of images and expressed sense of alienation is implicit in the notion of specular culture as presented by Debord. (Debord, G. 1967) Further, the presence of large urban screens could connote an Orwellian image of surveillance and control. Nam June Paik responded to dystopian fears with his "Good Morning Mr Orwell" as part of the New Year celebrations in 1984. He highlighted the importance of video and satellite television as liberating as long as it is used interactively. *"Orwell only emphasized the negative part, the one way communication. I see video not as a dictatorial medium, but as a liberating one. That's what this show is about, to be a symbol of how satellite television can cross international borders and bridge enormous cultural gaps…the best way to safeguard against the world of Orwell is to make this medium interactive so it can represent the spirit of democracy not dictatorship"* (Paik, N. J. 1984)

Art as Intervention

Brecht drew attention to the increased disempowerment of the audience since the development of the radio, *"Let the listener speak as well as hear…bring him into a relationship instead of isolating him"* (Brecht, B. 1986)

Benjamin highlighted the importance of a proactive relationship between audience and producer *"What matters, therefore, is the exemplary character of production, which is able first to induce other producers to produce, and second to put an improved apparatus at their disposal. And this apparatus is better the more consumers it is able to turn into producers_ that is readers or spectators into collaborators…"* (Benjamin, W. 1978)

Others highlighted the implicit dynamism between audience and artist in the development of artworks. Philosopher John Dewey in 'Art as Experience" (Dewey, J. 1934) underlined the audience's role in the interpretation of meaning in art. Marcel Duchamp that the interpretation of artworks involves creativity,*"The creative act is not performed by the artist alone; the spectator brings the work in contact with the external world…and thus his contribution to the creative act"*. (Kepes, G. 1960 p111-112) This was reaffirmed by Roland Barthe's assertion that the work of art is a dual process between writer and reader, and that authorship involves multiple input. *"We know that to restore writing to it's future, we must reverse it's myth: the birth of the reader must be ransomed by the death of the author"*. (Barthes, R. 1977 p142-148) The concentration here is on the relationship between the artist, the environment and the audience and the interplay that takes place.

This is a huge leap from the renaissance philosophy of one worldview, truth and divine-right and Henri Lefevre identifies the period from 1910 as a time where all that was taken for granted in the classical world became shifted as developments in technology, philosophy, science, engineering and mass production, had a profound impact on our understanding and experience of the world, the very structure of the city had changed, expanding the way that we inhabit the world into the sky and deep below the earth with high-rise buildings reaching skyward whilst trams are tunnelling underground.

"The fact is around 1910 a certain space was shattered. It was the space of common sense, of knowledge (savoir), of social practice, of political power, a space hitherto enshrined in everyday discourse just as in abstract thought, as the environment of and channel for communications; the space too of classical perspective and geometry, developed from the Renaissance onwards on the basis of Greek tradition (Euclid, logic) and bodies forth in Western art and philosophy, as in the form of the city and the town." (Lefevre, H. 1991, p25)

The new philosophies impacted on our interpretation of art, the avant-garde questioned the very institution of art. Futurist artist Luggio Russolo explored manipulating the senses through cataloguing the sound types brought about

through industrialisation using the street as his instrument. The Surrealists were very interested in the street as a creative starting point, and in-particularly Paris. Surrealist poet Louis Aragon celebrated the urban environment as having "the wonderful sense of the everyday".

Söke Dinkla identifies the movement away from the traditional gallery setting from the early twentieth century and at the same time a development of interaction within artistic practice from the object as art towards performance and interactivity as a prelude to media art. From this perspective the move away from the traditional gallery and the interest in artist and audience interaction went hand in hand. This also suggests that the movement away from the art establishment towards public engagement was empowering. (Dinkla, S. 1996, p279) Art works moved from the gallery to the theatre exploring active interaction between artist and viewer through typography, performance and sound. Filippo Tommaso Marinetti in the manifesto "Variety Theatre" commented:

"The Variety Theatre is alone in seeking audience's collaboration. It doesn't remain static like a stupid voyeur, but joins noisily in the action, in the singing, accompanying the orchestra, communicating with the actors in bizarre dialogues". (Marinetti, F. T. 1913)

Lucy Lippard identifies a move during the fifties and sixties away from the fetishisation of the object and the "dematerialisation of the art object" (Lippard, L. 1997), towards audience participation, interaction and performance from the Situationist movement, to Fluxus, which often took place on a stage like venue and Happenings events, taking art events out of the traditional gallery and into the streets, with a sense of theatre and an interplay between audience and performer.

Play and Ludic Interfaces

Richard Sennett underlines the importance of role-play in society and argues that the modern being's search for "true" or "authentic" character as a result of capitalism and secularization has lead to a "crisis of public life". (Sennett, R. 1986 p27) In the eighteenth century role-play was an expected part of polite society. *"… in a period like the 18th Century, actor and stranger would be judged on the same terms, and what one could learn from the one in the domain of art, one could learn or apply to the other in the special domain of impersonal life. And therefore in a very real sense, art could be a teacher about life; the imaginative limits of a person's consciousness were expanded, just as in an age in which putting other on, posing, and the like seem morally inauthentic, these limits are contracted"*. (Sennett, R. 1986 p41)

Viewed from this perspective art can teach and inform us about life and can offer the opportunity for imagination and creativity. Sennett argues that the pre-industrial city offered the opportunity to engage with theatricality as part of life. Henry Fielding in 1749 spoke of the street and the theatre as "literally" intermixed and no longer a metaphor. Sennett suggests that without the opportunity for play, we are bereft of a basic perquisite to a full life, underlining creativity as key to this. *"It is robbed of the expression of certain creative powers which all human being possess potentially- the powers of play- but which require a milieu at a distance from the self for their realisation"*. (Sennett, R. 1986, p264)

The importance and conventions of play was being asserted and reassessed at this time. Jean Jacques Rousseau referred to play as an essential learning tool in "Émile", or "On Education" (Rousseau, J. 1762) and it was during this period, in 1793, that Friedrich Schiller, in a letter to his sponsor defined a new meaning for "play". He said that it could express the simplest to the most complicated of ideas from: *"…the aesthetic state", "a state of the highest reality so far as the absence of all limits is concerned" where we can experience a "unity of human nature. "* (Schiller, F. 1962 p607) Schiller believed that play draws together the objective with the subjective to create culture. Karl Groos had identified a potential for impact of play on culture and on promoting creativity, he also highlighted an "aesthetic presence" in play. (Groos, K. 1901) Schiller, who also identified a beauty in play, reaffirmed this. Huizinga looked to trace all forms of culture back to play; he saw play as a need to create order, therefore as potentially beautiful. (Huizinga, J. 1938, 2008) Friedrick Buytendijk further aligned play to the creative act, describing the play object as figurative, defining play as stimulative and unpredictable, and with the potential to open up opportunities for fantasy, lending it's self to interpretation and association. (Buytendijk, F. J. J. 1932) Scheuerl made an association of art and play, and saw the relationship as that between process and form, both of which are accomplished in the moment. (Scheuerl, H. 1965)

Johan Huizinga defined play as an activity external to everyday life, but totally absorbing and thereby suggesting a liberating quality, "Summing up the formal characteristics of play, we might call it a free activity standing quite consciously outside "ordinary" life as being "not serious", but at the same time absorbing the player intensively and utterly." (Huizinga, J. 1938, 2008)

Roger Caillois identified limitations to this definition as this excludes gambling from the definition of play but also notes that while mystery can be part of play is not a necessary component to make it part of the definition and conversely that mystery can be revealed through the nature of play. (Caillois, R. first published 1958) Caillois identified six elements, which defined play as *"Free", "Separate", "Uncertain", "Unproductive", "Governed by rules" and "Make believe"*. (Caillois, R. first published 1958, p128)

Claus Pias identifies a need to make a distinction between play and games*"…not about games (Spiele) but rather about play (Spiele), about a playful attitude"* (Pias, C. 2011, p164) and notes that the German word for 'play' and 'game' is the same, 'spiele'. Hans Scheuerl defined

games as having five attributes; (i) "freedom", no goal outside it's self. (ii) "Inerfinitude" with no preconceived ending, (iii) "closeness of the game" the rules or defined area of play, (iv) "ambivalence", movement between rule and chance, serious and fun, impulse and cognition, immersion and reflection, (v) "virtuality", separate from "real life" and the self. (Scheuerl, H. 1965, p607)

This definition maps on to Caillois method, however provides a little more distinction than Caillois' definition of play, which tallies to the characteristics of open systems, specifically the idea of "infinitude", in some closed systems there are only one of two possible endings, and the concept of "ambivalence" how far unexpected outcomes are possible, or the potential for rule-breaking, or using chance to impact on outcomes.

For the purposes of this study we have used Scheuerl's definition of play and games as a method to create a framework for the observations of user interactions in the installation "Occupy the Screen" referred to later in this paper. The framework was used to evidence observations, recording participants reactions, their time spent in the installation, and engagement with the screen and other participants.

Systems of Interaction

"All arts can be considered interactive if we consider viewing and interpreting work as a kind of participation". (Sakane, I. 1989 p3 in Rokeby, D. 1995 p134)

Whist this acknowledges a relationship between artist and viewer in the construction of meaning, as discussed above, theorists such as Benjamin have promoted a much more proactive relationship between artist and audience, making a distinction between "producers" and "consumers" identifying the former as active and the later as passive. (Benjamin, W. 1978 p101-120)

Lev Manovich states that by definition the computer interface (HCI) is interactive, but that it is a mistake to identify all art that uses computing as interactive. (Manovich, L. 2005) Sometimes interactive works appear to offer the audience creative opportunity, through an interface that provides choices, however point and click and motion tracking can often disguise nothing more than a series of choices made by the artist. Sharon Daniel argues that the collaborative aim of media arts focuses on the potential to create new experiences and exchange revealing new insights, but can be overshadowed by the appearance of audience autonomy and choice, disguised by the physical function of the interface. (Daniel, S. 2011, p74) Jane Kelly reaffirms this.

"Real Collaboration is often undermined by the authority of the artist, who retains control of the technology. The apparent autonomy given to a participating spectator is often a false front, simply a product of digital technology's ability to offer more varied, but still strictly controlled routes through a closed set of prescribed material" (Kelly, J. 1997)

Sharon Daniel goes further making a distinction between interactivity and collaboration, and sees the former as a passive user experience. (Daniel, S. 2011, p74) Margot Lovejoy, however argues that interactivity can be divided into two approaches the "monologic" (point and click) and the "dialogic" approach which enables a collaborative exchange between artists and potentially multiple participants provided by *"telecommunications that interactively make use of global network connectivity"* (Lovejoy, M. 2011, p14) which Margot Lovejoy describes as *"open"*.

Jeffery Shaw and Peter Weibel identify three narrative types of interactive works, *"transcriptive forms"*, multi-layered narratives, and "*recombinary permutation"* involving an element of chance with random programming and *"distributed forms"* which offer open systems for multi-direction communications to take place. (Lovejoy, M. 2011 p18) These definitions suggest a continuum between open and closed systems; "distributed forms" at the open end and "transcriptive forms" at the closed, with "recombinary permutation" in the middle.

Roy Ascott identifies a focus in interactive art on *"whole systems, that is systems in which a viewer plays an active part in an artwork's definition and evolution"*. (Ascott, R. 1999, p67) Ascott proposes that the removal of the 'second observer' or 'phantom audience' is a necessary precursor to the truly "whole system", so all participants are fully active in the outcomes and the potential for spectacle is removed, in order to achieve *"an open ended evolution of meanings and the closure of an autonomous frame of consciousness"*. (Ascott, R. 1999, p70)

Stiles and Shanken also identify "agency" as an important factor in interactive systems. Meaning and intention as well as effective communication to an audience are important. They argue that artworks *"must activate semiotic signification that is literally full of meaning"* (Stiles, K. and Shanken, E. 2011, p35), potentially changing audience understanding through *"agency"*. They refer to Douglas Browning's definition of agency, *"The concept of the agent is required in order to allow for the possibility of freedom, communication, comprehension and mystery. "Culture in general…rests upon…agency"*. (Browning, D. 1964)

Stiles and Shanken argue that interactive works should offer the audience "agency"; a proactive role, with freedom to make decisions and be creative, offering opportunity to change and influence society. *"Agency involves the freedom to create, change, and influence institutions and events, or act as a proxy on behalf of someone else. In both cases agency is measured by the ability and the responsibility to have a meaningful effect in a real-world, inter-subjective social conscience."*. (Stiles, K., Shanken, E. 2011, p36)

Occupy the Screen

"Occupy The Screen" (Sermon, P. Gould C. 2014) was a site-specific work commissioned by Public Art Lab Berlin for the Connecting Cities Festival event "Urban Reflections" from 11 to 13 September 2014, linking audiences at Supermarkt Gallery Berlin and Riga European Capital of Culture 2014. This installation builds on our practice-based research and development of previous interactive works for large format urban screens such as "Picnic on the Screen", originally developed for the BBC Public Video Screen at the Glastonbury Festival in 2009. Connecting Cities was a EU consortium involving big screen curators and artists who initially came together for a workshop as part of the Transmediale Festival 2014 in Berlin. Through our presentation of research findings to date the initial workshop considered what the essential criteria were for future urban screen interventions.

This new installation pushed the playful, social and public engagement aspects of the work into new cultural and political realms in an attempt to 'reclaim the urban screens' through developments in ludic interaction and internet based high-definition videoconferencing. Through the use of illustrated references to site-specific landmarks of Berlin and Riga, audiences were invited to "Occupy the Screen" by climbing the statues in both cities, with scenes reminiscent of the crowds claiming the Brandenburg Gate after the fall of the Berlin Wall in 1989. The concept development of "Occupy the Screen" was inspired in part by 3D street art as a DIY tradition, referencing the subversive language of graffiti. The interface borrows from the "topoi" of the computer game, as a means to navigate the environment; once within the frame the audience becomes a character immersed within the environment.

"Occupy the Screen" linked two geographically distant audiences using a telematics technique; the installation takes live oblique camera shots from above the screen of each of these two audience groups, located on a large 50 square metre blue ground sheet and combines them on screen in a single composited image. As the merged audiences start to explore this collaborative, shared ludic interface, they discover the ground beneath them, as it appears on screen as a digital backdrop, locates them in a variety of surprising and intriguing anamorphic environments (see fig. 1).

"Occupy the Screen" aimed to include the widest range of urban participation possible and aligns to a Fluxus "Happening" in a move away from the object as art towards the street environment and the "every day" experience. It also borrows from a tradition of early 20th century media developments where audiences were transfixed by the magic of being transported to alternative realities though early film at the traveling fairs. Lumière contemporaries, Mitchell and Kenyon, whose films of public crowds in the 1900's present a striking similarity to the way audiences react and respond to "Occupy the Screen". These pioneering fairground screenings of audiences filmed earlier the same day possess all the traits of live telepresent interaction, albeit the latency in processing, whereby the audience play directly to the camera and occupy this new public space by performing to themselves and others when screened later.

Figure 1. "Occupy the Screen". Audience participants in Riga interacting with the screen. 11 Sept. 2014 ©Sermon, P., Gould, C.

The position of the urban screen as street furniture is ideally suited to engage with people going about their everyday life, and often the most interesting outcomes are discovered through the ways that the public interprets and re-appropriates culture through "users tactics". (Certeau, M. 1980, p480) The interaction is an open system aiming to offer the audience a means of agency, defined as "freedom" to be creative and make individual decisions.

As part of the project development, workshops were held with the local community in Wedding-Moabit, Berlin, a multicultural demographic including various migrant communities. We were keen to ensure that all aspects of the community were represented in the development of content for the work and to find ways of engaging the audience in the installation, reflecting richer layers of experience relating to place through "hybrid nonlinear stories" rather than reflecting a "homogenous view",. (Lippard, L. 1997, p24)

The workshop participants identified personal landmarks and discussed their experience in the local environment, their history and cultural references, also their idea of tourist routes through that part of the city. In this way the public were able to advise the development of the work through their feedback and ideas to inform the content of the environment. We developed the landmarks suggested as well as artefacts relevant to the local and migrant communities, at the same time representing both of the cities involved, including cultural motifs as well as references to the county of origin. This follows the tradition of dialectic art as an intervention (Kester, R. 2004) and supports Roy Ascots proposal that with his definition of a "whole system" "a viewer plays an active part in an artwork's definition and evolution". (Ascott, R. 1999, p67) The installation further offered opportunity for

collaboration between audience and artist through an inclusive approach to creativity and sociability employing the “ludic”, nonsensical, and “phantasmagoria” of free play. (Sutton-Smith, B. 1999)

Our method of evaluation referred to earlier involved audience observation, both during the event and via line-out video recordings (see fig. 2) directly from the installation. The latter provided us with the most accurate record of audience engagement allowing us to observe the participants and their interactions through the very same image they caused and reacted upon. We also had local assistants to support the work and talk with audience participants in a familiar context and language.

Figure 2. “Occupy the Screen”. Line-out video of participants in Riga and Berlin. 13 Sept. 2014 ©Sermon, P., Gould, C.

The outcomes from both the observations and the line-out video were then plotted on a data map using a y-axis informed by Hans Scheuerl’s definition of games; from “freedom”, “inerfinitude” and “closeness of the game”, to “ambivalence” and “virtuality”. (Scheuerl, H. 1965, p607) Against an x-axis aligning to open and closed systems.

Drawn from a 31:44 minute line-out extracted video recording (Sermon, P. Gould, C. 2014) the following edited observations and analysis, using the Open/Closed matrix based on Scheuerl’s definition of games: “Freedom” to respond to each other at times negating the suggested environment is evidenced at 06:10 when a boy break dances across the floor, while a woman reaches forward to get into the bath. Examples of “virtuality” include instances of ludic play where people engage in nonsensical activities such at 08:45 two men (late teens) in Riga flap their arms as if to fly, another lifts his arms as if to glide. Imaginary play and narrative sequences emerge through participant’s interactions drawing other participants into the scene including at 04:18 a man (20s) in Riga shuffles from side to side while children in Berlin chase behind. There are many instances of “mimicry” across age groups and locations such as at 02:02 two women (in their 40s Riga) enter the screen and hold out their hands to rescue a boy and a man both in Berlin. Examples of “visual trickery” centered on the joining together in the two locations include at 07:45 three men (20s) in Riga, and two women (20s) in Berlin form a line and dance.

Instances that fit into the category of “closeness of the game” happen when participants remain faithful to the environments, and do not diverge from the suggested scenes, such as at 09:13 a man and woman in Berlin (20s) balance on a plank across a hole, a man in Riga (20s) steps in and gestures a wobble as if to almost fall.

Instances of “infinitude”, take place when the ending is unpredictable, they are situations that were unexpected so often have elements of the ludic which is closely aligned to “virtuality” such as at 11:07 a boy jumps from the quay into the boat, joining the boy in Berlin, while a woman in Berlin stands on the quay.

Instances of “ambivalence” or the movement between rule and chance, occur when people respond to the environments, often with unexpected outcomes such as at 06:55, three woman, two in Berlin and one in Riga (20s) sit on chairs at the table while a man in Riga (20s) stands on the table. At 07:00 the woman in Riga moves to stand on the table then jumps to the floor, the women (20s) in Berlin move their hands to spur her on. In the next frame 07:11 the woman in Riga (20s) moves back on to table top, the man (20s) in Riga moves to crouch in front of the table, all three woman stroke his head. The unpredictability of the actions are encouraged through the changing interface and in the next scene at 07:24 two men in Riga and a man and woman in Berlin stand on the floating cube of turf, while a woman holds the ankles of a man in Berlin.

Through this research we found that the environment and timing have a large impact on the way that an audience responds to an interactive work. Participants were at liberty to decide whether to engage with “Occupy the Screen”, and as soon as we turned the installation on even for testing people were keen to participate within the work, aligning with the notion and criteria of “freedom”. Having no goal outside it’s self; the environment was available for people to engage with as they wished. The inspiration was drawn both from the cities of Riga and Berlin, with input from the communities, but also from the idea of street interventions such as anamorphic pavement art where from a particular position the characters can look as if in a precarious situation.

In “Occupy the Screen” this included suspended on a plank high above a lake, or on an over sized wooden bridge. The installation was designed for the audience to engage in an intuitive way and there was no preconceived ending, in-keeping with the characteristic of “Infinitude”. The area of play was clearly demarked as a space via a blue box groundsheet in both Berlin and in Riga identifying a theatre of play, once in the space the participant engages as they wish. The environment may suggest activities or events but the audience is free to respond as they choose so that rules are limited and focus on the defined area of play in relation to the category of “closeness of the game”. This also meant that

"ambivalence", movement between rule and chance, serious and fun, impulse and cognition, immersion and reflection, were constant and in flux throughout engagement with the work. It is this fluidity, which is key to the characteristic of an open work, that there is much opportunity for the unexpected and that chance encounters can change the direction of a narrative that is unfolding.

We used our experience of previous installations to inform elements of the design to include objects that people can engage with, but also playing with perception of vision and illusion. This included a Pop-Art inspired tunnel, which participants intuitively jumped into, and steps which disappear into an underground bunker. There were also other events staged in Riga's Esplanade Park, with loud pop music playing through out each night, which initially seemed a little intrusive, but in actuality contributed to the work. From our observations optical illusions acted as a signifier of play, people inherently recognised the environment as playful, this may have been successful particularly because it represented "virtuality", a space separate from "real life".

We also used the notion of the computer game as a design reference, inspiring a child in the audience at one point to shout "Wow Supermario". We incorporated references such as box hedges suspended in space, which participants recognised as a game platform to jump on and between. The environments often implied a physical response such as jumping, diving or climbing, including a swimming pool to dive into, coloured boxes to climb across and a bridge to jump off. This may have contributed to the active approach that the majority of the participants took. This may have been further enhanced by the music, and many people engaged with the environment through dance. One woman stayed for several hours at the installation dancing and interacting with the other participants, returning the next night to do the same.

Figure 3. "Occupy the Screen". Audience participants in Berlin interacting with props. 12 Sept. 2014 ©Sermon, P., Gould, C.

The night-time showing of the piece, further added to a sense of playfulness, as people walked through the park on their way out and back from bars and clubs. The installation ran each night until 1pm to co-inside with the Berlin festival. We introduced ludic or nonsensical elements at times such as a boat (see fig. 3), which people responded to immediately by jumping into it.

People of all ages took part and adults were as likely as children to engage, particularly because of the late showing. We observed an uninhibited willingness to play from children. One girl played for hours engaging with the set, pretending to sit at the table, jumping into the tunnel, walking the plank etc. She engaged in a very performative way, with confidence and exaggerated movements. We also observed this enhanced ability to perform in some adults as well as responding to the environments they tended to engage with others from Berlin, pretending to scratch someone's head, or hold hands in order to jump into the tunnel, or lift someone up from the pool. The remoteness of the installations appeared to give confidence to cross into personal space that might otherwise be seen as a physical invasion of space. In many ways "Occupy the Screen" broke down cultural and social barriers, both in the local communities, but also between two cities, Berlin and Riga, where new collocated spaces and creative encounters could be founded and occupied.

Through this research project, we have developed a framework for open participatory artworks for urban screens to maximise audience agency through play, engaging the public in new ways in the urban environment, offering the public agency and developing events that create memory. Levels of openness were measured through a data map, from which we were able to define key characteristics, to provide a framework for open interactive systems for urban screens.

Acknowledgements

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Authors Biographies

Charlotte Gould (http://www.charlottegould.org) has developed a number of interactive environments for urban screens. She is currently developing location specific work in which the user becomes an active participant in the narrative and explores methods of user driven content. She graduated with a BA Honours Degree in Graphic Design from Chelsea School of Art in 1990 and was awarded an MA in Creative Technology from the University of Salford in 2003. Charlotte Gould is a Principle Lecturer and Academic Programme Leader for Visual Communication at the University of Brighton.

Paul Sermon (http://www.paulsermon.org) is Professor of Visual Communication at the University of Brighton. He has worked for over twenty years as an active academic researcher and creative practitioner, primarily in the field of telematic arts. Having worked under the visionary cybernetic artist Professor Roy Ascott as an undergraduate Fine Art student, Paul Sermon went on to establish himself as a leading pioneer of interactive media art, winning the prestigious Prix Ars Electronica Golden Nica in Linz, Austria, shortly after completing his MFA at the University of Reading in 1991. An accolade that took Paul to Finland in the early 1990s to develop one of the most groundbreaking works of his career Telematic Dreaming in 1992.

[Session 8]

Exploring Culture through Visualization and Interaction

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City to City: Revealing Place to Place

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Abstract

City to City is an interactive artwork that visualizes the geography of the internet, from place to place, and allows individuals to see their own unique participation in it. Users conduct their online activities and observe their own inquiries, distinguished by color graphics and sound, as messages travel from their points of origin to their destinations. Participants are able to see the visible and distinctive paths that compose the larger, collective global internet. *City to City*'s visualizations reveal the map of online traffic along with our dependency upon the invisible infrastructure of place to place connections; this infrastructure forms the foundation for all of our daily online activity.

Keywords

Visualization, Mapping, Internet, Interactive, Public Space

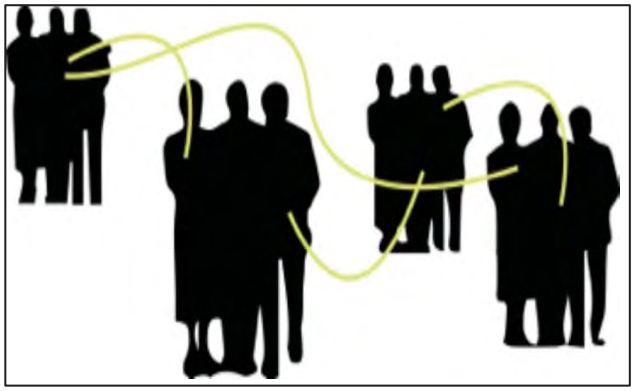

Figure 1: *City to City*, poster excerpt, January, 2014

Introduction

City to City maps the invisible geography of internet traffic, using graphics and sound to visualize and animate paths of online activity from their points of origin to their final destinations. A large map of the world is projected on a wall. Viewers of the installation opt-in as participants and carry out their online activities. Each individual is identified by color and sound; s/he can see her/his own distinct presence on the projected map of the world. Visitors see themselves become part of a growing network of other local users, all of whom are physically present in the same space. [Figures 2, 3, 4]

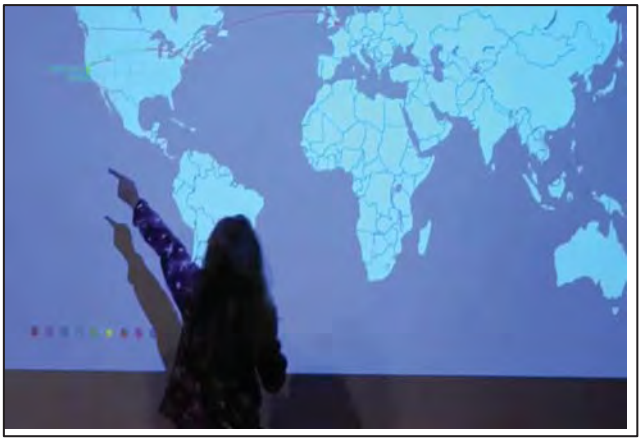

Figure 2: *City to City* installation view, Zero1 Garage, San Jose, CA, February, 2014

Figure 3: *City to City* installation view, Zero1 Garage, San Jose, CA, February, 2014

Figure 4: *City to City* installation view, Zero1 Garage, San Jose, CA, February 2014

As the map of visible and audible trajectories grows larger, and as each trajectory traverses across the globe, the routes connect city to city on the way to their destinations (Figure 4). In effect, this growing pattern of trajectories forms an overlaying second map which represents the hidden global interdependency of place to place, and metaphorically an emerging global intimacy, of which we are all a part.

Related Work

There is a growing body of works that create new cartographies outside of conventional Cartesian space through data visualization and use of the World Wide Web, and other locative media tools or systems. Some examples are listed here.

*Kit Galloway and Sherrie Rabinowitz's Hole in Space (*1980) is a seminal work using emerging satellite technologies linking two sites-- Lincoln Center for Performing Arts in New York City and *The Broadway* department store in the Century City Mall in Los Angeles. Cameras at both sites transmitted live feeds via satellites allowing passersby to see and hear each other. While *Hole in Space* enabled both visual and auditory connection and ours does not, both works enabled viewers to see themselves radically differently in relationship to the larger, invisible global network system and extend their perceptions of themselves beyond local.[1]

Like *City to City, The Virtual Dinner Guest* uses networks to create a site of social engagement the extends beyond the local, with a view to global community building. *The Virtual Dinner Guest* organizes dinners using video conferencing bringing people from different cultures, politics and geographic locations together to share a meal and conversation. Rooted in peace-building and conflict resolution, Eric Maddox, the project's founder, has held dinners in thirteen countries and across four continents.
(See: http://www.virtualdinnerguest.com).

Stamen Design, founded by Eric Rodenbeck in 2001, is a San Francisco based research studio using data visualization and interactive design to produce stunning, innovative maps. Using the map as an interface, the range and depth of their work are examples of the scope and aesthetics now possible thanks to emerging cartographic and analytical tools. (See: http://stamen.com)

The Satellite Sentinel Project uses satellite imagery to track evidence of atrocities on the ground in Sudan. Founded by George Clooney and John Prendergast in 2010, the project monitors changes on the ground and alerts policymakers, new organizations and activists to activate a global networked alarm system. *The Satellite Sentinel Project* fosters a new brand of global witnesses. (See: http://www.satsentinel.org/).

Background

City to City was the culminating project of a 2013-14 Fellowship which Zero1[2] and Google awarded to Paula Levine. The call was to develop an artwork that served to "interpret or illuminate the current state of difficulty associated with molding cultural policy so that it conforms to the reality of a society that is more connected with, and dependent on technology than ever before.[3]"

Levine's fellowship proposal was situated at the intersection of mapping and empathy, exploring implications of how interconnected and interdependent networks were changing and reshaping our daily lives. Her recent projects visualized the impact of distant geo-political events by transposing them upon areas otherwise untouched by those circumstances (TheWall, 2006, http://*thewall.name*; TheWallTheWorld, 2011, http://*thewalltheworld.net*; SanFrancisco-Bagdad,2004, http://*shadowsfromanotherplace.net*.).[4] In effect, these works aimed to conceptually collapse geographical space so that the impact of an event could be simultaneously viewed on both familiar and unfamiliar ground.

[1] Galloway and Rabinowitz were pioneers in early Satellite Arts and founders of the Electronic Cafe (1984) which preceded current projects using satellite and web technologies to bridge borders and boundaries. (See: http://www.ecafe.com).

[2] *Zero1: The Art & Technology Network*, is a Silicon Valley arts organization that sponsors a wide range of art, technology and science programs bringing together corporations, community and artists for project development, incubation of ideas and community collaborations. http://zero1.org.

[3] From the Zero1 Fellowship call for submissions, July, 2012. The residency ran between January, 2013-May, 2014.

[4] See: http://paulalevine.net for detailed project descriptions.

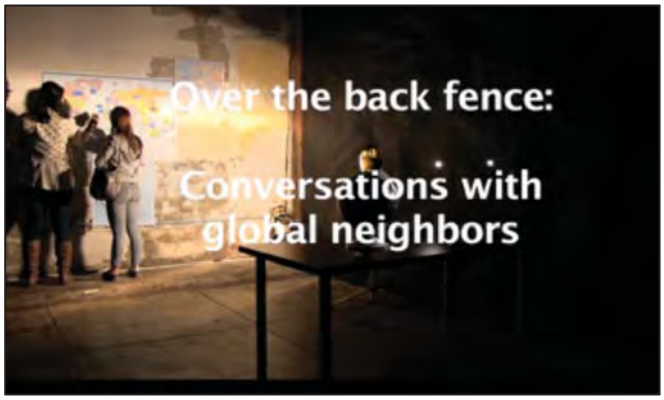

Figure 5: *First Friday*, Installation by Paula Levine, March, 2013,

Bridging between previous work and the Zero1/Google fellowship, Levine's initial plan was to design a platform that would, in effect, collapse the distance between local public space and public spaces elsewhere. This would allow participants to create and participate in a web of global communities that built upon the already existing place to place system of global internet connections.

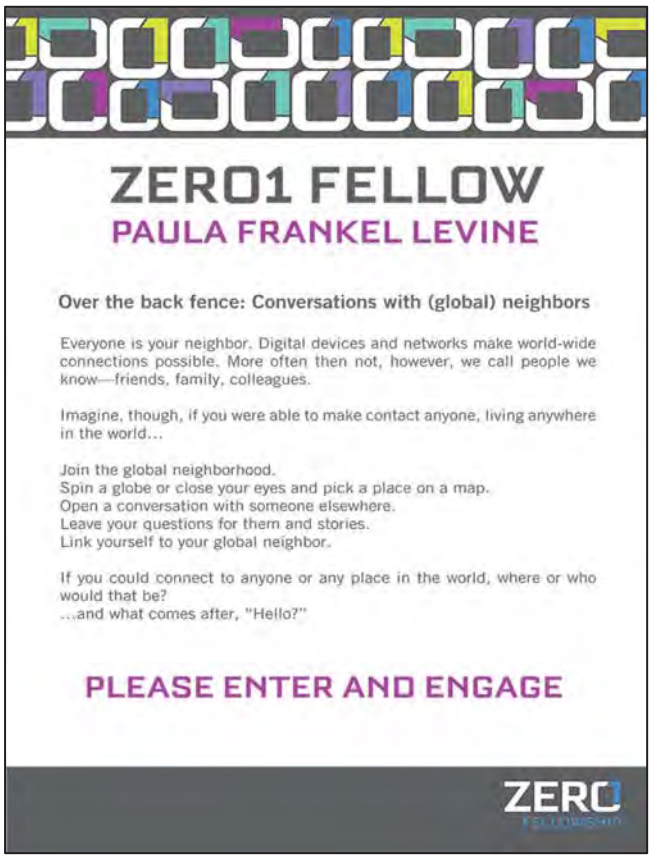

Figure 6: *First Friday*, Installation poster detail, March, 2013, Zero1 Garage, San Jose, CA

Process

Zero1 hosted the community of San Jose during the city's monthly *First Friday* events, which were described as when "street meets geek." (Figure 5). Galleries in San Jose's South First Area, including Zero1, could draw over 700 visitors to view art and participate in various cultural events and activities. Zero1 opened their Garage gallery space to visitors to view works in progress by current fellows and provide opportunity for the public to engage in conversations with them about their work.

Levine used the *First Friday* events in 2013 (Figures 5-7) as opportunities to conduct qualitative research focusing on visitors' use and understandings of the global internet system: how users spent their time online, their estimates of time allocated among work, research or entertainment, the places they would connect to over the course of a day, and their conceptual understandings of their own presence within the larger internet system. Through conversations, interviews and questionnaires, she consulted with about 100 participants and gathered data on patterns of use, expectations, as well as on visitors' impressions of themselves as part of the internet. Levine's goal was to formulate ideas for new designs that fostered place-based connections, such as a community-based system of networks bridging public space to public space, creating a more public global common ground for crowd-sourced global exchanges.

She discovered from research results that people thought in terms of person to person (peer to peer) rather than place to place connections. When asked about the value of place to place connections to support community building through, for example, open public platforms connecting one city or town's public space to another for networked collaborative events or message boards, participants hadn't considered such models of connections and questioned their use, application and value. Many participants expressed beliefs that diverse geographic locations already existed through multiplayer online gaming or group platforms like Google Hangout or Skype. Few could see how networked locations might function, or what they might be used for.

As the result of these conversations, it became apparent that we might focus on two initial objectives: first, to change people's perception of the World Wide Web by reflecting their own place and participation within it; second, to reveal the place-based system of connections in existence that sustained online user activities before considering ways to bridge between locations and build global community.

Our challenges became:
1. How to create an experience that would allow the public to envision themselves as a part of the global network as

active participants, indeed contributing shapers of the network itself?

2. How to make the public more aware of the invisible presence of the place to place infrastructure that was already in place, that supported and sustained their daily online lives?

Figure 7: *First Friday*, Installation detail. March, 2013, Zero1 Garage, San Jose, CA

Figure 8: *City to City*, Interactive installation, Zero1 Garage, San Jose, CA. January-May, 2014

City to City

Implementation

The web is a system of interconnected devices, and we, as users, are rarely aware of the physical locations of these devices or the paths that on-line inquiries take to travel from their point of origin to their destinations. *City to City*, as an interactive installation, addresses both--the reality of the physical devices located at various points in the network, and the paths that connect origins and destinations.

City to City opened at Zero1 Garage in San Jose on January 22, 2014, and was on view through May, 2014. (See Figures 2, 3, 4, and 8 for exhibition documentation). A large map of the world is projected on the gallery wall. *City to City* provides a wireless access local hub for visitors to Zero1 Garage to log into and access websites. The network traffic passing through the hub is captured, traced, geolocated, and displayed on the map.

When a user visits a website, s/he is usually only aware of the two endpoints of source and destination. The messages generated by a website visit may actually pass through many intermediate routing devices, located in different time zones, geopolitical regions, and continents. In *City to* City, the physical paths traversed by viewers' traffic, as they surf the World Wide Web, are interactively displayed on the map, making visible the intermediate place to place connections that enable the illusion of direct peer to peer user experiences.

In addition, as each animated network path passes through intermediate locations, pitched sounds are played on the *City to City* sound system. Pitches are selected based on the distance between the source (San Jose, for the opening at Zero1 Garage) and the intermediate network nodes. The result is a visually and aurally interesting display of the selected internet traffic travelling through the *City to City* wireless hub.

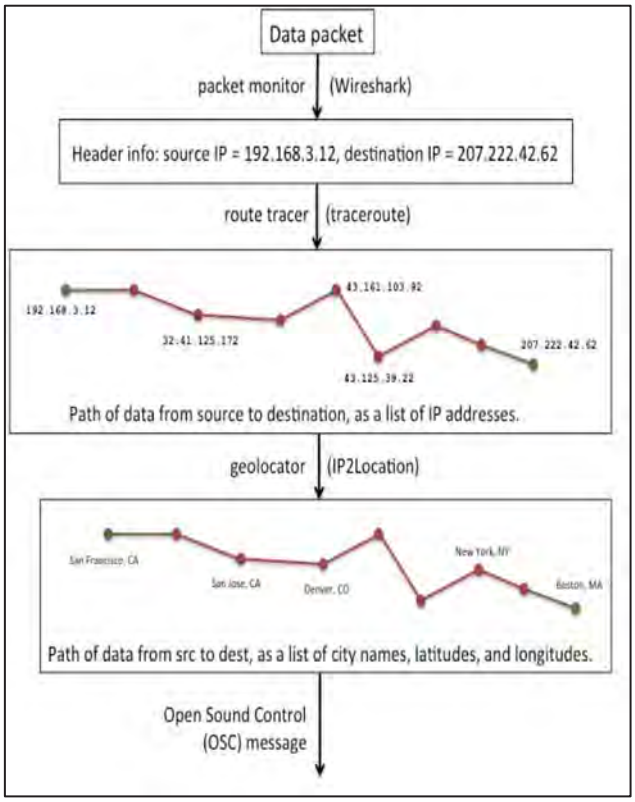

Figure 9: *City to City* software block diagram

Technical Details

The internet is a massive network of *nodes* with each node identified by a unique number--the *Internet Protocol (IP) address*. For example, when a user at the *City to City* installation site in San Jose, California, makes a connection to a website hosted in Berlin, Germany, the access follows a path consisting of a number of nodes, from San Jose to Berlin. To trace and display an internet access made by a user, the *City to City* software system goes through the following main steps:

1) Data packets using the *City to City* wireless hub are detected by the *Wireshark* packet monitor. (https://www.wireshark.org).

2) The IP addresses of the source (always Zero1 Garage) and destination are extracted from each packet.

3) The *traceroute* utility, found in most Unix and other common operating systems, is used to find all network nodes in the path taken by the packet, from source to destination.

4) The *IP2 Location* geolocator[5] looks up the location (i.e., name, latitude and longitude) of each node, based on its IP address. The path taken by the user's internet access is traced on the projected map. In addition, the node location data is mapped to pitches based on distance. This sonification is rendered as the path is traced on the map.

Each viewer's internet access is processed on-the-fly by *City to City*'s software system, as the outgoing message packets of an access are detected by Wireshark. Traceroute and geolocation sometimes require a few seconds to deliver their results; hence, there is a slight delay from the moment a viewer initiates her/his access, to the display of the path on the projected map.

Project Outcome

Through the opening of *City to City* in January, 2014, and on various subsequent First Friday events at Zero! Garage, , we observed that visitors were quickly drawn to the map of internet trajectories. They seemed to understand quickly and intuitively the main operations of the installation. This was verified in conversations with participants. While many were creating internet accesses and obseving their trajectories on the map, others observed the results of the participant's engagements. (See: Figures 2,3,4,8).

City to City exposes the unexpected. For example, shortest or most direct routes are not always ones taken. Instead, network messages may take paths of least resistance in situations where high traffic demands are an issue.

The project also makes visible a daily worldwide system of mutual dependency within a borderless world. *City to City's* map, of seemingly frictionless connections over huge distances, appears in striking contrast to daily realities on the ground—ones of daily struggles, skirmishes and territorial conflicts over international and regional borders and boundaries.

Conclusion

We have come close to a system of networks that Leonard Kleinrock described in 2001 as one that serves "nomads as they move from place to place in a way that is transparent, integrated, convenient and adaptive." (as cited in William J. Mitchell's *The Cyborg Self and the Networked City,* 2003). It appears that another model is emerging--one of a rapid globalization that is bringing people in closer proximity to each other than ever before. It is a world that, according to Jeremy Rifken, is becoming "transformed into a university public square."

> While the backlash of globalization--the xenophobia, political populism, and terrorist activity--is widely reported, far less attention has been paid to the growing empathic extension, as hundreds of millions of people come in contact with diverse others.

City to City connects participants to their online activities and reveals the presence of the hidden infrastructure of place to place connections that makes online lives possible. There are many leaps from an awareness of the hidden place to place connections, to networked communities and a transformation from nomad to global citizen. The first step, however, is envisioning more innovative platforms using existing network infrastructures to foster bridges between and among people, in order to empathically connect local needs and global actions, as well as local actions and global needs.

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Installation documentation of *City to City* is from the *Zero1 FellowshipX Exhibition,* Zero1 Garage, San Jose, CA. (January, 2014-January,,2014)
http://zero1.org/exhibitions/fellowshipx.

Video documentation of the graphic and sound mapping of the network traffic generated by participants can be found at: https://vimeo.com/100775811. This video, along with addi-

[5] http://www.ip2location.com

tional project information, can be found on the *City-to-City* website: http://city-to-city.net.

• All photographs are by Paula Levine.

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Authors' Biographies

Paula Levine is a media artist whose work brings together daily life and global politics. Utilizing various media, objects and venues, her work configures common ground between sites of political trauma or upheaval, and places untouched by these events. She has been an artist in residence at The Banff Centre for the Arts, the Experimental Television Center and the Djerassi Foundation, and has been the recipient of many awards and grants. Her essay "On Common Ground: Here as There," is a chapter in The Mobile Story: Narrative Practices with Locative Technologies (Editor: Jason Farman). She is a Professor of Art, San Francisco State University. Website: http://paulalevine.net

Bill Hsu has built interactive pieces and installations in collaboration with Peter van Bergen, John Butcher, James Fei, Matt Heckert, Lynn Hershman, Jeremy Mende, and Gino Robair, among others, and performed in the US, Europe, Asia, and Australia. Articles on his work have appeared at huffingtonpost.com and slashdot.org. He teaches and does research in the Department of Computer Science at San Francisco State University.
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DaDa Visualisation

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Abstract

Inspired by Tristan Tzara's DaDa poetry, in which the words of a newspaper article are randomly reassembled to create an original poem, DaDa Visualisation is a whimsical interactive artwork producing dynamic generative visualisations based on a catalogue of poems. This paper outlines the work and examines the key issues and ideas to which it responds. It defines data visualisation as a lens that is increasingly applied to all aspects of our lives, and while typically heralded as a revelatory scientific instrument it shows data-vis as a creative cultural form. Fundamentally, DaDa Visualisation is an irreverent celebration of our fascination with data and data graphics but also provides a valuable critical perspective, reminding us that data visualisations are neither benign nor impartial but the product of authorial agency.

Keywords

data, visualisation, generative, art, poetry

Introduction

A common mantra of today's networked society is that we are drowning in an ever increasing sea of data and the way to bring order and sense to this otherwise incomprehensible volume of information is through data visualisation. The mantra has evolved for good reason; the scale and rate of data generation is estimated at 2.5 quintillion bytes of data daily with over 90% of the world's data generated in the last two years. [1] The issue is not only quantity but the fact that much of the data is illegible in its raw state; our only way of appraising these data sources is through some kind of representation. Consequently, and as importantly, the rise in data production has seen a reciprocal increase in the incidence of data graphics, with data visualisation earning a privileged status in our data-centric culture. And as we become more familiar and literate with data and its graphical representation we are examining every aspect of our daily lives through the data lens. The rise of personal analytics and with it personal tracking devices, services and apps is just the latest example of our growing fascination with data collection and representation. It is from within this context that DaDa Visualisation emerges and it is to our insatiable appetite for data visualisation that it responds.

DaDa Visualisation

The title of the work is inspired by Tristan Tzara's DaDa poetry, in which the words of a newspaper article are randomly reassembled to create an original poem. Rather than newspaper articles, DaDa Visualisation treats poetry as a dataset for dynamic generative visualisations. The work consists of two distinct parts; the physical and the virtual. The physical component is a simple thermal receipt printer situated on a slender white plinth. [Fig.1] The virtual component is a web catalogue customised for mobile devices and presenting a series of poems contributed by notable Australian authors; Paul Hetherington, Lucy Dougan, Ross Gibson, and Jen Webb. [Fig.2] An audience member can peruse the poems, make a selection and see it transformed into a series of data graphics via the thermal printer.

Figure 1. The title to DaDa Visualisation's catalogue of poems, designed for viewing on mobile devices.

The website is a modest production; the poems are laid out simply as per the authors' original compositions, the bold title typography and minimal colour scheme providing visual character - a direct reference to Tristian Tzara's "Bulletin DADA" of 1920 [2]. [Fig.3] Each poem is accompanied by a "DaDa Visify" icon which, when tapped/clicked, brings the thermal printer to life. After a moment's hesitation, the printer spews out a print 7cm wide and between 40-70cm in length. [Fig.1] Below a cryptic re-worded title at the top of the page, the print features a stream of graphics separated into vertical blocks by thin horizontal borders. [Fig.4] The blocks offer an assortment of different graphical approaches, most accompanied by a succinct descriptive label. The "Word Length" and "Vowel Frequency" blocks are the most recognisable as conventional graphs; Word Length is a simple bar chart and Vowel Frequency is a regular line graph. "Letter Count" is also of the graph variety but offers a less typical rendering with tonal density indicating the total count of each letter. A number of bold typographic blocks provide statistical summaries such as the total number of characters, words, and lines, as well as the most popular letter, punctuation and word. "Char : Space : Punc" indicates the relational ratios of characters, spaces, and punctuation. Finally, two pattern blocks are untitled and unexplained but their layout and spacing suggests a connection to the visual composition of the original text.

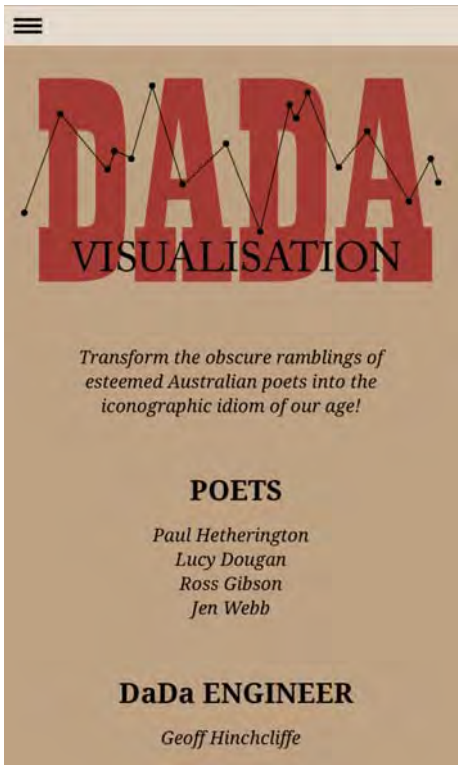

Figure 2. A poem in the process of being output from the thermal receipt printer.

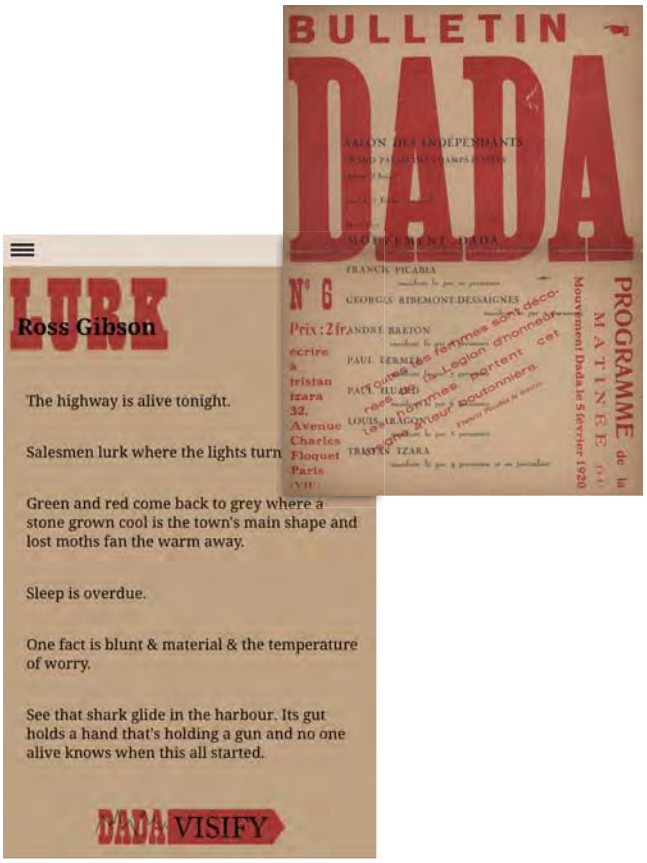

Figure 3. Bottom left: "Lurk" by Ross Gibson displayed in the mobile web interface. Top right: "Bulletin DADA" by Tristian Tzara, 1920.

There is a playful enquiry driving the different graphical representations and a clear concern for the visual aesthetics: the banality of a letter count is converted into a beautiful mosaic of tonal discs; the irrelevant measure of vowel frequency is painted as an elegant intertwining structure of ligaments and joints; the abstract patterns of illegible letters and word blocks create stark graphic compositions revealing incidental rhythms of the original text. [Fig.5] But the most remarkable characteristic of the work is its subject-matter; written poems are an unlikely source for a data visualisation. In treating written poems as a data source DaDa Visualisation foregrounds our fetishistic relationship with data and its representation; its logic seems to be that if we can use data-vis to reveal new meaning about "big data" (the human genome, global warming, national census data), why not use its revelatory powers on poetry? Here data visualisation is a lens that can be applied to any source and increasingly the purpose of that application is aesthetic rather than practical. In this regard, DaDa Visualisation joins a rapidly expanding field of practice concerned with data visualisation as an aesthetic creative medium.

The field is represented by sites such as infosthetics.com and flowingdata.com, both of which use a blog format to report on works and events related to visualisation as a creative form and practice. It should be emphasised that the examples celebrated in sites such as these are firmly grounded in the science of data analysis as well as its aesthetic representation. Perhaps more than any other practitioner, Nicholas Felton has driven the development of data visualisation as an aesthetic lens. His "Feltron Annual Report" series, which present his own, often banal, personal data as beautifully crafted data graphics today exist as a distinct genre of infographic visualisation. [3] The significance of the works, initially viewed as humorous curiosities, continues to increase particularly with the immense growth in "personal analytics" and the "internet of things" - both of which are notable for their presence in our everyday lives. The everyday is a complex cultural context and one that demands very different aesthetic approaches to the office, lab or work site. [4]

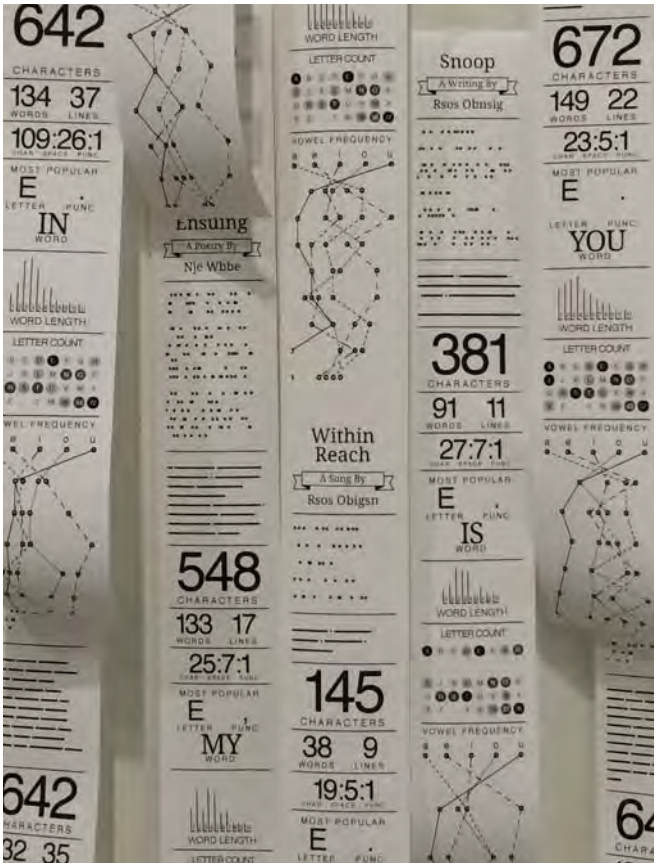

Figure 4. A collection of visualised poems.

Like others from this emerging field, DaDa Visualisation celebrates data-vis as a creative form but through its absurd production of charting written poems [Fig.4,5] it speaks to our obsession with data and to our fascination with seeing our reality quantified and charted. The dislocation between the screen-based text and the thermal printed graphics emphasises the black-box nature of data visualisation: data goes in, magic happens, and visualisations emerge. There is no option to interact or even witness the visualisation process. While somewhat oblique, the graphics are also entirely "accurate". They remind us that data visualisation is not an impartial scientific instrument but a complex cultural form; a form that we typically afford an abnormal authority.

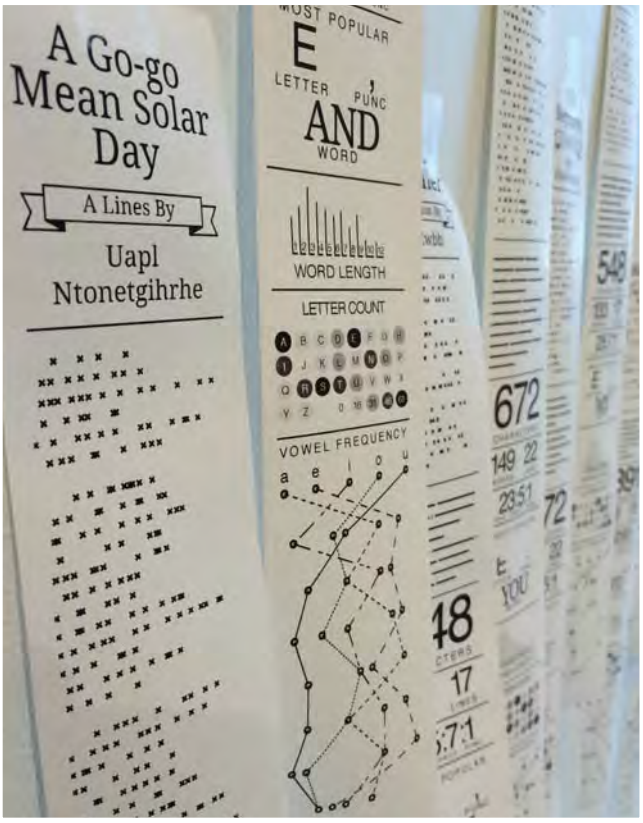

Figure 5. The title in the foreground is generated by replacing the original words with similar terms. The letters of the author are randomly reorganised to form the nonsensical name.

Data scientist, Pete Warden, draws our attention to this implicit trust stating that the *"wonderful thing about being a data scientist is that I get all of the credibility of genuine science, with none of the irritating peer review or reproducibility worries"*. [5] In the same post Warden cites various cases in which his own work has been used by journalists and social groups to substantiate spurious claims with no understanding of the quality of the data or process that generated the visualisation. Guardian data-journalist John Burn-Murdoch echoes Warden's concerns, citing the case of the Washington Post's *"Map of the world's most and least racially tolerant countries"* which enjoyed viral social media exposure and syndication by dozens of large media sites despite criticism from qualified experts regarding the methodology and data upon which the map was based. [6] Burn-Murdoch notes that comparatively, the criticisms had less than 1% of the social media exposure of the data map.

These examples point not only to the potential misuse of data visualisation but also to its persuasive power and our propensity to trust graphics without the same scrutiny we apply to text. Burn-Murdoch posits that this critical inability stems from education - while we are taught to critique text, *"data visualisations are overwhelmingly used simply as a medium of displaying final results"*. [7] With its "before and after" view of a poem, DaDa Visualisation questions the conclusivity of data charts and makes apparent the violence involved in the transformation of data to graphic form. It shows that all data graphics (accurate or not) are an abstraction, a performance of an original "text". And with its cryptic and poetic graphical renderings, DaDa Visualisation's approach to the performative is intentionally provocative, challenging common conceptions that utility and legibility should be prioritised over all other aesthetic concerns [8]. It ignores such obligations to a legible truth, instead focusing on visualisation as a medium that can question and entertain as well as inform.

Conclusion

While conventionally viewed as an instrumental form, data visualisation is increasingly being explored as a creative medium; a lens that can be applied to all manner of data and information. In its bid to render the poems of four notable Australian poets as data graphics, DaDa Visualisation reveals the absurdity of our efforts to see all aspects of our lives quantified and visualised. It reminds us that data visualisations are neither benign nor impartial, and are far from conclusive; they are products of an authorial process which is as much about the ingenuity of adaptation as it is about the accuracy of the form.

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Living Mandala: The Cosmic of Being

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Abstract

This paper presents the motivation, background, and implementation of *Living Mandala: The Cosmic of Being*, an interactive graphics installation that combines real-time data, multi-cultural mandalas, scientific imagery, cosmological symbols, and sound. Built with an open source programming language and environment, this living contemporary symbol is an exploration into uncharted territories of the human soul sculpted by our present time. Its interactive revolving graphical system visualizes our perceptions of life (microcosm) and the universe (macrocosm), our connections to ancient mythology, cosmology, and cultural heritage, and the relationships among humankind, science, technology, and nature in a globalized society. Merging cultural traces—art, history, science, and technology—this living organism alters every moment, responding to the movement, color, light, sound, and temperature of its surroundings. Following ancient quests, it separates indigenous mandalas from traditional cultural context to build one that is contemporary and universal.

Keywords

Mandala, Visualization, Data, Interactivity, Real-time, Cosmology, Mythology, Universe, Knowledge, Symbol, Graphics, Icon, Nature, Generative, Technology, Digital Art, Processing, Arduino, Center.

Introduction

What is Mandala?

> The vegetative universe opens like a flower from the earth's centre,
> In which is eternity.
>
> William Blake [1]

In Sanskrit, mandala means secret circle and center—the symbol of the cosmos in its entirety, while the square is the symbol of the Earth and human-made world. Its traditional design hence often consists of a series of concentric forms, suggestive of a passage between different dimensions. In this essence, it pertains not only to the Earth but also to the macrocosm and microcosm, the largest structural processes as well as the smallest. It is the gatepost between the two. Thereby the mandala is a living structural matrix subjected to the infinite processes of growth and transformation by the virtue of the ever-changing relationships both internal and external to its basic structure. [2] The center is the beginning of the mandala, the origin of all forms and processes, and ultimately the eternal potential. The center of the mandala is not only the external space but also of time. The center of time is *now*. [3] When living in the present, one's physical existence and position in consciousness unfold like a mandala at the center of one's own compass, awareness, and experiences. Expanding from its center, mandala is a manifestation reflecting human consciousness and perception of the universe in their present time, which continually appeared in rituals and art forms throughout history.

Digital Artworks Inspired by Mandala

Although the roots of digital art are ancient and varied, digital art came into existence shortly after the development of the computer, which emerged in its modern form in the 1940s. [4] During the six decades of human-computer interaction and computer graphics development, mandala and its abstract symbolic form have continuously influenced artists to explore and create new artworks digitally. James Whitney's astounding analog film, "Yantra," (1957) anticipates the digital visual effects of brother John Whitney's "Catalog" (1961) and mandala-like symmetry of James' "Lapis" (1966). In the tradition of cymatics, pioneered by physicist Ernst Chladni in the late-eighteenth century, "Protrude/Flow" (2001) by Sachiko Kodama and Minako Takeno interactively transforms three-dimensional patterns in black magnetic fluid to stimulate viewers' most primitive emotions, which appears to be choreographed to its sonic environment. [5] "Nanomandala" (2003) is an installation by media artist Victoria Vesna, in collaboration with nanoscience pioneer James Gimzewski. It projects images in evolving scale from the molecular structure of a single grain of sand to the recognizable image of the complete mandala, and then back again. Inspired by Buddhist and Islamic art, Anne Spalter manipulates city footages around the world to develop patterned compositions that explore the concept of "modern landscape" in her works such as "Meditations" (2014).

Rationale and Objective

> Where is the Life we have lost in living?
> Where is the wisdom we have lost in knowledge?
> Where is the knowledge we have lost in information?
>
> T.S. Eliot [6]

As a Chinese artist living in the Western world who continuously explores visual art and cultures, it is astonishing

for her to realize that certain universal symbols appear in different cultures and represent eternity, divinity, and harmony. One of those is mandala, the symbol of the round of life and death, of the cosmic procession of beings, planets and stars, of earthly seasons and galactic cycles. [7] Whether it is the Chinese I-Ching, Navajo ceremonial sandpainting, Tibetan meditation sandpainting, or Aztec calendar, mandalas present views of humankind as the microcosm through their own compasses. Since our world has dramatically transformed in the past two hundred years and the stages of human development remain the same as they were in the ancient times, the artist's intuition led her to wonder what a contemporary mandala would be, for which this project was created.

Digital media provides a means for artwork to consist of motion, time, light, data, sound, and interactivity, which serve artists to envision and represent the complex message of their work. *Living Mandala: The Cosmic of Being* is a new approach to visualize mandala, an ancient art form, in a contemporary context using digital technology.

The three components of this project present three different timeframes:

- The thirty-six colorful mandalas from sixteen cultures on the bottom layer represent the past five millennia;
- The fifteen white semi-transparent graphics of human studies on the middle layer represent the past five hundred years;
- The real-time computer generated interactive graphic system on the top layer represent *now*, the center of time.

When the three images from each group overlap representing different times and human consciousness simultaneously, *Living Mandala* is born, which connects art, culture, science, information, and technology from the past to the present in a harmonious and meditative unity (Figure 1).

In his most influential theological work *Pensées*, Pascal said, "Man is but a reed, the most feeble thing in nature; but he is a thinking reed… All our dignity consists, then, in thought. By it we must elevate ourselves, and not by space and time which we cannot fill." [8] The multicultural mandalas and graphics of human studies on the bottom and middle layers are the visual representations of human thoughts in various fields including cosmology, mythology, mathematics, physics, chemistry, and more. These fine images are as if the atoms of an intellectual sphere coming out of our past. When this beautiful sphere blends with real-time interactive graphics representing *now*, this marriage signifies human cognition as a whole through a condensed timeline. Such sophisticated and universal visual experience with appropriate sound effects could communicate with the audience from various backgrounds at mental, spiritual, sensory, and emotional levels. This experience might lead to deeper contemplations among the viewers, so that the seeds of knowledge could be sowed in accordance with each viewer's inner compass.

Living Mandala: The Cosmic of Being not only reflects our present awareness and perceptions of the universe, but also investigates the changing relationship between humankind and its environment since the Industrial Revolution. The objective of this work is to expand aesthetic experience and enhance human perceptions of the rapidly changing global environment, the universe, and the center of being. Enriched by profound cultural heritage, this dynamic and symbolic graphical system bridges ancient mandalas, cosmological icons, scientific and technological studies, nature elements, and real-time interactive graphics, through which new meanings and imaginations emerge.

Figure 1. A screenshot of *Living Mandala*: Tibetan Sandpainting Mandala by Tibetan Buddhist monks from the Drepung Loseling Monastery, Information Technology, Wind. © Jing Zhou.

Making of This Mandala

Using known technology, this project was built with Processing (an open source programming language) and Arduino (an open source hardware).

Edward Tufte, a pioneer in information design and data visualization, stated that among the most powerful devices for reducing noise and enriching the content of displays is the technique of layering and separation, visually stratifying various aspects of the data. [9] With complex graphics throughout human history and intricate interactivity, the system consists of three overlapping layers each representing a different timeframe, shown in Figure 2. The bottom layer contains multicultural mandalas in five thousand years of history; the imagery on the middle layer shows human researches in the past half millennium; the top layer generates real-time interactive graphics responding to the movement, color, light, sound, and temperature of its surroundings.

The Bottom Layer

On this layer is a looping animation of thirty-six mandalas and cosmological circular imagery collected from sixteen

cultures in five millennia. The image changes calmly every five seconds.

In order to make a diverse and balanced mandala collection from world cultures as many as the artist could find, the searching and selection process is both time-consuming and rewarding, because some ethnic groups created many more mandalas than others.

The sequence of the thirty-six mandalas was organized in accordance with the aesthetic quality and cultural diversity, which the artist intended to present in the project. Mandalas were often used in rituals and ceremonies of many spiritual traditions for focusing attention, meditation, and establishing a sacred space, so it is important to inherit such aesthetic, meditative, and integrative qualities in this digital mandala, which would bring a sense of beauty, tranquility, and relaxation to the audience. As a result, in order to ensure smooth transitions from one mandala to the next, the image sequence was carefully arranged to harmonize the changes of colors and symbols from each mandala to the next. Meanwhile, this interactive mandala was designed to reflect our contemporary consciousness and perceptions. As the Internet and air travel enable millions of people today to experience different cultures with great speed, not showing two mandalas from a similar culture in a successive order is more suitable to visualize this concept than grouping mandalas by regions or cultures. Therefore, this seemly random sequence of mandalas indicates a dynamic and globalized society in which we live.

Here are the thirty-six mandalas divided into twelve groups in alphabetical order.

Africa
- African Bwa Sun Mask

Australia
- Aboriginal Painting (20th Cent.)

Central Eurasia
- Scythian Kelermes Mirror (6th Cent. BC)

Far East
- Chinese I-Ching and Zodiac (30th Cent. BC)
- Chinese Zodiac Bronze Mirror (7th Cent.)
- Chinese Cosmological Mandala (12th Cent.)
- Chinese 100 Longevity Characters
- Japanese Mandala (17th Cent.)

Hinduism
- Hindu Chakra
- Indian Sri Yantra
- Jain Meditational Yantra (17th Cent.)

Judaism
- Jewish Merkabah Mysticism
- Jewish Sepher Yetzirah Wheel

Middle East/Mughal Empire
- Arabic Miniature (16th Cent.)
- Egyptian Zodiac (50 BC)
- Islamic Mosque Ceiling, Tr (15th Cent.)
- Mughal Emperor Shamsa (17th Cent.)

Multiple cultures
- Aztec, Greek, and Egyptian Ouroboros

North America
- Diegueño Ceremonial Sandpainting
- Navajo Ceremonial Sandpainting 1
- Navajo Ceremonial Sandpainting 2

South America
- Aztec Calendar
- Maya Calendar

Tibet
- Tibetan Mandala
- Tibetan Sandpainting 1
- Tibetan Sandpainting 2
- Tibetan White Tara Mandala

Western Europe
- Byzantine Art and Zodiac (13th Cent.)
- Celtic Bronze Disc (500BC–500AD)
- Celtic Cross
- Chartres Cathedral Labyrinth, Fr (12th Cent.)
- Christian Celestial Maps (18th Cent.)

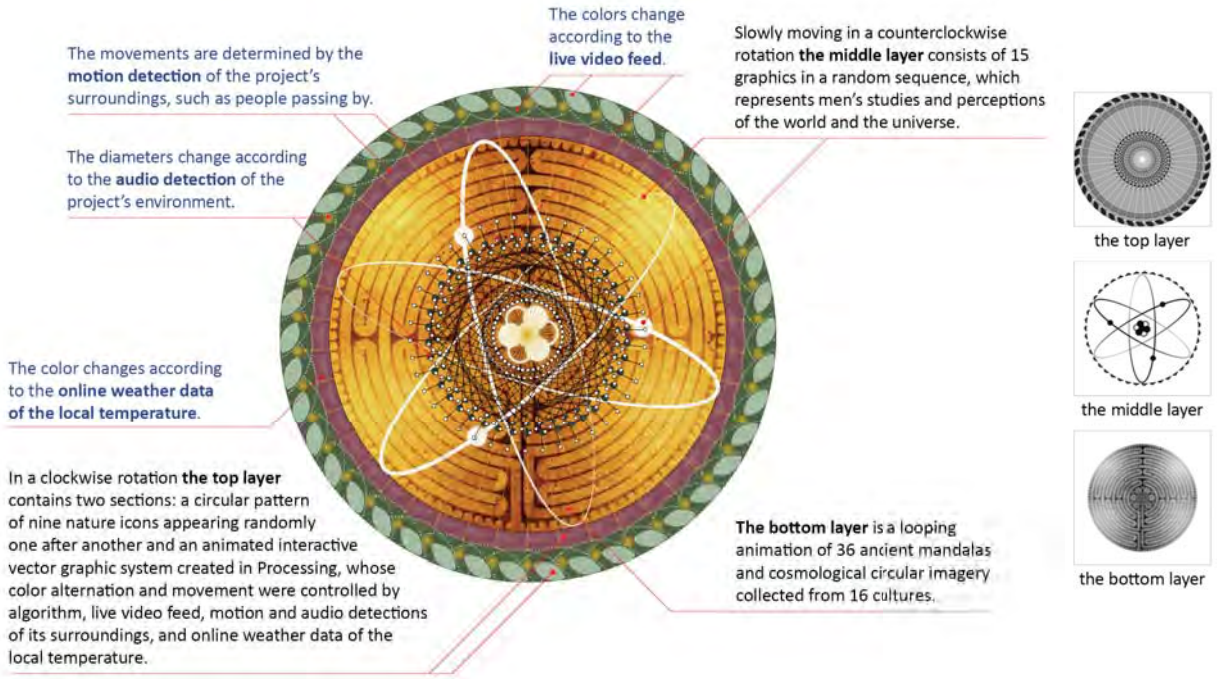

Figure 2. Diagram of *Living Mandala*. © Jing Zhou.

- Greek Phaistos Disc (20th Cent. BC)
- Strasbourg Cathedral Rose Window, Fr (15th Cent.)

The Middle Layer

Slowly moving in a counterclockwise rotation the middle layer consists of fifteen white semitransparent circular graphics, carefully selected by the artist, in a random sequence indicating the dynamic of change in the past five centuries. Every graphic image was either designed by the artist or recreated digitally based on a public domain image. Those images represent human studies and perceptions of the world and the universe, among which are the Vitruvian Man, the path of Venus relative to the Earth over eight Earth years, the constellations, the golden ratio pentagram, the planetary orbital paths, phyllotaxis patterns, the Seed of Life, Galactic Geometry, the Platonic solid – dodecahedron, GPS satellite constellation, atom diagram, and the illustrations representing Industrial Revolution, information technology, sound waves, and the electric field.

The Top Layer

In a clockwise rotation the top layer representing *now* contains two sections: a circular pattern of nine nature icons appearing randomly one after another and an animated interactive vector graphic system programmed in Processing.

Albert Einstein wrote, "A human being is part of a whole, called by us 'Universe,' a part limited in time and space". [10] Although this art project bridges many aspects of humankind in art, history, culture, mythology, cosmology, science, technology, anthropology, etc., it is equally important to combine classical elements and basic components from the natural world, which are part of the universe. For instance, in classical thought the four elements earth, water, air, and fire frequently occur in ancient Greece, China, and India. Thus the following nature icons were created by the artist for this project: water, fire, mountains (earth), stars, leaves (wood), wind (air), feathers, shells, and animal tracks.

This interactive vector graphic system was designed to be able to see, hear, feel, and think, as if it was a creature, shown in Figure 2. The live video feed and motion detection allow it to see; the audio detection makes it sensitive to sound; the changing colors synchronizing with online weather data of the local temperature indicates how it feels; the color alternation and movement determined by algorithm enable it to think.

The Installation

Living Mandala: The Cosmic of Being can be presented on monitors and projection screens. All external hardware devices are packed in a custom-made black acrylic box. The background sound is a combination of meditation music and chanting from different cultures. However, this project could also be shown in silence or with white noise.

The Conclusion

The interactive graphics installation presented in this chapter connects the potential of digital technologies with traditional art, culture, mythology, and scientific studies, in order to create aesthetic and meaningful experiences for diverse viewers. *Living Mandala: The Cosmic of Being* is much more than an animated interactive infographic. It transcends the concept of mandala and touches the core components that matter today: mixing multiple data streams in a single platform; building an environment for consideration of data in cultural and temporal realms; presenting a framework in the context of human history; and packing striking and universal visual components and conceptual thinking into a limited presentation space. Furthermore, it translates the dynamic contemporary cultural landscape—a modern approach to an ancient quest—to enhance human cognitions and perceptions of the universe and humanity in our time.

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Born in China, Jing Zhou is a multimedia artist, designer, and educator in USA. Her work has been widely shown and collected internationally including: Triennale Design Museum, Milan; British Computer Society, London; Asian Cultural Center, New York; SIGGRAPH Art Gallery; ISEA; Royal Institution of Australia; Danish Poster Museum; Sardinia Film Festival, Italy; Athens Video Art Festival, Greece; Taksim Republic Art Gallery, Istanbul; FILE, Sao Paulo; Korea Visual Information Design Assn.; Goethe Institute Alexandria, Egypt; Hungarian Electrographic Art Assn., Budapest; Mundaneum, Belgium; Brown University; public collection of the WRO Media Art Center, Poland; Waikato Museum, New Zealand; SDAI Museum of the Living Artist, San Diego; and Chinese Culture Center of San Francisco. [www.jingzhoustudio.net]

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Reopening the inscription
Rodrigo Arteaga, from the inscription to the phenomenon

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Abstract

Maps are a key element in the practices of Rodrigo Arteaga and of Fitz Roy, despite the different backgrounds, and the interval of centuries. Fitz Roy is the commander of *Beagle* and *Adventure* who explored the Chilean landscape cut by the oceanographic topography, channels, rivers and capes from Patagonia to the Antarctic Continent in the nineteenth century. Rodrigo Arteaga is the young Chilean artist, in exhibition since 2009, whose work deals with expanded cartographies like hydrographic basin, astronomy and others. In *Libros Abiertos* a series from 2012, Arteaga juxtaposes pages taken from old volumes of anatomy, botany, astrology, maps of the watershed. The capillarity of rivers and tributaries are displayed next to scientific images of arterial anatomy and membrane fragments suggesting what, in a way, resembles calligraphies to be interpreted. We know that for the observed phenomena to be transcribed into a flat topography, various tools and much knowledge are needed. And yet the transcription should be intelligible in the Knowledge Network. This is exactly what Fitz Roy wanted from the phenomenon transformed into a readable abstract inscription. Rodrigo Arteaga predicts that the inscription is reversible and can be reopened into the observed phenomenon again.

Keywords

Maps; abstract inscription; phenomenon; Knowledge Network.

The narrative of Fitz Roy's travel attempts to account for a variety of natural phenomena that influenced the navigability in the southern hemisphere. His purpose, in addition to following instructions bound by the economic and political interests of the English Crown when exploring the passage from the Atlantic to the Pacific, was to improve the navigation charts by providing updated information. Winds and sea currents, water and weather temperatures, earthquakes, climate changes are described just as well as the recognition of flora and fauna and of the society under development in such an inhospitable land: the shock of the settlers with the natives, the adaptation of foreigners and the survival of the natives and their social system, used to few resources and hard weather, facing the presence of missionaries and explorers who docked on their land. The details of his daily records on the tides and winds were useful to reconfigure the old Spanish maps of the coast and rivers. Furthermore, as a good surveyor and meteorologist observing on the spot, Fitz Roy was able to realize how these data influenced the navigation. [1]

Travelers and shipwrecked, helped each other sharing information and supplements as they could. They formed a network, which can be exemplified in the fact that they used one of the small islands as a place to exchange their correspondence, in the Post-Office Bay, so named because it was where sailors sought for received letters and other letters for which the addressee was at a location on their route (ROY, 2013, p. 420). The Beagle and Adventure ships under Fitz Roy's command could be considered mobile laboratories. The surveys made in those days are comparable to projects of environmental census nowadays, with their measurements, charts and graphs, with data collected in different languages and formats. The Beagle became famous in history for having for five years a renowned researcher on board, Charles Darwin who was part of the group of 74 members, most of them sailors. According to Fitz Roy's remarks the young biologist could contribute more than the surgeon in charge of the health of seafarers, who in his spare time would be also responsible for taking notes on the specimens collected during the trip. Charles Darwin, during the voyage, kept constant correspondence with his former teacher John Stevens Henslow. Despite the distance and the difficulty of communication, the collaboration between the two narrowed. Henslow in England was Darwin's advisor, guiding Darwin, through letters, as to how he could continue his research. It was he who received the boxes with the assessment of the surveyed specimens from the southern hemisphere. The task of scientists is only effective through networks, technoscientific networks, if we are to use Latour's term. And we see Charles Darwin implied in two networks that led him to the southern hemisphere: still young when he left as a research biologist at the Beagle, led by Fitz Roy (1831- 1836), and then in his maturity when he had Fritz Müller as his collaborator making remarks in the open (a friendship kept over the years, from 1861, when Fritz Müller read *On The Origin of Species* until 1882, date of Charles Darwin's death). Fitz Roy and Charles Darwin and / or Fritz Müller and Charles Darwin characterize cartographies of knowledge, or Knowledge Networks according to Latour. Knowledge Networks nourish the Calculation Centers with the mobilization of scientists going abroad to exotic places first, and then in their return, comparing the new data and species that were brought from the peripheries with the ones of the collections. The species away from their places of origin, inside a collection - data centers where the capitalization of knowledge happens - are transformed into abstract entries that are comparable within the collection, and so universal.

Knowledge Networks

Knowledge Networks are nourished with the movement between the periphery and the center. Taking and bringing specimens within scientific expeditions has mainly two different purposes: when moved to the peripheries for cultivation aiming the survival of sailors, as the case of shipwrecks from exploratory trips, or when they are brought to the Centers for study means, drawn or as dried specimens, exsiccates, and inserted in the collections and herbariums spread in Europe, such as Kew Royal

Botanic Gardens in London, to where several examples of South American flora were brought. [2]

Figure 1. Tillandsia tenuifolia var. surinamensis, one of the specimens collected in Brazil and sent to Europe by Fritz Müller, that today is part of the collection of Kew's Herbarium, Royal Botanic Gardens as a dried plant. [3]

The parameters of Natural Sciences were present in the practices of Fitz Roy and of the naturalist Fritz Müller while they were exploring the southern hemisphere in the nineteenth century, *i.e.* the *in loco* observation phenomenon; the inventory in the open; and the conceptual instrumental able to interpret the data. In the case of Charles Darwin, who followed Fitz Roy to the southern hemisphere at a very young age, we can only speak of representing phenomena out of his reach when he was already ill and settled in his native country, continuing with his search through collaborators.

The network of Charles Darwin and Fritz Müller materialized through letters. Fritz Müller was the naturalist researching the Atlantic Forest under demand. Charles Darwin now repeating the role of his former teacher John Stevens Henslow. was the older scientist giving the guidelines for the research to be undertaken in the forests of the southern hemisphere, which became foreign publications from the Calculation Centers, legitimized by the circle of renowned scientists. "Many instructions are to be given to those sent around the world on how to stuff animals, how to dry up plants, how to label all specimens, how to name them, how to pin down butterflies, how to paint drawings of the animals and trees no one can yet bring back and domesticate ". But it is important to set the same coefficients, the same parameters, in order to have instrumental knowledge. [4]

The technosciences are carried out through complex networks, not homogeneous, either knowledge or financing networks, and through the use of specific instruments such as "templates, graphics totals, tables, lists" allowing us to link many disciplines. The purpose of technosciences is action and control from a distance. "Going from 'science' to 'technology' is not going from a paper world to a messy, greasy, concrete world. It is going from paperwork to still more paperwork, from one centre of calculation to another which gathers and handles more calculations of still more heterogeneous origins". [4]

Not only the climate conditions, the study of hydrography, geology are implied in the map, but also the engineering of boats and navigation instruments, political and economic trends. We could consider that every work that collects environmental data and places it "into the paper world," tries to encompass a fleeting and transient reality, - for the monitoring of the environment would have for purpose the capacity to predict changes and disasters, to facilitate access to unknown regions and, in short, one day being able to reconstruct the phenomenal world from the information gathered and preserved in the form of abstract inscription. However neither the water temperature, nor the height and frequency of the waves collected, for example, as measured in 2005 by the buoy Station 31201 in Florianopolis coastline, in a survey undertaken by the Universities UFSC and USDC, was able to predict such a rare hurricane in southern Brazil. And neither the prevailing currents nor the winds at the Strait of Magalhães and Beagle Channel, as reported by Fitz Roy, reconstitute the phenomenon of the sea itself, even though they assist new navigators entering these waters.

Abstract inscriptions and living organism overlap one another and take turns in the work of Rodrigo Arteaga. Such detail can be seen in *Convergence,* from 2013, in which the artist, after researching in the microbiology laboratory of San Joaquin Medical Center, grew colonies of filamentous fungus on glass slides to populate his maps thus giving the heraldic inscriptions an organic quality. Another installation displayed by the artist in October 2014 in the Gallery *Afa Arte Contemporaneo*, in Santiago, Chile, shows a plant that survives on a thin layer of soil on an old volume of a botanical treatise. [5] This encourages us to travel the technoscience networks described by Bruno Latour in *Science in Action* (1987/2011). These are the technoscience networks for which the trip captained by Fitz Roy bringing the young scientist Charles Darwin to the southern hemisphere could come as an example. But Arteaga recreates, in an exemplary way and with great sensitivity and precision, the link connecting the inscription in the book of botany to the plant in the world, and from this back to the graphic inscription on the botanic book. The plant springs from the book, so to speak, and builds this bridge, as an example of connection between the living species and the abstract inscription, such as the scientific illustration and the data in the book of botany. [6] Were the works by Arteaga and other artists who make environmental census, aestheticizing or fictionalizing science?

Reversely, searching for an inscription in the correspondence between the naturalists on expedition and the scientists in the study centers, or in their published data, can also be an investigation of artistic value. [7] Reopening the "inscriptions" gives rise to the collaboration network that allowed the storage of collected information, and brings to light various instruments, such as maps, tables, several studies even of economic and political decisions involved in the expeditions. [8]

Figure 2. Rodrigo Arteaga 2014. Image of the author.

Figure 3. Rodrigo Arteaga 2014. The plant springs from the book reopening the abstract inscription.

Image of the author.

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Too Big To See: The Need for Design Strategies to Visualize Multiple Spatiotemporal Datasets

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Abstract

Tracking software paired with 3D modeling now provides animations of movement in nearly every context of our highly sensed world. However, few visualizations exist that show adjacent systems, usually because of wildly divergent data. One such spatiotemporal adjacency is crucial to our safety – our increasingly cluttered skies rapidly filling with drones, budget airlines, helicopters, weather collection sensors and Asian satellites. The scale, number, tiered altitudes and variant speeds of aerial hardware are a physical reality that can only be understood through the moving image. However, no visual model exists to reveal all the machines when stratified causing our culture to lack an understanding of the expanding system. Can stratified aerial traffic be represented through a hybrid of informative data visualization and evocative information arts? What are semiotic strategies and taxonomic delineations that can merge into a visual language understandable across the growing number of cultures now involved in aerial movement and its dangers? This paper will present a creative context to explore visual strategies for better cognitive and perceptual understanding of multi-tiered, spatiotemporal data. Creative design tools will provide insight into finding meaning in dynamic data and may lead to advances in understanding other sets of Big Data.

Keywords

4D Data Visualization; Information Arts; Strategic Design; Spatiotemporal Semiotics.

Introduction

With multiple launches across several nations, Asia's aggressive entry into the space race is quickly adding to the proliferation of hardware in each layer of airspace. The systems above require great cultural, economic, and political coordination yet there seems to be no singular control. In addition, they are separately represented through disparate spatiotemporal animations that are becoming increasingly important as tools of prediction. Individual aeronautic and aerospace software only visualize the assets within their industry, treating altitude layers as lanes of traffic.

As early as 1978, NASA predicted that satellite collisions would increase the amount of debris to a point where a permanent junk belt around the earth could make space flight too dangerous. The invisible borders between altitudes are disappearing and 2009 marked the first space disaster caused by sheer numbers as two communications satellites collided, scattering deadly debris across low earth orbit. Weapons to destroy surveillance satellites were deployed by China in 2007 and 2010, creating debris that classify as the planet's largest environmental disaster and causing further collisions. Current spatiotemporal tracking visualizations failed to predict any of these occurrences. An improved visual model of aerial strata movement is crucial for safety, public understanding, global policy, environmental discussion, artistic resource, and political and economic clarity.

Starting From The Ground Up

Although these animation models can be perceived as technical or scientific visualization, they also closely tie to digital humanities as the resulting tools are often used to inform in cultural and social contexts. The social impact of this design problem can be seen in the ugly racist slurs towards the Chinese in the comments section on NASA's space debris visualization on YouTube. [1] An effective visualization can enhance a cross-culturally shared understanding of aerospace utilization. Finding a solution is both challenging and beneficial due to its interdisciplinary approach but it must begin by looking at research trajectories through data visualization, motion graphics, information arts, big data, art+sci collaborations and media philosophy.

In Data Visualization

Cartography has stretched to consider 4D data visualization semiotics from many perspectives including perceptual psychology, effective design and color strategy, interactivity, and realism vs. abstraction. Temporal visualizations within cartography were pioneered in the 1960's with the work of Torsten Hägerstrand who developed a time-based model for understanding human migration. Hagerstrand's space-time path illustrated navigation through an environment in a new way and affected the development of geographic information systems that visualize movement data. More recent researchers expanding the diversity of ways to present complex spatiotemporal datasets for better understanding include Menno-Jan Kraak and laboratories and research centers like The Bartlett Center for Advanced

Spatial Analysis at UCL and MIT's Senseable City Lab which both focus on large scale temporal visualizations in mostly urban contexts.

Research in computer graphics has focused on generating increasingly realistic displays; the successful abstraction found and accepted in cartography pre-computer has not carried over to the computer age. Recent research suggests however, that we are beginning to see a return to symbolization systems and map-type taxonomies. The deluge of temporal data and advances in technology are allowing for more thematic portrayals. In addition, the modes of design - color, font, layout, metaphor – are recognized to have distinct cultural meaning in data visualization. These cultural implications appear in the research of Mei-Po Kwan who juxtaposes visualization strategies of temporal datasets created in China and the U.S. She highlights the differences between Eastern/Western visualizations, stating that "Chinese and U.S. terminology and approaches to space and time concepts and their integration in GIScience research draw from distinct deeply established cultural, historical, religious, and scientific traditions and foundations." [2] She argues that we must find a shared language regarding complex concepts related to space-time integration research.

Information sets that are too large and complex for database management tools to negotiate is appearing in nearly every discipline. In addition, computational sensing is finding new patterns and shifts that were once indiscernible. Machine learning real-world applications have flourished over the last two decades. Theorist Lev Manovich outlines three trends in information display: designers and scientists are trying to show more data, represent relationships between more dimensions of data, and break from the ideological paradigm of simpler, reductionist approaches that may not apply to the current evolution of complexity. Properly visualizing scale and recognizing the abstract feelings associated with Big Data may help understand it.

In Motion Graphics

Two examples from media history, one mechanical and one on film, are still effective spatiotemporal displays. Orreries were antique mechanical models of the solar system not used for scale or prediction but holistic understanding of multiple objects travelling at multiple speeds across multiple layers. Charles and Ray Eames' "Powers of Ten" was a 1977 film commissioned by IBM to show the relative scale of the entire universe. The image advances on the 'y-axis' from a frozen moment in a Chicago park by zooming to limits of the observable universe and then back to the limits of known atomic structure. In this, it provides a profound historical example of strata visualization within one holistic semiotic language. Government and scientific communities are developing powerful software to model, simulate, visualize and analyze dynamic aerial systems. However, like lanes on a highway, each industry stays within a specific band of vertical space. There is no collective system that combines these animations. MIT's Ben Fry posits that "there is a space of highly complex systems for which we lack deep understanding because few techniques exist for visualization of data whose structure and content are undergoing continuous change." [3]

In Information Arts

Data Visualization embraces clarity yet the emerging field of Information Arts favors evocation placing Cartography in a tug-of-war between them. Many within the visualization community consider adding artistry a reduction in precision to reach a broader public; art and visualization have distinct functions and "in the case of Information Visualization, Form follows Revelation." [4] However, others argue that the era of a single minded pursuit of clarity will be replaced by the importance of engagement, that visualization is becoming a mass medium. "By recognizing that being expressive and engaging doesn't mean giving up clarity, we will have fulfilled the promise of visualization." [5] Still others insist that due to massive new data, art's abstraction and aesthetic skills are now required in information display, as science "ha(s) no photo-realist technologies to fall back on." [6] And finally, some believe that the best direction is a hybrid of both objective and subjective strategies, joining to form new insight.

In Art + Science Collaboration

The Data Visualization/Information Arts dichotomy is contrary to visionaries in both science and the humanities working to form research partnerships. There is much extant research by scholars who acknowledge the value of art/sci collaborations in moving knowledge forward, partially driven by the humanities now being confronted with large datasets themselves and having to "create practices that incorporate their own disciplinary values and ethics." [7] In a personal communication, leading nano-physicist Dr. James Gimzewski explained, "Science tends to be, in my opinion, too reductionist… and increasingly in science we're more and more aware of complexity, that we can't isolate something. An artists' natural way to work is non-reductionist; it's the opposite. They can look at very complex problems in a way that we are trying to learn."

In Media Philosophy

By presenting the hovering hardware as a system outside the context of human perception, alternative display may connect to metaphysical movements in Object Oriented Ontology and speculative realism. Researchers like Timothy Morton and Ian Bogost argue that philosophy should encounter non-living things and objects. Object-oriented Ontology (OOO) questions Kant's view that objects find their existence through our subjective perception of them and insists on objects existing and relating independent of us. Once we accept an object as a being, we can speculate on a larger range of interactions. Even if only metaphorically, a better visualization of a network of object-object relationships interacting above us, eerily independent from

our perception or consciousness, comments on the equality of object relations.

Beyond the Skies

Such a diverse background suggests that resolving this design problem requires a holistic approach, one often found in creative strategies. Indeed, arts-inflected methodology is offering new signification approaches in scientific visualization. NASA's recent ocean current animation was created by their 'van Gogh' team, designers who used brushstroke techniques from art history. As large quantities of data increases, effective visualization draws increasingly greater attention from researchers as well as practitioners in many fields, including science, education, engineering, interactive multimedia, medicine, etc. Finding the best possible visual strategy for explaining complex datasets is an important field for artists and sciences to create new knowledge and contribute to a richer understanding of the creative methods for spatiotemporal visualization and the mechanisms of the aesthetic components (e.g., sensory functioning, semiotics, animation, narrative, and cinema).

In addition, conceptualizing and measuring those components may reveal interdisciplinary approaches that integrate technology, media arts, and human cognition to enhance understanding. The repercussion of using new media art as a tool for elucidation of Big Data can be applied to a wide range of industries and sciences that have interests in utilizing their Big Data for enhancing user engagement (e.g., marketing), learning (e.g., education), and pattern prediction (e.g., transportation). The long-term impact affects science and art intersections exploring the problems of representing large-scale, complex and evolving systems.

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Author Biography

Scott Hessels (b. 1958) is an American filmmaker, sculptor and media artist based in Hong Kong. His artworks span different media including film, video, online, music, broadcast, print, kinetic sculpture, and performance. His films have shown internationally and his new media installations have been presented in museum exhibitions focusing on technology as well as those presenting fine arts. His recognitions include patents for developed technologies, references in books and periodicals on new media art, and coverage in cultural media like *Wired* and *Discover*. He is currently an associate professor at The School of Creative Media in City University of Hong Kong and executive producer of the Extreme Environments Programme which organizes art/science expeditions to environmentally significant sites.

[Session 9 & 10]

Interactive Text

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Esolangs as Experiential Art

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Abstract

Esolangs (for "esoteric programming languages") are a class of languages made by programmers at play, not intended for practical use. Ben Olmstead (creator of the *Malbolge* language) describes them as "pushing the boundaries of programming, but not in useful directions." [1] This paper looks at how these strange languages function as experiential art pieces, with similarities to Oulipean systems and Fluxus event scores.

Keywords

Esolangs, Esoteric Programming Languages, Language, Concept Art, Fluxus, Ouipo, Code Art

Introduction

Esolangs have been described as jokes, parodies, impractical research, scenarios of the improbable, or what can only be defined as programming languages by butchering the very definition of a programming language. 2

```
DO ,1 <- #13
PLEASE DO ,1 SUB #1 <- #238
DO ,1 SUB #2 <- #108
DO ,1 SUB #3 <- #112
DO ,1 SUB #4 <- #0
DO ,1 SUB #5 <- #64
DO ,1 SUB #6 <- #194
DO ,1 SUB #7 <- #48
PLEASE DO ,1 SUB #8 <- #22
DO ,1 SUB #9 <- #248
DO ,1 SUB #10 <- #168
DO ,1 SUB #11 <- #24
DO ,1 SUB #12 <- #16
DO ,1 SUB #13 <- #162
PLEASE READ OUT ,1
PLEASE GIVE UP
```

Figure 1. *Hello World* in INTERCAL (author unknown)

There are three strategies esolangs commonly take to express an idea. The first, and perhaps more obvious given that most code is a form of text, is through their vocabulary. The other two we can think of as logic-oriented esolangs and concept languages.

Languages like *LOLCODE* and *INTERCAL* both make strange use of keywords, although with very different approaches. INTERCAL, created in 1972 (and generally considered the first esolang), functions as a parody of languages of the time. It asks the programmer to beg and plead with the machine, personifying the compiler as a capricious autocrat who allows programs to compile or not based on how much groveling is done. Its language is cryptic and confusing, a puzzle for the programmer. 3

```
HAI
CAN HAS STDIO?
VISIBLE "HAI WORLD!"
KTHXBYE
```

Figure 2. *Hello World* in LOLCODE (Adam Lindsay)

LOLCODE (Adam Lindsay, 2007) personifies the "lolcats" meme. Starting every program with "HAI" and ending with " THXB E", the script in between is full of the familiar mix of baby talk and internet slang of lolcats. 4 These languages ridicule the authority of the machine through the actual text of the programs created within them. However, the code is still intuitive: using "visible" for "print" and "kthxbye" for "exit." The lolcats concept is added to the code without obscuring the code's function.

Programming languages are formal systems they are self-contained and closed, apart from references to computer operations. They are made up of commands which must compile down to machine code, a purely denotative space with no place for nuance: when we communicate with the machine, we can't insinuate or gesture; any ambiguity in the language is wiped out. Both these languages use elements of human language and expression to add back some of that gesture and nuance at the top level, even if it is stripped away in its conversion to machine instructions. Where commands in INTERCAL are confusing, they are only confusing to us, not the machine likewise, at the machine level, LOLCODE commands are the same as in many other imperative, procedural languages.

Befunge and brainfuck

Although nearly all esolangs rely on vocabulary as part of their method of expression, many esolangs are less vocabulary-oriented than those two examples. In 1993, Wouter van Oortmerssen designed *FALSE*, a language for the Amiga. The objective of FALSE was to support the smallest possible compiler (written in assembler, it was 1024 bytes). To reach this objective, Wouter used single letters for commands. 5

This obfuscated syntax was then picked up by two other languages the same year, both also written for the Amiga and using single-letter commands: *brainfuck* (usually spelled lower-case) and *Befunge*. Where FALSE was essentially a tiny version of the Forth language, brainfuck and Befunge began to explore the programming language space as systems of thought. These languages rely on logic more than vocabulary.

```
>                  v
v  ,,,,,"Hello"<
>48*,              v
v,,,,,,"World!"<
>25*,@
```

Figure 3. *Hello World* in Befunge (author unknown)

Brainfuck (Urban Müller, 1993) is Turing Complete, meaning that it can theoretically be used to write programs to do anything that can be written in, say, C++, only it is even tinier than FALSE, consisting of eight punctuation marks alone (resulting in a 240 byte compiler). In brainfuck, we can t write code that looks like "let x = 36" because all of those characters, from the word "let", to the spaces between words, are ignored. *X* means nothing to the language, and neither does 3 or 6. Instead, we move back and forth through memory using the angle brackets (< and >) until we get to a place we might think of as *x*, followed by 36 plus signs, each incrementing that memory cell from zero.

A more succinct alternative is to loop six times through the operation of adding six, like so:

```
++++++  ++++++ -
```

Alternately, one could count down from zero, as in 8-bit brainfuck, subtracting one from zero gives you 255. Or one could use nested loops to reach any number which, modulus 256, leaves 36. There are a great many ways of producing that single number, and choosing one over another becomes a matter of personal style or a chance to find a clever solution. 6

The complexity of brainfuck does not arise artificially each brainfuck command maps directly to a command in assembly code, the substrate of most languages. Rather than making these commands more human-friendly (like how, say, the C compiler does), it refuses to ease the translation, both with its odd syntax and its tiny selection of choices, thereby directly exposing the conflict between human thinking and computer logic.

Figure 4. *Hello World* in Piet (James Dessart)

Befunge (Chris Pressey, 1993), similarly, builds on complexity that arises from a simple idea. It uses 2D code rather than the ordinary formatted strings of text. Befunge programs run up and down the page (or screen), crossing itself in horizontal and vertical lines, like a maze. Because of its snaking structure, the same command can be read multiple times in different directs, in completely different contexts and with different results. Also, it ignores any code which is not in its execution path, meaning comments and non-executed code can appear amongst real code, making it hard to differentiate what is or is not part of the program.

Building on the 2D design of Befunge, *Piet* (David Morgan-Marr, 2001) gets rid of characters entirely, using images as source code. The compiler takes a similarly serpentine path through the image, only here the change in color from one

group of pixels to the next determine commands. Both changes in hue and in lightness have meaning; because it's delta-based (the change rather than symbol itself is the signifier), correcting a mistake in the code means rewriting all the pixels that fall after it. The language was named for Mondrian, and so much of the source code mimics Mondrian s aesthetic, although the rules of the language favor a shattered and sometimes lumpy, pixelated look.

Piet unifies the vocabulary-oriented impulse with logic-oriented code. Like INTERCAL, Piet creates a space between the look of the code and its actual function, making language visible in a way it isn't in traditional languages (which opt for clarity of style to emphasize code's function over its appearance). Where INTERCAL brings in an overflow of human expression that ordinarily has little place in code, Piet encodes it into an entirely different system with its own signifiers and style, whether it's used for simple abstractions or representational images. However, Piet also has the strange logic borrowed from Befunge like the logic-oriented languages, it is experiential in nature, a challenge for the programmers using it. This impulse to mix systems is reiterated in other work of David Morgan-Marr's, such as his language *Chef*, which uses (often extremely odd) recipes as code.

Esolangs as Performance Scores

It is tempting to compare Piet programs with Generative works, as some have a similar appearance to computer-generated images. Only here the look of the image is determined by rules which run on the *programmer*, not the machine. Geoff Cox, in his *Speaking Code*, looked at running code as performative. He sees it as a special type of performance, in that the machine always "performs" the same piece of code the same way: the speaking of the code and performance of it become flattened. 7 We can contrast this with work such as the Fluxus event scores, which leave enormous space for interpretation. Yoko Ono's *Fly Piece* (with the single instruction "Fly"), evokes many different things, leaving nothing specific for the "performer" of the score — that performer might be a reader, for whom an imaginary flight is invoked, or perhaps someone actually trying to physically interpret it. 8

Esolangs in the tradition of brainfuck and Befunge however, re-open this possibility in the score. Because they are open-ended systems, the writing of programs within the language becomes the space for this interpretation. They are experiential — you have to program in a language in order to understand it, it's not to be passively received. And even in brainfuck, code by different programmers may feel very different. An esolang with no esoprogrammers is a sad thing, a score with no performer. A language is a prompt.

The esolanger ais523, who co-runs the esolangs.org wiki, puts it this way: "it's much more interesting if the point of view of the language is one that you can think in independently." Ais523 singles out LOLCODE as falling short of this:

> I should also mention LOLcode, which has become pretty relevant as an esolang in the non-esolang community recently, much to the annoyance of most actual esolangers. It doesn't have much intrinsic interest for most of the reasons people are interested in esolangs, being mostly a simple imperative language derivative with the keywords swapped out... However, it appeals for things like its visual appearance and general attitude, which although are IMO the least important aspect of an esolang, are one of the most immediately noticeable. 9

To actually code in such a language does not lead to a greater understanding of its system we essentially get LOLCODE by looking at sample code. Richer languages, even vocabulary-oriented ones, may reveal more interesting ideas about language and code.

Conceptual Languages

Before a compiler builds a program, it has to parse the code. Some languages focus on this step. Like unperformable Fluxus scores, they produce no functional programs at all, serving only to verify source code, turning a language into a system of inclusion or exclusion.

The compiler for the language *Unnecessary* (eymaker, 2005), when run on any file at all, fails with an error message. An empty document, an image, a Word document, each is rejected as not Unnecessary. Only a file which can't be found succeeds in compilation—and it succeeds in creating an empty program, one which simply opens and closes. A single instruction—NOP (pronounced "no op" for "no operation") is the whole of the program. As Keymaker puts it:

> The main idea was that the language could not have programs, other than the kind that don't exist. (Can it have those then if they don't exist?) Then I noticed that every valid program (whatever that is) is a/the null-quine but that was more of a by-product of the main idea. Fitting nonetheless 10

A quine is a program which prints its own source code to the screen. The null-quine is a program with empty source code that prints its source (which is nothing) to the screen, producing no output. Unnecessary is a language with no keywords, no input, that can only make empty programs.

Is it possible to have esolangs that go even further than Unneccesary, requiring no machine to run? Chris Pressey, creator of Befunge and creator of the mailing list where much of the early esolang discussions took place sees it this way:

> [T]hey're made up of concepts, and these concepts would exist even if our computing equipment wasn't electronic, or wasn't digital, or if we didn't have computing equipment at all. It's just that having computing equipment makes it a lot easier to design and experience these programming languages. 11

A language is just a set of rules for symbols and their behavior. In a sense, they are an even more immaterial form than software more like fields of possibility for potential software. Making this field narrow enough, we can get languages that have no usability, like Unnecessary. Even with Turing Complete languages like brainfuck, the practical use of the language is never the point: they are designed for the experience of digesting their rules. What makes an esolang interesting is that it rewards this investment of thought.

While these three strategies are distinct, they are often mixed together, as in Piet (and, to some degree, INTERCAL), and in hundreds of others which have been written since that time. Each of these three approaches makes language visible in making programmers type strange things, or think through irrational logic systems. At their best, they create a space for human impulses of communication to overflow constraints of logic.

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Author Biography

Daniel Temkin (b. 1973) was recently awarded the 2014 Creative Capital / Warhol Foundation Arts Writers Grant for esoteric.codes, his exploration of programming languages as art. He has presented at conferences including Media Art Histories, GLI.TC/H, and hacker conferences such as NOTACON. His papers have been published in World Picture Journal, Media-N Journal and others, and have been taught at schools such as Bard College, Penn State, and N U.

His work has been a critic s pick in ArtNews, the New ork Times and the Boston Globe, shown at Mass MoCA, American History Museum, and galleries across North America and Europe.

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Steep (I): a digital poetry of gold nanoparticles

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Abstract

Gold exists simultaneously as reality and myth in a kind of superposition (a term from quantum mechanics referring to the ability to simultaneously occupy two positions such as yes/no or one/zero). In ancient times, ings Croesus and Midas were real life, historical figures that exist in contemporary life primarily as myths/metaphors referencing gold. More recent stories such as those of the londike and other gold rushes reinforce gold's position in the imagination as an object of desire promising untold wealth and/or misery.

There is another level where gold exists: as a material at the nanoscale, a nanoparticle. At this level, gold inhabits another superposition of sorts where it is inference (we can't see at the nanoscale) but equipment which can sense nanoparticles renders the information visually to us as an object.

Steep, a gold nanoparticle collaboration between Raewyn Turner, Brian Harris, Mark Wiesner, and Maryse de la Giroday along with a rotating list of collaborators is a multi-year, multi-disciplinary, and multi-installation project exploring the superposition (mythic and real) posed by gold nanoparticles. *Steep (I): digital poetry of gold nanoparticles*, the subject of this proposal and the first of the collaborations, is an artistic/poetic exploration of how these mythic/real particles may be affecting, changing, and disrupting the understandings we have of ourselves and our environments.

Keywords

nanotechnology, gold, nanoparticles, myth, metaphor, nanoscale, macroscale, environment, art/science, poetry

Introduction

There are many, many types of nanoparticles including gold, silver, aluminum, carbon, plastic, silicon, copper, and more. They are not new we have been producing, inadvertently, various nanoparticles for millennia. Examples of 'ancient' nanoparticle-enhanced materials include the Lycurgus Cup (gold and silver nanoparticles, 4th century CE, Late Roman), the red colouring in medieval stained glass windows (gold nanoparticles), and Damascus steel blades (carbon nanotubes found in the blades which were produced until 1700 when production ceased). 1

More recently (in the last 20 – 25 years) we have begun to manufacture all manner of nanoparticles, including gold nanoparticles, purposefully. The belief is that nanotechnology along with a set of associated emerging technologies such as robotics, synthetic biology, and artificial intelligence will have an impact equal to or even more disruptive than the Industrial Revolution's effects on agriculture, transportation, medicine, the arts, work, and all manner of existence.

Addressing some of the changes, issues, and ideas arising from nanotechnology and an associated set of emerging technologies is a grand task and *Steep (I): a digital poetry of gold nanoparticles* is, proportionately speaking, the equivalent of offering a single nanoparticle's worth (one billionth of a metre) as party to the endeavour.

Golden histories

Gold, despite modern challenges from platinum and palladium, has been and remains the most prized metal across cultures and throughout history.

King Croesus's name has been a synonym for wealth for centuries,

"… [John Gower] in Confessio amantis (1390):

> That if the tresor of Cresus
>
> And al the gold Octovien,
> Forth with the richesse ndien
> Of Perles and of riche stones,
> Were al togedre myn at ones…"

Croesus was ing of Lydia (560 -547 BCE) and is credited as being the first to produce and use gold coins as a means of exchange. 2 As for the other 'King' myth, there were at least three individuals named ing Midas but the one who survives best is the mythological entity turning everything his hand touched to gold. 3

In real life, the Lycurgus Cup (4th century CE Rome) is an outstanding example of how gold can play multiple roles. It is a cage cup made of gold extracted from the earth and beaten and heated for shaping. This cage holds a second cup, one made of glass and fashioned with gold and silver nanoparticles which endow it with extraordinary optical effects. It glows red (Figure 1) or green (Figure 2) depending on how the light shines on it. 4

The 'Cup' is an iconic nanotechnology image gracing the cover of the British Society's 2004 report "Nanoscience and nanotechnologies: opportunities and

uncertainties," which was written in response to concerns from Prince Charles about nanotechnology and a 'goo' scenario (the possibility that nanoscale devices, self-assemblers, would begin to self-assemble uncontrollably and ceaselessly snatching atoms from everything they came in contact with resulting in a denuded world of 'goo'). 5, 6 Feelings have calmed since that time, possibly due to the Lycurgus Cup itself, which demonstrates a benign and beautiful use of nanotechnology.

Figure 1. Lycurgus Cup (owned by the British Museum) glows red when backlit. Credit: Johnbod, 2010, no flash. Image is licensed under the Creative Commons Attribution-Share Alike 3.0 Unported license. Downloaded from http://commons.wikimedia.org/wiki/File:Brit Mus 13sept10 bro oches etc 046.jpg

Medieval glass windows in European churches with ruby red panes coloured by gold nanoparticles are thought to do more than look beautiful,

> "Professor Zhu said numerous church windows across Europe were decorated with glass coloured in gold nanoparticles.
>
> "For centuries people appreciated only the beautiful works of art, and long life of the colours, but little did they realise that these works of art are also, in modern language, photocatalytic air purifier with nanostructured gold catalyst," Professor Zhu said. 7

Zhu Huai ong is a professor at ueensland University of Technology in Australia whose expertise includes the direct photocatalysis of metal nanoparticles.

Moving beyond Europe, researchers found layers of gold foil beaten to a thickness of 100 nanometres when examining Namban screens from Japan's Edo period (1603 – 1868) which they reported in a 2014 paper. 8

Gold at the nanoscale has been part of our existence since before we had a means of describing it.

Figure 2. Lycurgus Cup (owned by the British Museum) appears green when frontlit. Credit: Johnbod, 2010, with flash. This file is licensed under the Creative Commons Attribution-Share Alike 3.0 Unported license. Downloaded from http://commons.wikimedia.org/wiki/File:Green Lycurgus Cup.jpg

Engineered nanoparticles, gold and otherwise

More recently, we have been exploring the use of materials measured at the nanoscale with a view to exploiting the properties associated with quantum mechanics. The US National Nanotechnology Initiative (NNI) has invested over 21B since the program's inception in 2001. [9 The European Union, the U , China, Japan, Canada, and Iran are only a few of the other jurisdictions which have invested untold amounts into exploring the quantum properties of nanoscale materials such as gold nanoparticles, carbon nanotubes, etc., with a view to enjoying economic glory as a direct consequence. Businesses too such as IBM, HP

Labs, Intel, L'Oréal, and more have invested extensively in nanotechnology.

Mark Wiesner (Professor of Civil and Environmental Engineering and Director, Center for the Environmental Implications of NanoTechnology CEINT at Duke University, North Carolina, US), notes informally there is more than one process for producing/manufacturing gold nanoparticles but this one is in common use today,

> "Gold nanoparticles are made about the same way as silver- you start with a solution of the metal salt and add a reducing agent. ou might also include some organic compounds that give the resulting particles a charge that prevents it from forming clusters with other particles. Maybe the most common method is to start with a solution of gold salt like HAuCl4 aka, Gold Chloride, Hydrogen Tetrachloro Aurate (III), Chloroauric Acid, or Gold Acid Chloride and use citrate both as the reducing agent and to create negatively charged functional groups on the surface that stabilize the particle against cluster formation." 10

Irrespective of production techniques, gold nanoparticles have proven to be of tremendous interest in health and medical applications, and in electronics, sensors, etc., and, to a lesser extent, in its use as a catalyst. 11, 12

While gold nanoparticle-enabled applications are currently coming to market with more being developed every day, there are studies into the risks associated with these materials. The nanoparticles, themselves, have not occasioned the levels of concern aroused by silver nanoparticles and long carbon nanotubes but there are issues. A research team at Stony Brook University (New ork state) published a 2013 paper detailing a study which suggested gold nanoparticles could cause cellular toxicity, specifically in certain types of adult stem cells. 13, 14]

Steep collaborative project

Figure 3. Raewyn Turner's hand covered in gold. Raewyn Turner, 2014.

As more gold nanoparticles are manufactured and 'pumped' into our air, our water, and our soil, we are becoming 'steeped' in gold as Figure 3 fancifully demonstrates.

This art/science project, initially conceived as a single cross-disciplinary art project invoking the notion of being steeped in something invisible which is both new (nanoscale) and familiar to us over thousands of years (macroscale), was developed by Raewyn Turner (artist) and Brian Harris (electronics designer for film and video). The project was expanded to include Mark Wiesner (previously mentioned Professor at Duke University, North Carolina, US), as a science consultant/collaborator and Maryse de la Giroday (writer) and has been reconceived as a series of virtual and/or physical installations with a rotating cast of collaborators.

One of the challenges of a cross-disciplinary project, including this specific poetry video/animation installation, is integrating the principals' (Maryse de la Giroday and Raewyn Turner) differing and, at times, opposing perspectives on representing gold nanoparticles in digital poetry form. Issues over language be it written, verbal, or visual and attempts to avoid dichotomies, for example, words vs. pictures, have required significant investments of time and effort to reframe the discussion and the approach to creating an installation which represents an emerging science (nanotechnology) and its uncertainties.

Steep (I): a digital poetry of gold nanoparticles

The first installation in the reconceived *Steep* series is *Steep (I): a digital poetry of gold nanoparticles*, and is designed as a poetic trilogy realized through onscreen animation and, in future, as a real life video installation. This trilogy, an onscreen piece, is a 'research work in progress' as poem, as animation, and as science communication. The visuals and language are metaphoric as informed by the science.

Yearning, the first part of the trilogy, focuses on gold and its role as a metal of desire. It takes inspiration from terms such as golden opportunity, golden rule, golden ratio, and others. References to its pursuit (inspired by Shakespeare's, "such stuff as dreams are made on") during the Klondike gold rush (taking place in the Yukon, a Canadian territory lying north of British Columbia and adjacent to the US state of Alaska) will act as metaphor for all the gold rushes. [15] *Yearning*, intended to convey how thoroughly gold permeates our culture and history, will also touch on the process of extracting gold from the earth.

Light/Shadow, the middle part of the trilogy, reviews our current understanding of the metal in its particle form. In effect, making the invisible, visible by proxy emulating how scientists view nanoparticles. (The process most commonly requires a scanning probe microscope of some kind where the probe's tip has been dragged across a substrate, sensing the particles by touch, recording the information as data, and sending the data to a software program, which then represents the data visually.)

More specifically *Light/Shadow*, will reference the optical effects made possible by the particles and seen, for example, in the Lycurgus Cup (previously mentioned) and in a 'golden fleece' developed in New Zealand.

> A gold nanoparticle infused yarn developed by Kiwi scientists is expected to be sold to wealthy buyers of luxury carpets, rugs and furnishings. Unlike the 'golden fleece' of Greek mythology the yarn and completed woollen products will not have a golden colour at this stage.
>
> The Aulana-branded wool has been developed by Professor Jim Johnston and Dr Kerstin Lucas of Victoria University after $3 million of research and development.
>
> A tiny amount of pure gold is combined with wool and the chemistry between the two causes it to bond and produce the colours of purple, grey and blue. [16]

Gold's new found role as a catalyst for chemical reactions, and its more common uses in medical applications are more examples of 'light' while the possibilities of toxicity, 'shadow', will also be represented in word and form. [17, 18, 19, 20, 21, 22, 23]

Finally, *Discovery*, the last part of the trilogy, is a meditation on the worlds represented by the atoms present in gold nanoparticles. Drawing on the notion of Erwin Schrödinger's cloud model of atoms rather than the more commonly taught planetary model (the Bohr Model named after Danish physicist Niels Bohr) and referencing William Wordsworth's 'I Wandered Lonely as a Cloud', also known as, 'Daffodils', *Discovery* hints at how little we know and the volatile state of the research and the knowledge. [24, 25, 26] For example, researchers in Finland published papers in July 2014 and in February 2015 where they noted that gold nanoparticles of 144 atoms behave like gold metal at the macroscale while gold nanoparticles of 102 atoms behave like a giant molecule. Meanwhile, researchers Carnegie Mellon University (in the US) noted in a March 2015 paper that gold nanoparticles of 133 atoms were not yet metallic. [27]

Animating Steep (I)

Yearning's opening visual sequence starts with a distant shot of the planet earth and a descent, drawing closer to show the tops of houses (which resemble nanorods from a certain distance). This sequence and subsequent visual imaging convey the 'yearning' for beauty, riches, and spirit. The visual style changes from one part of the trilogy to the next signifying the shifts in theme while retaining overall cohesiveness. *Light/Shadow's* visual design emphasizes the interplay between light and shadow, with work seen in shadow and gradually revealed. It parallels how bits of scientific information are acquired. Specifically, we are slowly learning about gold nanoparticles, for example, there was the realization that the Lycurgus Cup's optical properties are due to gold and silver nanoparticles. *Discovery* is the most conceptual section using images of gold nanoparticles taken with a specialized microscope to convey the ideas and science underlying the poetry and the notion of being 'steeped in gold'.

The serendipitously named 'particle system technique' produces an effect where visuals dissolve into particles. In this case, the plan is to use the effect so we can represent gold nanoparticles which then reconstitute themselves as new words and/or images. This proposed 'cloud' of gold nanoparticles and text is intended to signify Schr dinger's atomic model and Wordsworth's 'cloud' blending science and poetry with attention being paid to not being overly literal. Animation tools under consideration include After Effects, Maya, Vectorian Giotto, and/or Blender.

A current sample animation (working title: animated words video), included with this submission, features a high resolution aerial photograph of the hills of Hawkes Bay, New Zealand and 'words' (symbols used as placeholders for words) accompanied by music, a Jesse Cooper remix (Ben Sage). Final Cut Pro was used to create the work in progress.

Conclusion

Steep is an international art/science research project examining the impact gold and gold nanoparticles have had in the past and could have in the future. Designed as a multi-year, multidisciplinary project with a rotating cast of collaborators, *Steep* is based on the current state of scientific research and its flexibility as a project reflects the uncertain and disruptive state of nanoscience and nanotechnology (as they are sometimes referred to).

Steep (I) a digital poetry of gold nanoparticles, our first piece, is largely concerned with the elements of air, water, and earth or, more fancifully, gold in all its forms: myth, metaphor, and reality as it transitions visibly and invisibly throughout our environment.

The co-leads (Maryse de la Giroday and Raewyn Turner) for Steep (1) have artistic practices that while grounded in various disciplines exploit the state of 'not knowing'. This requires spontaneity and openness to a state of uncertainty. The following trilogy and video sample accompanying this submission are works in progress and are emblematic not only of the co-leads' artistic practices but of the uncertainties associated with nanotechnology and its disruptive impact (for good and/or ill) socially and environmentally.

a digital poetry of gold nanoparticles

Yearning

shards of sun
hidden in the river s silted bed
buried beneath the earth s skin

a beautiful killing
in the cold, cold river
in the darkness underground

opportunities made of gold
wealth beyond Croesus' and Midas' imaginings
shining brightest

londike calls
El Dorado beckons
siren songs of:

safe passage through this vale of tears
alchemical transformation from fear to joy
power over life and death
pleasure unending and unimaginable

kings and paupers answer
build empires
strive for godhood

Buddha, Jesus, Ganesha
and the others
sitting golden in their temples waiting tribute

flesh and spirit
striving towards
a beautiful eternity

Light/Shadow

golden cage
holding
the Romans' particulate offering
two-colour glass rainbow glowing red/green

wounded cerebrum
made whole
nanoporous gold-plated electrodes
electrifying neurons

New Zealand's woolen fleece
economy wrapped in gold
gleaming lavender

stromal cells
collecting
gold ceaselessly
until
a failure
to regenerate

European cathedrals paned in
photocatalytic purifiers made of gold particles
blazing red

mining nanogold in
sewers
deposits richer than the earth

harvesting the sun
with a fishnet made of gold
Au 144

poisonous nonpoison circulating
the air
the earth
the sea

Discovery

wandering lonely as cloud
a host of golden nanoparticles
rains down on earth

superpositioned quantum world
dead/alive
metal/molecule

classical physics
dead or alive
metal or molecule

simultaneous and incompatible truths
for now

metal particles—144 atoms of gold—Au_{144}
molecular particles —133 atoms of gold—Au_{133}
transmutation of Au particles from metal to molecule and back

Nature's alchemy
breathing them
eating them
drinking them
we become gold
discovering what we are

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Author Biographies

Maryse de la Giroday, independent scholar, writer, and science blogger received her BA in communication from Simon Fraser University (Burnaby, British Columbia, Canada) and was awarded an MA in creative writing and new media from De Montfort University (Leicester, U). Her BA honours project resulted in a video, "Bridging the Cultural Gap" on intercultural communication used as a teaching tool in Canada and the U.S. Her MA pro-

ject, “The Nanotech Mysteries: An Initiation into the Science and the Technology wiki” is mentioned in the 3rd edition (May 2014), “Digital Storytelling: A creator s guide to interactive entertainment” by Carolyn Handler Miller. Since 2008, she has written extensively about nanotechnology on her *FrogHeart* blog and has presented on the topic at regional, national and international conferences. During the 2014 autumn semester, she taught two courses, “Bioelectronics, Medical Imaging and Our Bodies” and “Nanotechnology: The Next Big Idea,” at SFU in the Continuing Studies program.

Raewyn Turner’s work is concerned with cross-sensory perception and the uncharted territories of the senses. She works with video, interactive installations and performances, painting and sculpture, working solo and in collaboration with artists, musicians, architects, dancers, performers and academics on installations, theatre performances, exhibitions and screenings. She is also a concept and design theatre artist and lighting designer and operator in large scale international performance in stadiums and theatres, for contemporary music and dance. She has worked in collaboration with Dr Richard Newcomb, molecular biologist, NZ. In 2011 she was recipient of a Fulbright Travel Grant for an artist’s residency at Monell Chemical Senses Center, Philadelphia. Her works have been shown in numerous national and international exhibitions and performances, including ISEA2013, Museum of Contemporary Art, LA, Parque de las Ciencias, Granada, Spain, 11th Prague uadrennial of Scenography and Theatre Architecture 2007, Prumyslovy Palace, Prague, Argentina, Georges Pompidou Center, and elsewhere.

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The Scroll Unfurled - Ancient to "Vanguard"

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Abstract

An historical understanding of the scroll is useful for creating within new textual genres. Books and text art-forms are destabilizing, energizing future possibilities. Yet we must look backward to the reasons this first information technology existed, as I do in my digital scrolls that report, communicate, purge, and narrate. In light of our changing "book landscape," we combine heirlooms, maps and artifacts with rounded and striped visual structures expressing the rich aesthetic of a *fading* old (slow) format. Where will the new and fast electronic formats lead our culture?

Keywords

Text, Scroll, Book, E-book, Digital Art, Artist's Books, Textile

Introduction

I use history, and books, intensively in my work in the realm of the artist's book – both the tangible and electronic. But I always use the newest digital tools and materials - so I had to ponder if there is a connection between the oldest form of information-recording and what is happening today. Out of concern about the possible demise of the physical book, I was compelled to explore its earliest roots.

There are a wealth of "connections" between the scroll– the oldest known book format, and present-day electronic books. Scrolls and hard drives and CDs are rounded - they spin and roll. We ***scroll*** on our electronic devices. We only read on one side of them; they are literally illuminated. Scrolls were one-sided – and were *artistically* illuminated.

Uses for, or the purposes of, scrolls over centuries of history have also informed my digital scroll-making. Like those before me, I dealt with human relationships in these scrolls. An early digital scroll expressed my search for strength during divorce, and in *Partners* the opposite is explored. Scrolls of the past recorded important life events. My *Fly to Safed* marks the occasion of a long awaited journey. *Flow* [below], combining transfer and direct ink-jet printing, is an imaginary, electronically-generated *picto*-graphic, "letter" of sorts that I wrote to my ancestors, honoring the important use of the scroll format for interpersonal communication.

Figure 1. *Flow;* Copyright, the author/artist

Destabilization

In *The Realm of the Circuit*, Charles Traub and Jonathan Lipkin posit that books are repositories for thought, and therefore power – the power to spread ideas and knowledge, which in the final analysis leads to profit. Over time, they became more and more portable and easier to reproduce; the digital download-able book is just the next phase in this process. The authors argue that in the traditional scroll, and book, content is FROZEN. [1] It was made and scribed, or printed, and could not change. This is not true with artist's books and scrolls, at least those that are designed to change/morph physically and interactively, and certainly not true with e-books.

Books traveled – first along trade routes – and slowly. Now they can travel at the speed of light. And with such massive changes is this dynamic, like those that we see today, things can become "destabilized."

There is a cultural rupture created by the possible (even presumed), slow and deliberate disappearance of the physical book. But the artist can help society confront this by a provocative analysis of 1000's of years of text, and by crossing from literature into other expressive spheres. As I use text, code, and relief picture-making, I have been investigating contemporary aesthetics within bookforms, recently the **scroll**, created both by hand and machine, and various hybrid techniques.

Scrolls as Fodder

This pivotal change and void (rupture?) moving from paper and print to ephemeral media is currently examined throughout the art world; many, like myself, use history to ground their analyses. Using new technology to make "old technology," – **the book**, among the oldest technology, I focus on sacred and ritual books. The earliest sacred books were typically in the form of a scroll, and they shape the basis of my exploration. The scroll is round, fluid and continuous, and must be unfurled. It is also (oddly) quite linear – often stripped together, and "striped" also, hence I design imagery that goes *around* and/or emphasizes striping and concentric lines. Sacred scrolls were richly ornamented; their protection was critical so they were bound, buckled and enrobed in beautiful containers.

The scroll was our original format of choice - a long rolled piece of parchment, paper, silk, etc. One gradually unrolled it, exposing one section at a time. Coiled into a round tube when closed, it worked "in-the-round," not unlike our vinyl records, CDs, DVDs and spinning hard drives. In today's world of iPads, e-readers, e-books and laptops, it feels like we've returned to yesterday. We read on only one side of a screen. We scroll through everything digital. Authoring, publishing, designing, and illustrating software all work on the premise of streams of information ~ upon which pages are IMPOSED, rectangles forced onto a flowing continuum (pagination). Using "forced" pages, new media/electronic artist Seth Ellis builds *flowing* scrolls bringing stories from the past to light. Ellis writes "My work is about finding new ways to tell stories – by making them site-specific, by creating them with randomizing programs, by asking other people living and dead for input. I'm interested in active, experiential reading." [2]

Elements in my scrolls derive from 19th and 20th century ceremonial and everyday objects and texts. Vintage papers, lace, maps, and odd relics are utilized or referenced. Interested in using modern technology to reincarnate symbolically rich, historic art and artisanry, I mine visuals with ritual, religious or mystical significance, and symbolic heirlooms. Akin to Ellis, exploring historical, mythical and ethnic stories through the digital lens of today, combining hand with byte, is the heart of my studio practice.

The Narrative

The yellow round form in *Flow* is based on the filigree top of a Sabbath spice box from the 18th century, near the area in central Europe from which my great-grandparents emigrated; as I constructed this imaginary painterly scroll-letter to those ancestors, I found it important to layer many softly printed phrases and circular elements. Half-real scenarios evolve in my mind, related to journeys I take. For example, *Caves and Flickers* [below] is about a house of worship in an embattled town, and a downhearted man thinking of entering its doors for a "flicker" of hope.

Figure 2. *Caves and Flickers;* Copyright, the author/artist

In other works I may simply journal my travels, as I learn about distant places, their arts, culture, history, and social issues. In *Open the Floe-gates*, to the right, note the maps, suitcase and sense of antiquity. It also questions the future of the narrative on *paper*. So precarious is the future of the physical book, that *Floe* is apt for its title – a floating sheet of ice – ready to melt, crack or self-destruct, disrupt!

The Rolling, Scrolling "Book"

The scroll's beginnings and its amazing connections to the book of today were a far bigger "concept" than I would have ever thought. A large part of the reason for that is how much book arts today – both digital and tangible – actually harks back to, or relies upon, the legacy of the scroll. I got caught up in this thought when I first saw Anselm Keifer's life-sized work in the book and scroll art forms.

Viewers of Keifer's art interact with his huge sculptural books made of the most unique and unexpected materials. They are both light and leaden, furling and rigid, or frozen, perhaps as Traub and Lipkin propose. [3] Yet they had (and have) a beautiful and weathered lyricism to them, as they "rolled" through space at the Smithsonian.

Exploring history – through art history – and its social structures (with all their social inequities), and its ethnic "stories," through the digital lens of today – with its evolving democratic global community, is essential to this body of work. Past cultures' stories, adapted digitally, wind

Figure 3. *Open the Floe-gates;* Copyright, the author/artist

through the coiled multi-substrate surfaces of my scrolls, Keifer's (though not digitally), and a group of like-minded artists that I identified and curated into two recent new technology art exhibitions. What will an unrolled scroll, scribed with leading edge tools, reveal? In the end, it is the story, concept, interactivity, and overall aesthetic experience that most matters.

The New Scroll – Group Exhibition

The show was titled **The New Scroll – an old technology reinterpreted.** Its first venue was the Hamilton Street Gallery, a pristine storefront gallery in Bound Brook, NJ. After that came Arts Guild New Jersey, an exhibition space and cultural center in a town aiming to become the regional arts district. With a little funding, a student-intern and two venues in place, I began carefully selecting art that made the right statement. I had previously searched all over, in various ways, to identify art-makers. Now this grouping of their works had to come together – and interrelate.

The gallerist and I wanted to show a broad range of materials and techniques, with an intensive focus on those with *unusual* contemporary twists on modern technology. The artwork had to have a visual narrative and/or use text. The list of those that work electronically comprised myself, Suzanne Stokes, Haley Nagy and Joohyun Pyune. Stokes is a (shadow-art) performance artist and printmaker, who expertly uses Photoshop to create serigraphs based on the performances – always with a richly choreographed story told in a vertical flow. Nagy is a book artist who uses electronically-controlled knitting to literally knit (revised) biblical words into her extra-long scroll installations. Pyune is a digital textile-print artist who uses all the art software and printing technology she possibly can to heat-transfer print sheer horizontal overlays that tell a story in three dimensions. All are interested in blending the old sources and techniques of their art with the newest ideas and processes in making their scrolls.

Bookforms and Possibilities

"Analog" book and scroll artist, Aimee Lee, states "I have adapted ancient techniques and materials in my art to revive and update tradition, and encourage the survival and evolution of the old ways, while adding layers of meaning to my practice." [4] Using digital tools to respect the vast knowledge of times past, making it relevant and accessible, is a common objective. Linking the past to the present intensifies the content, as seen in *Flagging Helicopters* [below], a scroll/work in progress. The story of a search for lost passengers from a voyage or flight that got inverted (note my upside-down triangular Dutch row-house roof-tops) is told through the use of "mined" metaphorical scenes and symbols.[1] Often looking backwards, revisiting your roots, drawing from the depth of the past, is the optimal way to grow, using this future-minded medium. Here, vintage-style memorial flower wreaths and *wedding band* quilt patterns are rich symbols for *all* times.

Figure 4. *Flagging Helicopters 1;* Copyright, the author/artist

1 Part of participatory group art project done with the Book Arts Roundtable (NJ, USA); to become an electronic scrolling book.

After looking at the literary and pictorial heritage of the scroll, along with some strong artistic interpretations, one cannot help but question how that early technology will continue to influence the computer scroll-like products of today and tomorrow. Hopefully the viewer will consider how *scrolls* can *now* be made and *rolled out*/distributed – perhaps "democratically" worldwide, and definitely at the speed of light. *Light* itself, or its meaning of expanding knowledge [enlightenment], even tells a story; below left a detail of a collaged scroll combining an illuminated manuscript and an x-ray style photograph and right is section of a scroll using a still from illuminated light/shadow theater.

Stories about centuries-old ceremonies celebrating a new life, such as in the piece below left, can easily unfurl in a nanosecond. It continues that scrolls, such as these, can be experienced as non-linear in much the same way we/our youth adapt to/evolve new computing. The horizontal units of the pieces can rearrange, sometimes three-dimensionally. Then the layers of meaning might change too.

Figure 5. Left: detail from *Dutch Lace on Sabbath*; Copyright the author/artist. Right: detail from *Ascend (scroll)*; Copyright Suzanne Stokes

Scrolls Abroad

It is important to note that there are other attitudes about the contemporary *scroll-as-art* experience in different cultures. Chinese, Korean and Japanese artists still today use the beautiful silk scroll formats from long ago; many artists offer provocative, unusual new interpretations. On a recent research trip to Oslo, Norway I studied the work of digitally invested textile and book artists, all makers of scrolls, up close. Galleri Format, a leading Norwegian venue, was vey informative in this regard.

There, I became versed in the work of Kari Dyrdal, who describes her encounter with digital tools as rich,

investigative, *disruptive* and constructive – all rather apt adjectives. Her work involves an intensive background in art traditions, yet it is innovative in its use of digital technology. While conceptual, it also strongly refers to substance and technique, which connects to a deep cultural appreciation for the heritage of the process, craft and its materials. The detail of a three-part scroll below, left, is especially rich in its use of fiber and computer printer-dyes, while quite changeable – even destabilized – in terms of the position each unit holds both vertically (according to its state of "unroll") and horizontally. It contains fairly illegible text as well. Notice its similarities to the piece on the right by Korean-born Joohyun Pyune, which also shows subtle symmetry within a transient sense of time and light. The digital medium is "perfect to visualize the ambiguity of the life experience." [5] Once posted, these

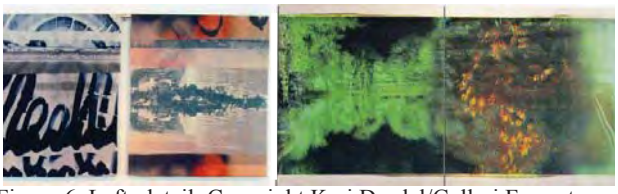

Figure 6. Left: detail; Copyright Kari Dyrdal/Galleri Format. Right: detail from *Five Seasons*; Copyright Joohyun Pyune

scrolls reach an internet audience in almost no time, and make an immediate, if not powerful, optical impression on the visitors at the public spaces in which they hang.

It is hard to discuss the modern scroll experience without including the ancient Jewish scroll, the Torah. It remains a vital part of the spiritual, literary, and aesthetic aspect of Judaic practice, comprising all elements of its crafting – the calligraphy, stitching, woodwork and ornamentation along with its musicality. Marvell Ginsburg writes that old Torahs that were dressed in jewel-toned mantles, topped by silver crowns, "looked like kings and queens," [6] placing an anthropomorphic spin on the sacred book. Interestingly, they become damaged by NOT being unrolled for many years, as happened when the Nazis confiscated and warehoused them. It is as if a Torah can only remain functional through the very act of repetitive interactive scrolling.

Yet, one can also wonder if there is another, radical, slower, more expansive or more *illuminating* way to "scroll" in future centuries. Should scrolling be more – or – less iterative? One or two-sided, or multilayered? What might electronic or analog scrolling look like decades from now? How shall that quickly-fading first information technology inform us? Meditative concentration is required to truly "read" or discern the scrolls of **The New Scroll.** Focus is necessary to grasp the art. But when we only scroll faster and faster – where will that ultimately lead us?

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Author Biography

Leslie Nobler is a digital artist, creating artist's books, surface design, and monoprints. Her recent work *reinvents* sacred books and ritual artifacts using alternative digital printmaking. Exhibitions internationally include New Jersey State, Noyes and Montclair Art Museums (NJ), Old-Main Art Museum (AZ), Athenaeum Museum (PA), Kemper Museum of Art (MO), Afri*graphics* Pretoria, and Digital Art Awards/Australia and China. Nobler has had multiple inclusions in SIGGRAPH Art Galleries. She is an Art Professor at William Paterson University (NJ) and curator/ lecturer at universities, museums and alternative spaces. Her work is represented internationally in museum and university art/book collections, such as Sheffield University, UK. A recipient of Surface Design Association and Puffin Artist's Grants, among others, she earned her BFA at University of Michigan, Stamps School of Art, MA at New York Institute of Technology and MFA at City University of New York - Hunter College.

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'Twitter': Practice in Writing
A recipe for Creativity & Creative Interpretation

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Abstract

This paper will explore how the way we read on the screen can create new forms of collaborative writing online. With reference to our 'Twitter: Practice in Writing' workshops in London 2014 and Vancouver 2015. As a younger generation move swiftly from print to pixel, reading no longer becomes deliberate and concentrated but rather a scan for information as our eyes follow an F-shaped pattern. Screen-reading encourages rapid pattern-making, provoking action, whereby words are merged with images. From scroll to moveable type, will twitter 'novels' give rise to twitter brains? How does it affect what we read and write? Has this change been recognized in the publishing industry?

Keywords

Screen; Reading, Writing, Graphics, Twitter, Novels; Brains: Technology; Type;

Introduction

In order to understand how screen writing and screen reading have evolved, a series of 'Twitter: a practice in writing' workshops were devised in London 2014. The first steps of this workshop devised ways for dismantling the most obvious and accepted of connections, be they between words, colours, shapes, or ideas. Then brought these elements together, in ways that have never been linked before. The critical issue here is that the new combination of colours/words/ideas must trigger new extensive connections and 'meaningful' associations in both the creator and ideally others. Mere linkages between disparate themes and concepts are insufficient, as witnessed in many drug-takers' meaningless ramblings or schizophrenics neologisms, creating only nonsense words.

We see the world, thanks to the creation in a new way because the extensive and therefore 'meaningful' associations have formed in our brains, previously triggered by these novel juxtapositions of previously disparate elements [3].

This changes clearly develops through our younger generations. Young people moved from print to pixel, today some 4.5 billion digital screens illuminate our lives. Words have migrated from wood pulp to pixels on computers, laptops, tablets and phones, with *our"…digital screens illuminate our lives... Letters are no longer fixed in black ink on paper, but flitter on a glass surface in a rainbow of colors as fast as our eyes can blink…We are now people of the screen…these newly ubiquitous screens have changed how we read and write." Kevin Kelly 2010*

Writing does not come naturally

The 2014 workshop was the starting point to illustrate the development of a framework that analyzed the use and production of typographic forms and text, which were influenced by the media-specific potentials of emerging technologies. The process aided design practitioners in their creative thinking and writing. The purpose of the workshop was to obtain a clearer understanding of opinions held by participants on the application and role of screen based text. By identifying the different natures of the interactive screen, media practitioners were able to experiment with creative methodologies. The workshop was designed to function as an ongoing series of experiments to further our understanding the nature of writing, and captured something of the elusive moment when thoughts turn into words. Moreover, the workshop explored how new media affects established design processes in terms of clarity of communication. If one is to achieve an understanding on the unique potentials of the development of typographic form, it is important to bear in mind the conditions in which the new media and new technologies influence the designing process.

The workshop outcome was informed by an understanding of the creative process as a holistic action with the capacity to simultaneously achieve both epistemological and ontological shifts. Furthermore it provided educators, researchers and students the opportunity to challenge the most obvious and accepted of connections, creatively, be they between a variety of words, that affected by colors, created by unique and experimental shapes, or innovative ideas. Whilst it became clear that they were not reading on line in the traditional sense, they were engaging in what is termed "power browsing' through links, blogs and all forms of social media. This is supported by the British Library's report (2008) where researchers found that everyone, *"exhibits a bouncing/flickering behavior, which sees them searching horizontally rather than vertically… Users are*

promiscuous, diverse and volatile." They navigate, they skim, and they pick out only key words.

Mass production

Despite the concerns raised in the previous paragraph, the usability of webpage's does allow for new forms of writing to emerge. These forms are based on interaction and dependent on the feedback of others through the unique meshing of graphics and words. It also rewards participation and performance rather than more contemplative behavior that print literacy has exhibited for generations. After all, post Gutenberg mass-produced books in the 15th century changed the way people read and wrote so that the technology of printing expanded the number of words available (from about 50,000 words in Old English to over a million today). More word choices enlarged what could be communicated but in contemporary society, less is more.

Using thumbs instead of pens, it appears that young people collectively write over 12 million tweets that comprise no more than 140 characters, per day from their phone. In terms of issues in contemporary writing, Jennifer Egan's Pulitzer Prize winning novel, A Visit from the Goon Squad *"an inventive investigation of growing up and growing old in the digital age, displaying a big-hearted curiosity about cultural change at warp speed*" [4], is an exemplar of what is happening. In her follow up work, *Black Box* propels a character from A Visit From the Goon Squad into the 2030s and a world of citizen espionage. But Black Box is only available as an eBook, and The New Yorker, on Twitter, first disseminated it. The tweets ran one a minute for an hour each evening, over ten days, starting on 24 May 2012.

So what do you do if *you* have a novel to write and you are not a Pulitzer Prize winner but you have something to say about your world and want to do this by creative participation? Artist Cory Arcangel's new book is a compilation of those who couldn't resist tweeting the words "working on my novel". Working On My Novel [2]. It's a compilation of tweets, found on twitter by searching for the phrase "working on my novel", and re tweeted by Arcangel's account of the same name. This is but one example, but as the artistic boundaries, in some cases, between producer and consumer in increasingly blurred; the relative ease of digital creation through twitter novels for example and online distribution and feedback may lead to production by the masses that rival production for the masses. The distinction between the producer of culture and the consumer of it is blurred. This is the one of the findings from the Twitter: Practice In Writing workshops from June 2014.

Publishing Industry

Drawing on debates informed by a series of roundtables at the Guardian newspaper (2013, London, UK) and the National Endowment for Science, Arts and Technology (2014, London, UK), writers, lawyers, publishers and economists explored the issues that are impacting on the global publishing industry. Whilst much of the debate tends to focus on digitization and on the transformation of products (books to e-readers, paper to screen) and the developments - called "social creativity"- there appears to be an unlimited source of innovation for social and economic aims. The value of alternative working as well as business models including the formation of new publishing consortia, new cooperative and participatory practices were acknowledged. This has led to the emergence of new economic models that challenge the boundaries between what we have traditionally considered to be the public, private and common realms [7]

For example, there are many small presses in the UK that bridge the gap between writers, new writing and industry, seeking experimentation and innovation where the question of nurturing relationships and collaboration is the primary concern. Smaller presses like SALT, INFLUX or Gallery Beggar Press in the UK ('high class boutique' presses) who publish up to 12 title a year (SALT) or 4 (INFLUX) but the same challenges are face large or small, risk versus money, good editors as good readers and no book sells itself, authors are always key. CompletelyNovel [5] is a self-publishing platform and book community, specializing in print-on-demand publishing which hosts an eclectic mix of authors writing across a whole spectrum of fiction and non-fiction.

What is a Book? What is a Novel?

"Siri write me a novel…"It's pretty easy to make 50k words of nonsense…we want to see is code that produces alien novels that astound us with their sheer alienness. Computers writing novels for computers, in a sense." Stephen Fortune, 2014 [fig 1].

So what is a book or indeed what is a novel? " Ulises Carrion (1985) poses such a question in his essay, '*The New Art of Making Books'* [1]. A book is a sequence of spaces and since each of these is perceived at a different moment, a book is also a sequence of moments; it is an autonomous space-time sequence. The content of a book is contained within the volume of the book. Elements or blocks of the content – both identical with the elements of the book and independent of it and from them texts, images- are organised within the space of the book.

The relationships between them are spatial rather than linear. Whilst the content of the book is organised and

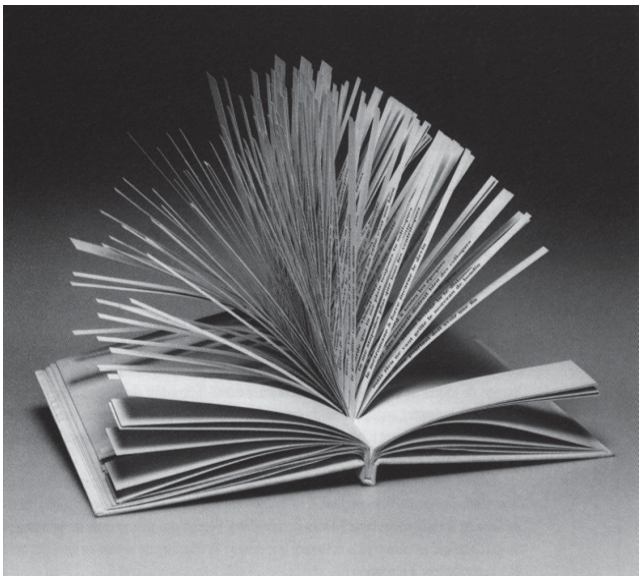

Figure 1. Raymond Queneau's One Hundred Trillion Sonnets

structured simultaneously in space, it is perceived consecutively in time and the time sequence only realised in the process of reading.

It is the reader who chooses where to start in the process of reading, where to stop, how and what to read, how fast, how slow and how attentively. Another example is the "A Thousand Plateaus" written in a non-linear fashion, and the reader is invited to move among plateaux in any order . It shows how such distinctions are operations on the surface of a deeper pasture with further complicated dynamics [8]

These stylistic choices are entangled in the book's content, as made apparent in the introductory section on "rhizomes"." Furthermore experimental approaches in writing also appears in Katherine_Hayles book 'Writing Machines' and in Tom Philips "A Humament" where both are exploring alternative techniques of the words through painting, collage and cut-up practices to create an entirely new version of existing writing.

Readers, while welcoming the new generation of electronic reading devices, still buy predominantly paper copies of books. Time and again the conversation leads to blanket statements about 'the end of books' where little attention is paid to the vast potential for new hybrid forms of text, and the fundamental shifts in the writing-reader axis that the new technologies are enabling. Attributing too much agency to technology is often tantamount to the abdication of responsibility, and we are concerned with broadening the discussion toward notions of ethics, collaboration, property and creativity. Is it possible that there is a potential transformation in the *relations* rather than *objects* (books, devices) that characterise the publishing industry?

You turn the page and guided or confronted by its structure, you manipulate the book – and through the interaction between book and reader something is revealed. Sven Birkerts (1946) in The Gutenberg Elegies: The Fate of Reading in the Electronic Age calls this 'deep reading' because we, the reader, are free to "indulge our subjective associative impulses; we dream our lives in their vicinity" and we hear "in the theatre of our auditory inwardness, voices that we conjure as our own as a sound print of the self." (ibid:146)

Birketts has a pessimistic perspective on reading in the electronic age since the printed page and the circuit driven, emerging (defined as information) technologies are not 'kindred' but are staged in opposition, undermining, what he states in his introduction as 'the once stable reader-writer' exchange. In Maryanne Wool's words (2008) "How much syntax is lost. Where is the "slow reading" movement? Will we become Twitter brains?" The brain, after all, is as plastic as words; writing can be as collaborative and social as individually conceived. In fact, as Woolf argues the brain was not designed for reading, as there are no genes involved as there are for language and vision.

The brain has adapted to read, so for one of the authors, my brain has to learn shortcuts to deal with one form of non-linear reading (there are exceptions of course).

Was this ever so? Lawrence Stern's cult classic novel,

The Life and Times of Tristram Shandy, written in the mid 1700s, is a rambling mock autobiography packed with eccentric characters, elaborate wordplay and lots of typographical and diagrammatic interaction. In attempting to tell the story of his life, Shandy goes back in time trying to explain to his readers what has shaped him, frequently digressing from his tale according to whatever interesting subject appears to him. He does not even get to the part where he is born until volume three.

An experimental book, hardly neither linear in time nor chronological in structure, is now considered a postmodern tour de force, visually exploiting the resources of print so that the physical shape of the book is expressive to touch and sight concurrently. Chapters are misplaced only to reappear later, out of sequence and out of time. Fragments of learning and intellectual scholarship are peppered with doodles, blank pages and distinctive punctuation that is almost captured in the film 'Cock and Bull' (taken from Tristram Shandy's last sentence) a cinematic labyrinthine directed by Michael Winterbottom in 2005.

Digital thinking

As leading author and developer Dean Johnson ('https://twitter.com/activrightbrain' and author of *#1 Design iBook 'Digital Publishing: The Next Steps'*) has noted, designers, working across platforms, need to re-examine usability. Often rarely an issue for simple print formats with centuries of familiarity, usability now needs to be a major consideration. Today, digital skills – and, even more importantly, a digital mind–set, a willingness to engage

creatively with the new possibilities digital formats create – are a vital part of every publishing department, graphics design school or thinking about writing a collective Twitter novel as we are exploring in our workshops A project that can include writing techniques in collaboration of different mediums, such us interaction, animation and sound. . But, stop for a moment and just look at Twitter and its brisk 140-character declarative sentences.

Creativity and Innovation are supposed and proposed to be key drivers of the UK economy particularly when subsumed under the 'creative industries' label. Can new forms of technology contribute (alongside the old forms of technology) to the re-prioritisation of relations between writers and readers, designers and prosumers, publishers and technology developers, industrialists and inventors? Our twitter workshops and CREATe roundtables suggest that they can. The merging of text and technology (as in YourFry) is but one commercial example [10]. Stephen Fry and Penguin's *YourFry* project has been created to ask questions about the nature of how we create and publish autobiography in the digital environment. The web is responsive, interactive and chaotic – what if the conventional autobiography is thrown open to the web? What might the results look like, what form might they take?

So what do you do if you have a novel to write? Go to Twitter, and tweet about the work you're not doing, of course, Maybe record it, annotate it, use a picture to describe it further, print it record it again, post it and so on…

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Janis is an artist, writer and curator, Professor of Visual Arts, Goldsmiths University of London. As Associate Pro Warden, Creative and Cultural Industries, her current research project, 'Whose Book Is It Anyway? IP, collaborative business models, and questions of ethics and creativity in digital publishing forms', focuses on cultural rights and is funded by the UK Arts and Social Science Councils via the CREATe consortia.

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Aesthetic Experience by Proxy: Science Description and Science Fiction in New Art Practices

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Abstract

The claim of the paper is that in many cases new artforms that make use of new, advanced science and technology, paradoxically, prompt aesthetic experience by means of simple text. The paper investigates the difference between the technical media of, for instance, works of bio-art, and the concrete material that the audience of such works encounter in the gallery. In relation to new artforms, the 'simple' paratextual descriptions of the works' technical media take on a significantly different role compared to the paratexts accompanying traditional artforms. While the paratexts' primary purpose is one of simply conveying information on the works' technical media (such as DNA-material, brain cells, digital software etc.), which are often hidden from the human sensory apparatus, in reality the paratexts simultaneously take on a second, but more important function: that of being the prime catalyst of aesthetic experience – thus substituting the work itself. The paper analyses the mechanisms of this new role of the paratexts accompanying scientifically advanced art and concludes that an important component is the conceptual character of allographic, informational paratexts. Curiously, this conceptual character is also a key feature of the advanced science at work in the new artforms.

Keywords

Aesthetic experience, paratext, bio-art, new media art, science, conceptual art, fiction, narration.

Introduction

How is aesthetic experience prompted by works of art that make use of advanced technology? What is it that makes such works aesthetically intriguing? One explanation that is often offered is that – compared to traditional art media – recently developed, advanced scientific procedures and technologies provide the works with new possibilities and dimensions, and as a result the new technologies themselves are at the focus of attention when critics and theorists analyse works said to belong to new genres like, for instance, bio-art, computer art, or nano-art. While fully acknowledging the importance of new technologies in works of art, this paper demonstrates a different approach: Instead of investigating technology and science in itself as the hotbed for the aesthetic potential of such works, the paper claims that what really acts as a catalyst for aesthetic experience in the audience encountering such works is good, old-fashioned text. Specifically, the texts that give rise to aesthetic experience are the paratexts that accompany and guide the reading of the 'real' texts. In this paper the texts are the works of art that make use of advanced science, and the paratexts investigated are wall labels, captions, or catalogue listings that describe the material of these works of art.

How this aesthetic experience arises is demonstrated by analysing the role of paratexts with the help of theory deriving from classic aesthetics (Immanuel Kant), literary theory (Gérard Genette), and art theory (Nelson Goodman, Dominic McIver Lopes, and Diarmuid Costello).

The two overall claims of this paper are: That simple, descriptive paratexts play a different role when they describe works of art that make use of advanced technology – these paratexts simply function differently than paratexts that describe more traditional artforms. And second: that, because of that different role, the paratexts in question actually take the place of the physical work of art as catalyst of the viewer's potential aesthetic experience.

The (new) role of paratextual description

In his book on paratexts from 1987 Gérard Genette made a thorough analysis of the diverse functions of paratexts. Working in the field of literary theory Genette's primary examples of 'texts' are novels, and the concrete paratexts he takes under consideration are: prefaces, covers, title pages, postscripts, critics' reviews, etc. The purpose of the book was to investigate paratextual messages according to their:

"[S]patial, temporal, substantial, pragmatic, and functional characteristics. More concretely: defining a paratextual element consists of determining its location (the question *where?*); the date of appearance, and if need be, its disappearance (*when?*); its mode of existence, verbal or other (*how?*); the characteristics of its situation of communication – its sender and addressee (*from whom? to whom?*); and the functions that its message aims to fulfil (*to do what?*)." (Genette 1997a, 4)

Illustration 1. David Hockney: *Mr and Mrs Clark and Percy*, 1970-1,The Tate Collection, London. ©David Hockney.

Out of the very elaborate system that Genette presents in his book, this paper focuses on the relationship between the two latter – the 'pragmatic' and the 'functional' – aspects of the paratextual messages.

At this stage it is of relevance to look at and compare three different paratexts that each describe the technical medium of different works of art. The term 'technical media' here refers to the way Lars Elleström uses the notion to describe 'the *actual* material medium, the "form", that realizes and manifests the latent properties of media, the "content"' – regardless of what that content might be (Elleström 2010, 17). The first paratextual example accompanies a work by David Hockney, *Mr and Mrs Clark and Percy* (illustration 1), and reads: "acrylic paint on canvas" (tate.org.uk). The technical medium of the second work, *Pancreas* (illustration 2), created by Thomas Feuerstein and Thomas Seppi, is communicated by this text: "glass, metal, plastic, technical equipment, brain cells, bacteria" (Wipplinger 2012, 224). Finally, the text that describes the technical medium of a work by Charlotte Jarvis, *Music of the Spheres,* (partly represented in illustration 3, next page) goes like this:

"1. Jarvis enlists British composer Mira Calix to write an original piece of music – she does this, inspired by the hum of the huge data storage machines in the server room at EMBL–EBI [European Molecular Biology Laboratory – European Bioinformatics Institute].
2. The music is recorded and encoded in a form that could be represented by the letters of DNA. That DNA was then synthesised and infused into liquid soap.
3. Calix's music is performed on stage by an orchestra. Bubbles of the DNA-infused soap will be blown about during the performance, filling the air with miniscule copies of the original composition.
4. As the bubbles float through the air, the musicians fall silent. The bubbles become the only physical manifestation of the music.

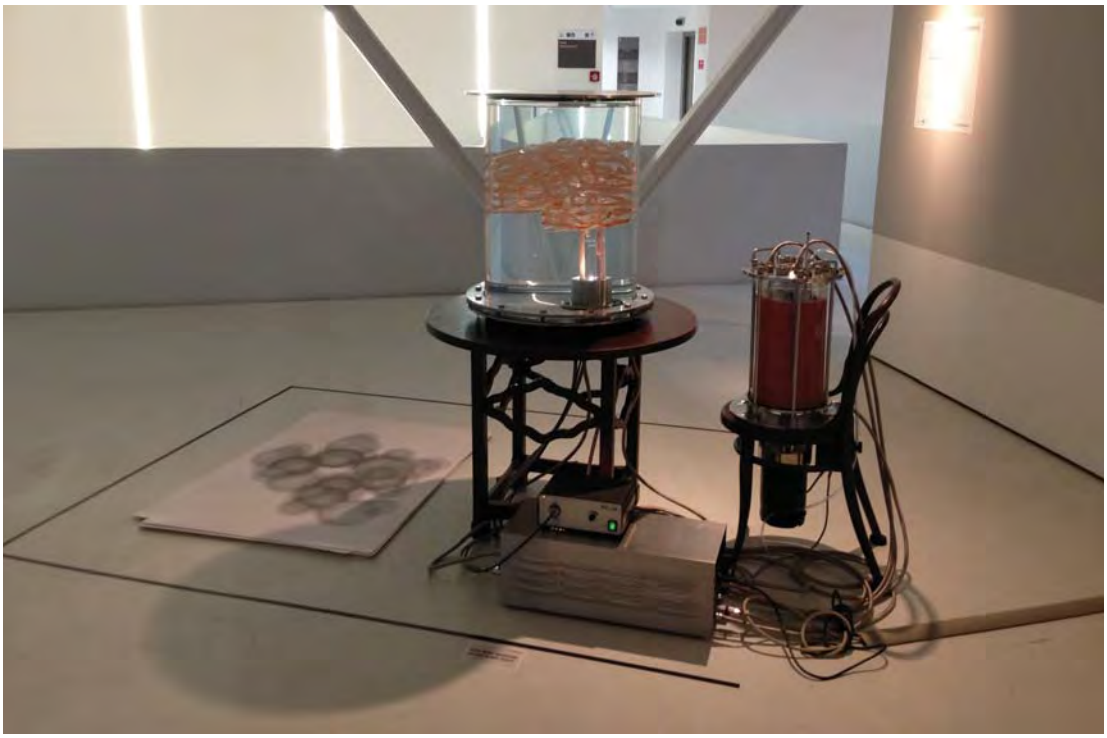

Illustration 2. Thomas Feuerstein and Thomas Seppi: *Pancreas*, 2012. Exhibition view: Ars Electronica 2013.

5. After the performance, the soap mixture is offered to audience members as they leave. Theoretically, they could have the soap sequenced, whereupon a digital file detailing the sequence of the DNA fragments would be sent to them.
6. Then, using instructions online and some smart computer programming, they can decode the fragments to recreate the music file." (Brownell 2014, 13)

The fact that the last paratext – even though it still only describes the technical media of a work of art – is considerably longer than the first two is understandable insofar as, in this case, the scientific procedures that make up the technical media are much more complicated and inaccessible to layman, and therefore in need of much more description.

The claim in the following, however, is that the paratexts above illustrate a tendency: Whereas traditionally there is a difference between what Genette terms informational and interpretative paratexts, these two types merge in the texts that accompany new works of art (like *Pancreas* and *Music of the Spheres*).

Informational and Interpretative Paratexts

Despite the different length of the three paratexts, and the fact that they describe the technical media of three very different works of art, they are of a similar pragmatic character insofar as they are all of the same type of, with Genette's term, illocutionary force. According to Genette, the illocutionary force, or the purpose, of paratexts may be that of communicating, for instance, 'sheer information', 'intention', 'interpretation', 'a decision', 'a command' of a work/text. (Genette, 1997a, p. 11). The illocutionary force of all three paratexts quoted above is that of conveying information on the technical medium of the works in question. In most traditional art forms, such information on the technical media is of little, if any, relevance to a hermeneutic interpretation of the work in the sense that to most viewers (experts or conservators excepted) it would not alter their aesthetic experience of *Mr and Mrs Clark and Percy*, if the textual information on the technical media read, for instance, 'oil paint on plywood' instead of 'acrylic paint on canvas'.

An example of a paratext that is not of informational but of interpretative illocutionary force could be this one, which invites us to consider the subject matter of David Hockney's painting in more detail:

Illustration 3 (right). Charlotte Jarvis and Nick Goldman: *Music of the Spheres*, 2013-. Photo: James Read

> "Close to her and therefore, perhaps, associated with her are the lilies, traditionally a symbol of the Annunciation and feminine purity. Likewise, the cat on Ozzie's lap carries symbolic resonances of the libertine and somebody who disregards rules and does as they please. Viewed in this way, *Mr and Mrs Clark and Percy* recalls the famous portrait of a married couple, *The Arnolfini Marriage* 1434 (National Gallery, London) by Flemish renaissance painter Jan van Eyck." (excerpt from longer text at tate.org.uk)

What this text offers is a different look at the scene depicted in the painting that transforms what we see from being merely an everyday interior with two figures to a symbolically loaded scene of tension in the relationship between two different characters – a scene that possesses numerous potential narratives on what is going on in the marriage, what happened earlier and what will happen in the future. Compared to the informational paratexts, "acrylic paint on canvas", it seems that interpretative paratexts like this one are much more hermeneutically relevant and carry a greater potential to directly affect viewers' aesthetic experience of the work. In other words: whereas the informational paratexts on the technical media reveal only what we can already see and/or expect, 'this is paint on a flat surface', the interpretive paratext above, to most viewers, reveals a surprisingly new (but not exhaustive) interpretation, which sparks our imagination and expands the scope of the work beyond its technical material.

As Genette himself points out, however, even if the illocutionary force of a paratext in theory is informational (like an unknown author's name) it may have an interpretive *function*. If, for instance, the name reveals the author's sex it "may have crucial thematic relevance". (Genette 1997a, 40). And it is exactly the *function* of the, in theory, purely descriptive and informational paratext accompanying new art forms that differs from its presumable function. Traditionally, as in the case of the two paratexts quoted that relate to the Hockney painting, concurrence exists between the implied illocutionary force and the function of each paratext: 'Acrylic paint on canvas' is meant to account for the technical medium and this is what it does – nothing more, nothing less – whereas the implied illocutionary force of the paratext that compares Hockney's painting with that of Jan van Eyck is one of hermeneutic interpretation and that is also its actual function. As we shall see in a moment, a similar neat distribution of roles between different types of paratexts is not at work in relation to *Music of the Spheres*.

The paratext describing *Pancreas*, however, holds a position between those of *Mr and Mrs Clark and Percy* and *Music of the Spheres*, insofar as the informational paratext comes in two versions in the catalogue in which the work is described: The short text ("glass, metal, plastic, technical equipment, brain cells, bacteria") is immediately followed by a longer text that elaborates on the items listed in the short one:

> "The processual sculpture PANCREAS transforms books into sugar (glucose) that feeds human brain cells. The books' paper is shredded, soaked in water, and pressed into an artificial intestine (fermenter), in which bacteria break the cellulose down into glucose. After filtering and purifying, the glucose is fed to the cells growing inside a glass tank (brain in a vat). The feeding of the artificial brain follows a strict diet: the brain food consists exclusively of Hegel's 'Phenomenology of Spirit'. PANCREAS is a pataphysical machine that uses biotechnologies in order to translate language and books, that is symbols and data, into matter and flesh. Glucose, as a universal fuel of life, which all cells, especially brain cells, feed from, becomes the artistic material for PANCREAS (Gr. pánkreas, pán = "all", kréas = "flesh")." (Wipplinger 2012, 224)

The short text briefly hints at the fact that 'invisible' material ("brain cells, bacteria") plays an artistic role. By elaborating on the technical medium briefly listed in the short text, the longer text reveals information on the technical medium that bears significant relevance to the aesthetic potential of the work, and which we will never be able to learn by use of the human sensory apparatus – no matter how much time we spend looking, smelling, listing to, touching or tasting the technical media – and which, most importantly, surprises us: The paratext mentions Hegel's philosophical masterpiece, *The Phenomenology of Spirit*, which argues for a teleological, historical move towards the conscious self-realization of the absolute spirit transcending material matter. Learning, from the paratext, that Hegel's work is used as simple, material fodder for brain cells (and thus fulfils a kind of homecoming that Hegel himself most likely did not anticipate) potentially prompts intriguing, yet undetermined and disinterested, activity – aesthetic experience – in the mind of the viewer/reader.

Thus, a difference is at work in the long *Pancreas* text between its illocutionary force (of conveying information of the work's technical media) and its function (of potentially prompting aesthetic experience, because the information conveyed about the technical media is so unexpected and surprising). The long informational paratext, which reveals the details of *Pancreas'* technical media, does not have the same illocutionary force as the interpretative paratext accompanying *Mr and Mrs Clark and Percy* even though it, in reality, may have an interpretative function. Instead, *Pancreas'* paratexts equivalent to the Hockney painting's interpretative paratext are the catalogue texts, written by different scholars and curators, that elaborate, for instance, on the meaning of recurring motifs in Thomas Feuerstein's oeuvre. Despite its length, the long informational paratext is 'only' a descriptive caption and not a reading of *Pancreas*.

In the case of *Music of the Spheres*, the merging between descriptive and interpretative paratexts goes even further, insofar as very little is (yet) written on the more traditional symbolic dimensions of the work (for instance references in the work's title to Pythagoras or other com-

positions bearing the same title). Instead, the technical dimensions of the work are often thoroughly explained while, to my knowledge, there is no official equivalent to the short texts of purely informational function, which accompany the other two works (see Higgins 2013, Brownell 2014).

Just like the aesthetic potential of the interpretive paratext related to the Hockney painting arose from the suggestion of elements that reaches beyond the scope of what is strictly visibly in the painting, the description of *Music of the Spheres* tells us that there is much more to the work, than what we (can possibly) see. Now, we are used to interpretative readings of works – whether they stem from art critics or children – and in that sense the possibility of adding new interpretations of a work of art never comes to an end. What is different in the case of *Music of the Spheres* is the fact that the paratext does not add a new *symbolic* reading to the work; instead it alters the character of the *physical material* in front of us in a very surprising manner. By means only of simple informational paratext, a container of childish soap bubbles is magically transformed into a DNA-material that contains a MP3-code with a piece of music. A fictive equivalent would be if the informational paratext describing the technical media of *Mr and Mrs Clark and Percy* did not read 'acrylic paint on canvas' but instead: 'all red colours in the painting consist of blood from a dead cat.'

Hence the first claim of this paper: The paratexts related to contemporary art that makes use of advanced science often take on a different, additional role in which seemingly simple descriptions in reality function as radical revelation in the minds of the audience. To some extent art has always incorporated science and new technology – from mathematical calculations of the linear perspective in a renaissance painting to Nam June Paik's experiments with magnetic manipulation of electronic TV-signals to music in DNA or brain cells in an installation – and since all these works of art presumably have informational paratexts describing their technical medium, neither the paratexts or the role they play are really new. But they play a different role from the presumed, simple, descriptive one. What I hope to have demonstrated is that such paratexts' also play a paramount role in the aesthetic experience of the works. The remaining part of the paper analyses a peculiar implication of this fact: that the paratexts in question take the place traditionally occupied by the 'text' (the physical work of art), and become the actual catalysts of potential aesthetic experience in the viewer.

From Science Description to Science Fiction

As demonstrated above the paratext describing the technical medium of *Music of the Spheres* holds a greater aesthetic potential than the physical work that we can approach by use of our sensorium. One significant reason for this is that *Music of the Spheres* does not exist as one physically coherent work – and not just because many of the elements are so small or abstract that we humans cannot sense them; after all, even DNA very much exists. More importantly, the elaborate technical and scientific mechanisms of the work (made known to us only through the informational paratext) are combined in ways that are new, not only to the artworld but also to the field of science (see Goldman et al. 2013), not to speak of the perspective of the layman. It is for this reason that, throughout this paper, I have made use of the unidiomatic notion 'works of art that make use of science and new technology', and refrained from using terms like 'digital art', 'bio-art', or 'new media art'.

Admittedly, it would be easier to refer to a work like *Pancreas* as, for instance, 'bio-art' in order to quickly give a rough hint to readers or potential viewers about what to expect when experiencing the work (see Lopes on appreciation in art and aesthetics (2010, chapter 4; 2014, chapter 9)). However, as the description above indicates, *Pancreas* could also be considered 'sculpture' (Feuerstein's own words), 'performance' (due to the processing of paper and the 'live-ness' of the brain cells), 'installation' (as suggested by the way it is exhibited in the gallery), 'scientific experiment' (what kind of paper is best suited?), 'critical reading/reverse engineering of Hegel', just to mention some of the more or less established categories that would fit such a work. None of these different labels fully capture all aspects of *Pancreas*, but they each suggest different ways of categorizing and hence interpreting the work, at the same time as they preclude the others.

Similarly, it would seem reductive to label *Music of the Spheres* according to a specific artform label. It can be considered 'music' (composition/performance), 'bio-art' (DNA-encoded material), 'software-art' (the music is embedded in the DNA in MP3-format), 'multiples' (the audience each gets a soap bubble container), 'scientific experiment' (new method in molecular biology is applied to the field of art), etc. None of the suggested categories, however, would be able to grasp the trans-categorial character of the work, just like none of the physical dimensions or stages of the work could represent all the work's technical media.

The soap bubble device depicted in illustration 3 represents only the visual dimension of a fragment of the technical media accounted for in the informational paratext. The photo is taken from Charlotte Jarvis' website's description of *Music of the Spheres*, which also contains photos that depict the server room at EMBL and people with protective rubber gloves who handle pipettes and fluids ('Art for eating' website). No single photo represents the work better than the others. Even if we were present at the live concert, mentioned in point 3-4 of the paratext, would we have a clue about the work, had we not read the informational paratext. Instead of *a* physical entity or object, *Music of the Spheres* is an abstract idea consisting of numerous different concrete, physical objects and actions that cannot be physically combined in the same space. In fact, the only thing that provides the audience/viewers with a

sense of the work's form (that is, its spatial and temporal extensions and limits) is the informational paratext.

Allographic, conceptual reduction

A significant feature of the informational paratext is that it is, what Nelson Goodman terms 'allographic' which means that it cannot be forged because it consists in a 'numeric' score. Literature is an allographic art because, in the case of, for instance, Thomas Grey's poem *Elegy* "any sequence – even a forgery of the author's manuscript or of a given edition – that corresponds to a correct copy is itself correct, and nothing is more the original work than is such a correct copy." (Goodman 1976, 115-116). *Elegy* is *Elegy* regardless of whether it is printed in a hardback or handwritten on paper napkins, as long as the words and syntax are combined so that they spell Grey's *Elegy*.

In the case of the informational paratexts accompanying works of art that make use of advanced science and technology, the allographic character, contrary to the one of a poem or a novel, consists not in correct spelling or grammar, or even in the use of a certain syntax or language. What must be conveyed very precisely is not letters or words but the *essential content* of what makes up the technical media of a work. The aesthetic potential arises from the so-called 'raw' information (on the technical media) that the paratext reveals. The exact manner in which this raw information is delivered is not crucial as long as the essential message is received. Hence, a traditional equivalent to the informational paratext would be the oral narrative, which relates to the (unwritten) tale in the same way as the paratext relates to the inaccessible work of art. Or, to be more precise, the written informational paratext functions as a physical manifestation of the work, which in itself is what Genette refers to as "an ideal object of immanence" (Genette 1997b).

In his elaboration on Goodman, Genette states that:

> "The allographic work […] exhibits the paradox (and practical inconvenience) of being entirely itself only in the ideal object it immanates in; but this object, because it is ideal, is physically imperceptible, so that there exists, even for the mind, nothing more than a vanishing point that can be defined but not observed." (Genette 1997b, 125)

The fact that some of the most important material dimensions of a work like *Music of the Spheres* are inaccessible to human perception poses some interesting questions to our understanding of the mechanisms of aesthetic experience. Immanuel Kant's distinction between cognitive faculties and sensory experience seems to be challenged here, since, traditionally, sensory experience is considered to be a necessary foundation for aesthetic experience in art. However, the reading of Kant's aesthetic judgement as governed by perceptual or formalist dimensions in a narrow 'Greenbergian' sense has been convincingly contested by professor of philosophy Diarmuid Costello, who suggests that

> "the default understanding of Kant's formalism should be the 'expansive' formalism that Kant operates with throughout the *Critique*. […] it is the unified organization of aesthetic attributes required to present an idea that constitutes the work's form" (Costello 2013, 294).

Costello specifically investigates how Kantian theory allows aesthetic judgement to arise on the basis of conceptual art in the strong sense – that is works of art that belong to the institutionalised domain of visual art but which have no perceptual features at all. His core example is Robert Berry's work *All the things I know of but of which I am not at the moment thinking: 1.36pm; June 15, 1969*, which consists 'only' in the title that is perceptually allographic in the sense that it does not matter which font, size or colour is used when writing the title. The reason that such works are still able to evoke aesthetic judgement in the subject is that they refer to an idea rather than to a concept, and hence they are judged freely. With reference to Kant, Costello argues that the aesthetic idea in the work of conceptual art does not depend on perceptible features, in the same manner as the aesthetic idea of a literary work does not rely on perceptible features like words or syntax which is proved by the fact that the aesthetic idea of the literary work remains unchanged even if the work is judged by reading it in a translation to a different language (Costello 2013, 296).

Does this mean that *Music of the Spheres* is to be considered a conceptual work of art? One thing that could, wrongly, lead to such a conclusion is that Genette – with reference to Husserl's phenomenology – accounts for the mechanism of conceptual reduction as a characteristic of allographic works of art (Genette 1997a). Transferred to the context of this paper: If we have ten different informational paratexts describing the technical media of a work – some handwritten, some narrated orally, some in German, some using a higher readability index than others – the reduction consists in studying the different versions (of which none can ever be 'complete') so as to subtract all insignificant features, to condensate the paratexts, in order to value only their essential elements. This allographic reduction strips the work to its conceptual core, and this is actually the function of the informational paratexts accompanying *Music of the Spheres*.

The paratexts related to *Music of the Spheres*, however, despite being just as allographic as *All the things I know of but of which I am not at the moment thinking: 1.36pm; June 15, 1969*, are not meant to evoke the work's aesthetic idea – 'only' its technical media. In principle the informational paratexts under scrutiny in this paper serve merely as a communicative service that conveys practical information on the advanced technical media of work; they are meant to evoke judgement of the work's aesthetic idea no

more that 'acrylic on canvas' is meant to when applied to a Hockney-painting. Similarities have been suggested between conceptual art and technologically advanced art, for instance due to the fact that both "interrogate the conventional materiality and semiotic complexity of art objects" (Shanken 2002, 438), but the focus of this paper has been on the effect of the informational paratexts, and not the works of art – conceptual or not – in themselves. And this investigation has shown that the actual *function* of these paratexts is potentially highly aesthetic. In effect these paratexts – which, due to their informational character, tend to fly below the radar of new media art scholars – play a performative role that is similar to the role played by conceptual art paratexts that constitute the aesthetic idea of a work.

The traditional roles of text and paratext are potentially reversed: A consequence of the aesthetic function of the informational paratexts is that the physical objects that we encounter in the gallery – the objects that we think of as the work of art itself – are not necessarily the primary source of aesthetic experience. Instead the work – which we traditionally presume to be the text in Genette's sense – in effect functions like the supplement, the paratexts, while the informational wall label or the trivial caption, functions as the very text. The physical objects and acts in the exhibition space serve as mere exchangeable props that do not in themselves act as catalysts for aesthetic valuation of the overall work, but strongly depend on informational paratexts to reveal to the audience what the work consists of. The work of art – even if it is a huge installation like, for instance, Wim Delvoye's *Cloaca* (2000-2010) – is invisible without the descriptive paratexts. We are thus dealing with aesthetic experience by proxy. This may sound rather depressing, but the aesthetic experience of conceptual works of art may be every bit as rewarding as that which is prompted by an autographic, sensuously accessible work of art.

An even more ultimate, and theoretical, consequence is that the work's advanced technical media, pointed to by the paratext, does not even need to exist in order to generate aesthetic experience. Instead of highly advanced soap bubbles with DNA-code/MP3-file there need only be ordinary soap bubbles. If the informational paratexts are able to convincingly persuade the audience that the phenomenon in front of them is soap bubbles containing MP3-files encoded in synthetic DNA-material, then the aesthetic implications are the same whether this is actually true or not. Even if the paratext was science fiction instead of science description, it would possess the performative power of evoking aesthetic experience – as long as the audience reads it as a simple, valid description of a highly advanced and intriguing work of art.

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Comparing Two Sound Design Styles: Between Determinism Emergence And Interactivity

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Abstract

In the design process of sound installations, the composer designs his sound for a real or a virtual space according to the listener's walking path. One way to design this walk is to allow the listener to interact with the system via Non-Player Characters[1]. For a given piece, the creator affords the interactor a certain amount of freedom; and the system, according to its level of self-sufficiency, a certain amount of autonomy. We assume that these choices are directly related to design styles: the "scripting style" and the "emergent style". In the scripting style, the designer takes the point of view of the interactor, who becomes the narrator. In the emergent style, the designer takes the point of view of Non-Player Characters. We have designed two versions, composed in each style, of the same interactive sound installation *The Listening Walker*. This paper is mainly devoted to a comparative analysis of the sound design styles experienced, and to the presentation of the two artistic and development experiences.

Keywords

Emergence, Interactivity, Narration, Sound Installations, Video Games

Introduction

One of the authors of this paper has worked as a composer on numerous sound walk art installations [1]. During the last decade, her work has been influenced by the design methods used in video games, leading to interactive pieces. In the design process of such pieces, as compared with interactive music works, the composer conceives his spatial sound design in a real or a virtual space according to the listener's walk path. Such an installation shows the evolution of the composer's role from a deterministic creation to a non-deterministic one [8]. For a given piece, the composer affords the interactor a certain amount of freedom; and to the system, according to its level, a certain amount of autonomy. According to these two parameters each art piece can be positioned somewhere within the DIS triangle (Figure 1), the vertices of which represent the Designer, the Interactor and the System. In [2] and [3] a set of interactive pieces are analyzed in order to place these works within the DIS triangle.

[1]A Non Player Character (NPC) in a video game is a character controlled by the game as opposed to the avatar controlled by the player.

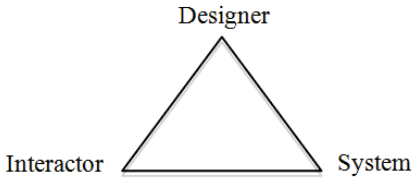

Figure 1: The DIS triangle

In this triangle, the designer has a very particular role: he is the decider. He may choose to create a piece for which execution is perfectly controlled, near the D position. He can decide to design his composition as a generative and emergent art system, near the S position. He can also afford the Interactor a high degree of freedom - collaboration in the execution of the piece. Of course, any mixture of these three positions can be considered and has been experienced by artist and designers.

Our research attempts to investigate conceptual and practical tools that allow the sound designer to understand and choose his position within the DIS triangle. We assume that this choice can be directly related to a choice of designing style. We designed two versions of the same interactive sound installation *The Listening Walker*. First, we present the concept of the sound installation *The Listening Walker* and the two design styles. Next, we present a set of criteria with which to compare the two styles. Finally, we explain our experimentation and development process. To conclude, we pose questions relative to the artistic consequences flowing from these two design styles and present our future work.

The Listening Walker

The Listening Walker is an artwork produced as part of the Terra Dynamica project, funded by the French government. The purpose of this project was to bring to life Terra Numerica, a static virtual city [4]. The production of an artwork, the scripted version of *The Listening Walker*, using the Terra Dynamica technology, was one of the tasks assigned to the CNAM. The title of this piece comes from a book by Michel Chion [5]. The installation was created in Paris during the "Futur en Seine" festival in June 2013.

The goal of this sound walk is to discover a virtual district of Paris around the Pantheon. The interactor walks around this part of the city wearing headphones with personal binaural sound rendering. The experiment takes about ten minutes. This installation is designed as a video game with different levels of exploration. The interactor's reward is the discovery of the city mainly via sound. Success depends on his listening behavior: NPCs surroud him, interpreting his moves, the direction he takes and the time spend listening to particular sounds. Depending on the listener's attitude, each NPC has his own reaction, such as running away, getting closer to the listener, ignoring him or helping him to discover secret areas. The listening walker must be aware and must try to understand these NPCs.

The Two Design Styles

The Scripting Style

An interactive narration is written according to the scripting style if it takes the interactor's point of view. He is the narrator of an interactive scenario, written in a procedural form. The rules are contextual and related to a relative chronological order determined by the path the interactor follows. So any variability inside the narration is linked to the interactor's previous experience, and in particular, his trajectory. Each NPC's behavior is described in relation to this experience at a given point and time of the interactor's path.

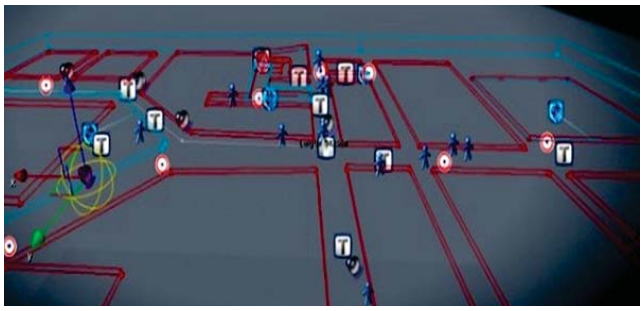

Figure 2: City 4 map in the CryEngine editor

As an example, consider the City 4 version of *The Listening Walker*. City 4 is a constrained itinerary in which the interactor, hearing a sound, starts from an empty space and gradually builds the city. Invisible barriers are set up in the space as interaction spots. These set off events when the interactor enters their influence area. A trigger can set off a sound, create a new road or a new building. The triggers are also logically ordered. Some of them can only be activated if the interactor has come across previous ones. This logical scripting ensures that the events occur in a non-anarchic way as well as ensuring the consistency of the itinerary.

The Emergent Style

An interactive narration written according to the emergent style takes the point of view of each NPC as a potential narrator. It has its own perception and memory, which influences its behavior, described in a generic (non-contextual) way.

As the player appears at the intersection of rue Saint-Jacques and rue Soufflot,
A sound hidden in rue Saint-Jacques 2 is activated;
When the player arrives over there,
A part of the urban outline of a district becomes visible;
(see FlowGraph /entities/FloorAppear :FloorSoufflotPantheon).
The sound of rue Saint-Jacques 2 deactivated
and a bass tone comes up rue d'Ulm;
An NPC – Le Chevalier – appears visually, read a text and heads towards the back of the Pantheon following a given path;
If the player follows him, he triggers a sound moving around him;
If the player stays longer enough listening the moving sound, two more sound entities are triggered;
If the player tries to catch them at the intersection of rue Clotaire and place du Pantheon, they vanish;
NPC Bakal appears place du Pantheon, talking to himself.

Figure 3: Example of City 4 map scripting

For example, City 5 is an open itinerary. The interactor travels on the map from one area to another. Each area is controlled by an NPC. Its main goal is to follow and memorize the movements of all characters (avatar of the player and NPCs) that are or have been located in the controlled area. So a trigger, like an invisible barrier, is no longer a mechanism associated with the interactor's avatar, as in the scripting style, but part of an NPC's perception system. Global geographical zones, like districts, become themselves interaction controllers. This is also mostly the case when each NPC perceives the interactor in its own area. This determines the elements of the city (sounds, lights, outlines, buildings) that the NPCs will reveal at a given time and a given point of the listener's experience.

Bakal's control a zone situated between rue Soufflot, rue Le Goff and rue Saint-Jacques 1. His main personality is to be fearful.
Bakal's behaviour :
Each time someone enters my zone,
I activate a given set of sounds and lights
I identify the intruder.
I increase the visit count of the given intruder.
If an intruder is present in my zone and if it is a player and if it is his first visit,
I speak to the player.
If an intruder is present in my zone and if it is a player and if it is his second visit,
I appear, silent, in front of and at a given distance from the player.
If the player comes too close of me, I run away.

Figure 4: Informal specification of Bakal, a fearful NPC.

A First Comparison of the Two Styles

A Game Design Point of View

In the context of creating an interactive walk installation like *The Listening Walker*, an object-based methodology inspired by Game Design is certainly applicable and, from our point of view, efficient.

The scripting style of design has been, until recent years, the main one used in the game industry. Such an approach has some clear advantages. On the one hand, it is a subjective narrator-driven interactive storytelling style, which is rather easy to understand. Its validation, which uses program tests, is "classical". On the other hand, this method relies on describing a universe as a kind of egocentric, centralized simulation. As a consequence, describing autonomous NPC behavior is difficult, or even impossible. The development of evolving games (Massively Multi-player Online Role-Playing Games, Facebook games, games based on physics...) pushes the emergent design style.

According to Jesper Juul's classification of games [9], the scripting style leads to "games of progression", that is to say games in which rules are contextual. The emergent style leads to "games of emergence", in which rules are relevant in all situations. From the designer's and hence the composer's point of view, the scripting style of design leads naturally to a branched approach of interactive narration and, therefore, to "progression-style" game types rather than to "sandbox-style" ones[2].

The Narrator and the Memory

The scripted design writes the story from the point of view of the interactor's avatar. This is the method; the universe and the events exist only when they have been or are perceived by the interactor. In this way he is the narrator and he holds in his memory the events involved in his narration. In the emergent approach, each NPC has its own memories thanks to its own perception system. For example, Bakal has the memory of each intruder in his zone. The story is described with respect to what has been perceived and remembered by each actor (avatar and NPCs). In both cases, it is possible, from a narrative point of view, to simulate a universal narrator who has knowledge of events that no or not all actors have seen or heard.

Finding a Place in the D.I.S Triangle

Returning to the introduction of this paper, the main open question is: how much freedom and knowledge is the listener afforded?

From the point of view of an electroacoustic composer working on spatial sound installations, most of our work was created for a given indoor or outdoor area using a set of speakers adapted to the chosen space. In such artworks, the sound and the spatial sound rendering are synchronously controlled. Each piece has a beginning and an end, and a given duration. The freedom of the listener consists of being able to walk, wait, sit or lie down somewhere within the performance space. A previous work on interactive soundscapes, *Listen Lisboa*, produced at IRCAM [6], used the same approach. The listener is walking through a physical empty space hearing sounds through geo-localized headphones. According to his trajectory, the listener is able to hear different versions of the same soundscape, without having real control over it. As a consequence the writing of *Listen Lisboa* relies on the scripting style.

In this current research, the composer is moving towards more open works. The goal is to give the interactor a more potentially accessible and comprehensive interpretation of the piece, which is constructed as an emergent composition through the use of intelligent agents.

Using the scripting style leads to design a piece in a constrained space (a progression in a corridor). The designer may open the map, giving the interactor more choices, with an understanding of the consequences of his decisions. The piece will be designed as a walk in an open space and a local and implicit description of the NPC's behavior, using the emergent style.

In this way, a controlled composition of the two styles and the structure of the map are a way to design and implement a piece at a defined position in the DIS triangle.

The Two Versions of the Listening Walker

Aspects of the development process of the scripted version

This development is part of the OCTAVIA[3] project. The scripted version was designed using a method strongly inspired by the level design of adventure games, as well as the maze principle [7]. The interactor's avatar appears at a given initial point of an empty map. Invisible barriers and their associated triggers are placed according to the possible paths of the interactor's avatar. The paths and the triggers are partially ordered to create sound events and the revealing of roads and buildings. Triggers are also used to guide the interactor: they lead to sound events located within the space. NPCs, according to scripted behavior, try to seduce or intrigue the interactor. As the city is progressively revealed, the path of the avatar becomes more and more constrained by the walls of the buildings. The story ends when the last trigger is activated, revealing the Pantheon. The mapping between triggers, events and NPCs behavior is written using Flowgraph, the graphical programming language of a game engine (CryEngine[4]).

Aspects of the development of the emergent version

The main principle here is that any action is decided and executed by a Non-Player Character using its own perceptions, decisions and actions. Its behavior relies only on the events that it has been able to observe and memorize. The empathic relationship between the player and the NPC are the same on both versions. However, the corresponding actions and rules are non-contextual. For example, a rule for Bakal, in the scripted version is written as follows:

"When I (the interactor's avatar) arrive at the crossroad, Bakal appears.

If I move too close to him, Bakal runs away".

[2] "A sandbox is a style of game in which minimal character limitations are placed on the gamer, allowing the gamer to roam and change a virtual world at will. In contrast to a progression-style game, a sandbox game emphasizes roaming and allows a gamer to select tasks." http://www.techopedia.com

[3] Tool for Creating and Testing Atmosphere Life Interactive and Autonomous. http://www.masagroup.net/products/innovation

[4] http://www.crytek.com/cryengine

In the emergent version, the behavior of Bakal is described as a finite state machine, and the same rule becomes:

"Each time I (Bakal) perceive somebody near me,
I identify him
If it is the first time I see him and he comes too close to me,
I run away"

Therefore Bakal is defined by:

- His perception: Bakal can see in front of him (180 degrees), hear all around him without any distance limit, and receive messages from all other NPCs.
- His possible actions: Bakal can walk, run, speak a set of given sentences, sing a set of music, can be visible or invisible, and send messages to all other NPCs.

To summarize, the design process follows these steps:

- Structure the map into districts.
- Choose the set of NPCs.
- For each NPC define his perception, decision-making and action system.
- Specify all messages exchanged by NPCs.
- Define the NPCs' finite state machines.

Conclusion and Future Work

Comparing the two styles

The use of video games tools is probably a good choice as they are designed to support both styles. But, in both cases, the translation of an informal specification into a formal one is a complex task.

From an artistic point of view, the possibilities opened up by the emergent style are very promising. But this way of thinking about an artwork as a set of localized and dynamic pieces is a break with the habits of music composers. The scripted style is a much more comfortable way to think and develop an interactive sound walk. To summarize, based on the results of our experiment, it is easier to write a story, even an interactive one, than to design an open world. The artist gives up control of space, time, and progression in a story and then takes as a designer a new position. So the most interesting artistic challenge is to design an evolving process, an open combination, rather than a final, fixed object.

Our comparative analysis takes the point of view of the designer, and, more specifically, that of one of the authors of this paper. As a consequence, it cannot be directly generalized. With the help of the sociology department, we arranged interviews with seven well-known artists and designers from various fields. Eric Viennot, the Game Designer of *In Memoriam*, one of the first Alternate Reality Games, summarizes the result of our study:

"At a given time, as a designer, we are creating a universe where some emerging part of the story may appear. It is something that we did not really forecast. It is really interesting and I call it emergent narration...

I like to master the time when the player feels a given emotion. I think that we must find in some way a mixed solution: too open works lack artistic dimension."

Future Work

The comparison of the two versions of *The Listening Walker* takes only the point of view of the composer. Up until now, only the scripted version has been exhibited. As the two versions are developed, it is possible, by conducting a public survey, to have the point of view of the interactor. Of course the scope of the results is limited to this piece but it is probably a unique experiment as the same piece is rarely developed twice.

We are working on sound walks in a real city, using an augmented reality 3D sound system. As a consequence, we will try to specify and prototype efficient authoring tools.

Acknowledgments

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Printed Radicality

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Abstract

The static and unchangeable printed page seems to be hardly considered in years 2010s as a key tool for political and radical strategies, as human beings are constantly looking at a few personal screen-based devices, most of them updated in real time. But there are a few cultural elements in traditional media, which are still playing a decisive role in the circulation of culture. Among them the recognition of their aesthetic "forms," even if digitised in both design and content. The familiarity with those forms is based on metabolised "interfaces" (we're all culturally "natives" when it comes to radio, TV, and print) that makes them almost invisible, especially when translated for the digital realm, delivering the content in a more direct way. And since we recognise those forms instinctively, we "trust" them, and so we trust their content.

Keywords

print, publishing, fake, library, digitalisation, plagiarism, wikipedia

Newspaper as (fake) political imaginary

The form of the newspaper is still one of the most recognisable. What we can consider as the modern form of newspapers has only slightly changed since the 19th Century (except for the inclusion of pictures and colours), becoming a daily medium for quite a few generations, establishing itself as an aesthetic standard and a defined cultural object with its specific interface. That's why artists and activists have often used newspapers as an identifiable information environment and a daily object at the same time. From Andy Warhol's "Headlines" series [1], with huge reproductions of particularly dramatic front pages as frozen in time, to "Modern History" series by Sarah Charlesworth [2], tracking the use of the same picture on different front pages. But a specific conceptual manipulation of newspapers (and the conventional ecosystem surrounding them) has been employed by artists and activists to foster specific ideas. The "fake" newspaper, or accurately reproducing a real newspaper arbitrarily changing its content, has always been able to question the instinctive trust we have in this medium. If making fake copies and freely distributing them in order to attract public's attention (but then revealing as mere advertising flyers) is a remarkably old practice, dating back to the end of 19th century [3], the conscious use of those fakes as a political medium is more recent. In this respect, there are a few effective examples emerging especially in the 1970s. "Il Male" [4], for example, stemmed during the rise of leftist political movements in Italy, and especially the "Creative Autonomism" student movement in 1977. It conducted a few campaigns through fake journalistic "scoops" (all being simultaneously plausible and surrealistic) rendered in major Italian newspapers layouts and attached next to newsstands, generating sometimes quite harsh reactions and a lot of discussions in the streets. In the same years another two actions (officially anonymous) were accomplished. In 1979 in Poland, a fake of the major propaganda newspaper Trybuna Ludu was distributed during Pope John Paul II (Karol Wojtyla)'s visit to his homeland, sporting the banner headline "Government Resigns, Wojtyla Crowned King."[5] And in France, in 1977, a fake Le Monde Diplomatique was anonymously distributed to a certain number of subscribers, featuring very satirical comments on the Rote Armee Fraktion's Stammheim Prison bloodbath [6]. Thirty years later an impressive fake newspaper distributed in several thousand copies invaded the streets in New York City, on November 12, 2008: "The New York Times special edition" by The Yes Men in collaboration with Steve Lambert and The Anti-Advertising Agency, and anonymously sponsored. [7] It was set in the near future (July 4, 2009), featuring only positive news, briefly plausible after Barack Obama's election as U.S. President. The New York Times layout, fonts and graphic design were painstakingly reproduced (including the usual advertisements, satirically changed as well), so the majority of the public was easily fooled. A large network of volunteers distributed it for free in the city, even in front of the New York Times headquarters, without any legal repercussion. What was embodied here was the public imaginary, the articulated hope this historical event generated, historicised then altogether in a stable and recognisable format, without the daily compromises of major media. The group produced another few fakes, one of them in the form of the International Herald Tribune. Italian artist Paolo Cirio, instead, made a project composed by a web application, a workshop and an action in 2011, called in Veritas, It is centred on Italian newspapers, inviting people to invent their own story that can be composed as a headline sheet with the newspaper logo of choice, through the project's website. Then it's fairly easy to print it out and attach it (during the night) close to local

newsstands. [8] The use of fake newspapers in political campaigns has proven not to be a thing of the past. The classic strategy of purchasing a full front page ad, designed to look just like the real front page has been used many times. The Liberal Party in British Columbia did it in 2013, disguising the ad as "official" information, and so generating a whole national media case with polarised reactions about the Party ethics and the high risk of misleading the readers. [8] Even more, in 2011 there was a more direct political newspaper scam, when police identified a network of infringers who had been illegally producing and distributing fake copies of Ziarul de Garda and Timpul, two of Moldova's leading newspapers, trying to manipulate the public opinion ahead of elections by publishing negative articles about the pro-Western ruling coalition. [9]


EDIZIONE STRAORDINARIA

la Repubblica

Direttore Eugenio Scalfari

Dopo oltre cento anni si è avverata la cupa previsione di Carlo Marx

Lo Stato si è estinto

Il presidente Leone lascia precipitosamente il Quirinale. Chiusi Camera e Senato. Oltre 250 mila agenti dell'ordine disoccupati. La Magistratura e l'Esercito non esistono più. Agitazioni e paura tra i parastatali. Scuole chiuse a tempo indeterminato.

La fine di un mondo

di EUGENIO SCALFARI

PCI

Paietta spiega le ragioni di una sconfitta

di GIANPAOLO PANSA

ROMA

Il movimento è sconcertato

di CARLO RIVOLTA

Black-out anche nell' informazione

di DANTE MATELLI

Figure 1. Il Male, 1978, fake of "La Repubblica" front-page.

Plagiarism (from print to digital and vice-versa)

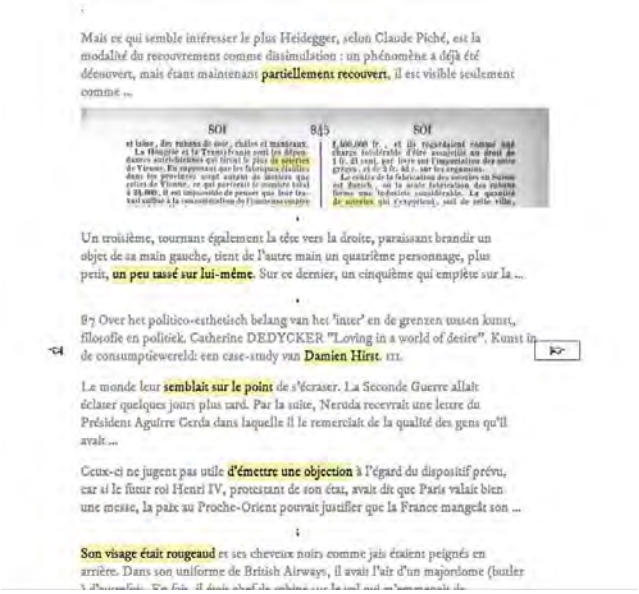
Newspaper fakes incorporate some forms of "plagiarism", mostly related to misusing a "standardised" visual form. This has been technically feasible since the mechanical reproduction of print, and even more with the lightning-fast speed and accuracy of digital (re)production. But the plagiarism of content is much older, and the very concept of plagiarism dates back to the Roman Empire. It was used for the first time by Roman poet Martial, complaining that another poet was "kidnapping" his verses, so he called him "plagiarius", which literally means "kidnapper." These were the verses he used to express his feelings:

Fama refert nostros te, Fidentine, libellos
non aliter populo quam recitare tuos.
si mea vis dici, gratis tibi carmina mittam:
si dici tua vis, hoc eme, ne mea sint.

(Fame has it that you, Fidentinus,
recite my books to the crowd as if none other than your own.
If you're willing that they be called mine, I'll send you the poems for free.
If you want them to be called yours, buy this one, so that they won't be mine.) [11]

There are plenty of more or less famous cases of literary plagiarism in history, but only some of them were publicly admitted (like the script of the TV series Roots, admittedly plagiarised by his author in some passages from the novel "The African," published nine years before). In contemporaneity, plagiarism seems easier than ever, especially taking advantage from "big data" sophisticated sources like Wikipedia, and so a few critical artworks have been developed consequently. Belgian artist Stéphanie Vilayphiou investigates how free software can deeply question the fixity of the printed page once it's digitised, and how the defensive copyright practices, historically consolidated can be challenged. In particular she writes various transformative software to create controversial versions of literature classics. Specifically, in her net art piece "La carte ou le territoire (The map or the territory)" [12] she selected a controversial book, Michel Houellebecq's "The map and the territory", which became renown and discussed in France for its evident quotes from Wikipedia, never acknowledged by the author nor by the publisher. She retrieved the book's digitised text and then wrote a software filter which parses it in sentences (or part of it) looking for them in the millions of digitised texts contained in Google Books, eventually finding the same sequence of words in any other books. The results are rendered then in their original typefaces, and the parts matching Houellebecq's book are highlighted in yellow. Visually the book is entirely transformed in a sequential digital collage of quotations (whose original authoritative printed context is still maintained in the background), definitively loosing even the last bit of originality. Vilayphiou ultimately questions originality and authorship through software automatisms, turning them into trackable

and technically demonstrable collective thinking. Another example of artistic practice deliberately using other people's writings in a specific context is Traumawien's "Ghostwriter" [13] series. The Viennese group performed a virtual "action" with their own software robots compiling and uploading hundreds of e-books on Amazon.com with text directly stolen from YouTube videos' comments, as if they were abstract dialogues. They have defined it an "auto-cannibalistic" model, and these e-books sport a very classic paperback layout as spontaneous instant books, redirecting the endless flow of comments in a specific form and freezing them in time. This action is obviously re-contextualising the original meanings, setting them in a new scenario and in a new literary form: from personal notes not necessarily relating each other, into a single continuous and sometimes surreal dialogue. What happens in the passage from one medium to another, is that the original spontaneousness and sometimes naïveté of the text once rendered as a book assumes the formal character of the adopted layout. The paradigm of access to "big data" is embedded in practices like the above mentioned, and the software programmer's vision is the only limit to what kind of results and new (digital and printed) forms can consequently be created.


Mais ce qui semble intéresser le plus Heidegger, selon Claude Piché, est la modalité du recouvrement comme dissimulation : un phénomène a déjà été découvert, mais étant maintenant partiellement recouvert, il est visible seulement comme ...

Un troisième, tournant également la tête vers la droite, paraissant brandir un objet de sa main gauche, tient de l'autre main un quatrième personnage, plus petit, un peu tassé sur lui-même. Sur ce dernier, un cinquième qui emplète sur la ...

87 Over het politico-esthetisch belang van het 'inter' en de grenzen tussen kunst, filosofie en politiek. Catherine DEDYCKER "Loving in a world of desire". Kunst in de consumptiewereld: een case-study van Damien Hirst. 171.

Le monde leur semblait sur le point de s'écraser. La Seconde Guerre allait éclater quelques jours plus tard. Par la suite, Neruda recevrait une lettre du Président Aguirre Cerda dans laquelle il le remerciait de la qualité des gens qu'il avait ...

Ceux-ci ne jugent pas utile d'émettre une objection à l'égard du dispositif prévu, car si le futur roi Henri IV, protestant de son état, avait dit que Paris valait bien une messe, la paix au Proche-Orient pouvait justifier que la France mangeât son ...

Son visage était rougeaud et ses cheveux noirs comme jais étaient peignés en arrière. Dans son uniforme de British Airways, il avait l'air d'un majordome (butler

Figure 2. Stéphanie Vilayphiou "La carte ou le territoire" screenshot, 2012.

Printing as a risky strategy

In the end of years 2000s there has been a few famous and dramatic cases of sensitive information leaks: Wikileaks and its small galaxy of information-wants-to-be-free "heroes" (Julian Assange, Bradley Manning, Edward Snowden) publishing secret or classified information from anonymous sources, and Aaron Swartz and his brave act of freeing the copyrighted academic knowledge of JSTOR [14] (Swartz committed suicide in 2013). The leaks' transmission and acquisition has been totally digital, but then traditional media has been deeply involved to make this information "public" (and implicitly to somehow certify the scale of the action with their innate "authority",) including printed ones, mainly newspapers. At a smaller scale, there are other cases using print as a tool for liberating secret information. Carl Malamud, for example, an activist dealing with the fact that vital parts of US law are secret and that you're allowed to read them only paying a quite high amount of money, has founded Public.Resource.Org [15] organisation, which digitises, and eventually re-publishes public domain materials. He has scanned, OCRed and re-published in print, codes like the "Public safety codes of California" or the "District of Columbia Official Code" including in the print a statement that says "being law, any claim about their copyright by the authorities is "null and void."" Answering the question "why print copies?" Malamud says that the print edition limits distribution with no "side effect of infinite copy" that scares standard and legal people, so making his efforts somehow still acceptable. In this case print is turned into a legally strategic medium of distribution, because of its slow duplication standards, as newspapers have been equally strategic for Wikileaks, being part of a clever tactic that considers the different role and weight of the respective medium, in order to seamlessly accomplish an effective distribution of the content.

The library, ultimate cultural centre vs. big data repository

"(Libraries) are nerve centres of intellectual energy [...] knowledge is power [...] and that power should be disseminated and not centralised."
Robert Darnton, Harvard University library director [16]

The physical library is one of the crucial spaces where the discourse about the new relationships between traditional and digital publishing is taking place. On one side the "global virtual library" is closer than ever with Google investments worth millions of dollars to digitise millions of books, and with plenty of other similar efforts at different scale, including some remarkably vast, independent and shared. On the other end the physical library's historically values as meeting and research space for citizens are simultaneously reclaimed and challenged. Funding cuts and innuendos about its obsolescence in the digital era, are dramatically permeating both common sense and institutional policies. Some libraries are reinforcing their role through digital initiatives, like the Toronto Public Library, which launched a Fahrenheit 451-themed alternate reality game, where people where invited to play it in the

city through telephone calls with the motto "Join the literary resistance." [17]

And the push on libraries to "reinvent themselves" can effectively be rethought taking the exchange of physical books as a starting point to expand the knowledge in new directions, creating less conventional models for that. So beyond platforms like BookCrossing [18], using a web-based platform and a simple social mechanism to share books in public places, the main question seems to be about which social role the exchange of knowledge can implement. For example there are different efforts in building what could be defined as "spontaneous citizen library". There are attempts on a small scale like the Little Free Libraries [19], a few thousands wood boxes scattered around the world where people can take or leave books, or Ourshelves [20], a San Francisco lending library open to everyone, with almost 300 members and 3.000 volumes, built around its community, planning to replicate around the city [21]. And if we take into account that Wikipedia has specific templates to add information in its pages about the availability of related content in local libraries [22], spontaneous social mechanisms connected to a self-managed physical exchange can be easily enabled. These kind of initiatives can question the library as a centralised facility, reconfiguring it as the outcome of a community, opening new possibilities. Teaching how to digitise books, for example, for example, could dramatically expand access, especially to forgotten titles which Google Books won't include or give access to for different reasons. Then involved people should assume their own responsibility in scanning and sharing, on a personal and independent level in building their own cultural history, preserving (physically) and sharing (digitally) all the knowledge that they think it's worth, as it has been done with music since the early 2000s.

Conclusions.

The historical importance of the printed page as a medium has still a great influence in cultural dynamics, and it can be used to trigger innovative and radical processes when approached with the new opportunities offered by digital technologies. Active and critical strategies can be then developed using the combined qualities of those two media. The most effective radical efforts has been historically supported by an innovative use of media and technologies, which has grounded the vision of new social and cultural models. The re-appropriation of public imaginary through printed fakes, the plagiarised use of online content on print, the ability to create social libraries, and the sharing of digitalised content, can structurally redefine the printed medium, turning it into a crucial opportunity to rethink our relationship with knowledge, both in contemporary and historical perspective.

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The Digital Diasthima: Time-Lapse Reading Digital Poetry

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Abstract

In moving texts, such as digital kinetic poetry, the reader-user might no longer control the duration of their reading, unlike the traditional and static nature of printed texts. The user deals with readable time versus executable time, the human time-line versus the machine time-line. By having an imposed and fixed number of milliseconds to perceive the text on the screen, the user might find themselves completing or imagining the unread text, following the dynamic forms with an imposed dynamic content. Yet, to understand the shifting reading patterns of digital poems, one has to consider another methods or tools that may complement traditional models. Therefore, performing a critical approach solely based in close reading methods might not accomplish a fully comprehensible reading of digital poetry. In this sense, following upon methods taken from other areas, e.g. time-lapse photography and R. Luke DuBois's concept of "time-lapse phonography" (2011), I introduce the notion of time-lapse reading as a complementary layer in order to close read disruptions in reading processes that demand a set 'experiencing' time when letters, words, lines or stanzas are replaced, with a case study on Philippe Castellin's *çacocophonie* (2013).

Keywords

Electronic Literature; Digital Poetry; Digital Diasthima, Time-Lapse Reading; Philippe Castellin.

Introduction

I am taking into consideration a critical reading of kinetic text, namely kinetic digital poetry. Kinetic digital poems are *performed* with time-based media as both a creative and a critical practice, e.g. onscreen running piece and live performance. In this paper, I am focusing on the critical *performance* executed when reading onscreen pieces, but also how its live performance might affect the very reading process. Time-based parameters operate as functions in diverse programming languages, allowing for a text or poem to run human language and/or code onscreen with a temporal interval determined by a precise number of milliseconds. Therefore, coding these functions helps creating dynamic text which, in turn, might result in diverse nuclei of creative practice: generative text, fiction and poetry, Flash-based or animated/kinetic poetry using other software, distributed/hybrid piece/practice, installation, site-specific installation, performance, real-time sensor-actuator work, and so forth.

Interactivity, Generation and Time-Lapses in Kinetic Digital Poems

One of the complex issues of close reading poetic text in motion is precisely and, first of all, 'just' reading. There are though two main modes underlying this issue: interactivity and non-interactivity. Interactive kinetic poetry often employs a degree of user participation or interaction, by means of mouse movement, keyboard input, joystick, haptic peripheral, touch-screen, sound or movement input captured by sensors (micro, camera, etc.), if one thinks of gallery-mounted pieces, database-pulling interference, etc. Nonetheless, interactive poetry might use several of these features and/or simply contain a speed controller, e.g. Rui Torres's *Mar de Sophia* (2005), Stephanie Strickland, Cynthia Lawson Jaramillo and Paul Ryan's *slippingglimpse* (2006) or Johannes Heldén and Håkon Jonson's *Evolution* (2013), which allows readers/users to change the speed at which the poem runs onscreen, in order to fully read the lines. [1] [2] [3] Hence, one is able to accelerate, slow down and sometimes even pause the unfolding poem. Non-interactive kinetic poetry presents no controller and, therefore, the reader/user might not be able to fully read the lines or words on the surface/onscreen level, if the running time is programmed to be quicker than human reading perception/cognition's skills – e.g. Philippe Castellin's *çacocophonie* (2013), Pär Thörn's *I Am* (2011), Scott Rettberg's *Frequency* poems (2009) and Young-Hae Chang Heavy Industries' *The Lovers of Beaubourg* (2007). So, if the reader is not able to fully read, how can they even close read? [4] [5] [6] [7]

Before replying to this question, there is another important distinction to be made, between generative and non-generative kinetic poems. Generative kinetic poems instigate a type of time-lapse, let us say, time-lapse α, which resides in the fact that the poem one reads or tries to read can always be different from screening to screening or, simply, if one refreshes the browser. Time-lapse α might then carry two problems: 1) one does not have sufficient time to apprehend the poem; 2) one tries to apprehend something always divergent. As of problem 2 some writers would vindicate that their pieces are intended to be conceptual, and, therefore, their argument relies mainly in the process, rather than in the output, which some would expect to count the most. However, other writers would advocate for the process as well as the degree of craft

achieved in the difficult task of creating poetic output out of a limited or unlimited pool of data, e.g. words. Non-generative kinetic poems, thus, might prompt a type of time-lapse β, which is precisely that of the above-mentioned problem 1: textual replacement might occur at a speed rate difficult for our (still) biologic eyes to cope with. Consequently, and returning to our question, how can one read something not totally readable, slightly readable or unreadable? Shall one create screenshots of parts of a poem evolving over time? Shall one screencast a complete running cycle of the poem? Yes, we can adopt one of these strategies. Yet, isn't this method – as Patricia Tomaszek (2013) referred – going against the very motional property of the poem? [8] Let me reformulate it, does one try to critique a poem's intrinsic dynamic and unfolding nature with a static and print-based reading paradigm? And, more, what if we consider a generative poem supposed to run over 2 x 60 minutes, 24 x 60 minutes, 1 year, 4 years, 23 years, 1000 years, n^x years? Can one actually critically perform close readings based on screenshots, lest to say, screencasts or video recordings? No, one cannot. So, I shall argue here, as I did before (2013), that generative art (visual, sound, textual, performative) is meant to be partially read, that is to say, insofar as one needs to extract a sample or pattern as a representation of totality. And that should be generally accepted, since the process fierce fully needs to be stressed. You wouldn't want to be in front of a machine neither for 4 years in a row, nor 1 week, so that you could experience a work of art, would you?

The Digital Diasthima: 7 Proposals to Approach Time-Lapse Reading

It is exactly at this point that time-lapse emerges as a significant reading method. In fact, one needs to acknowledge that same impossibility in non-controllable kinetic poems and allow for a meaningful time-lapse experience to fully flow within its creative matrix. That said, an interval or disruption is created when reading – what I have been defining as digital *διάστημα*, or *diasthima*, that is, a spatial or timely extension, dimension, interval, gap. The digital *diasthima* is a void, a blank moment in time and space, forcing a quicker human reading, which often ends/begins as a creative process itself by way of incomplete association, metonymy, and metaphor. If we can't read everything, what do we read then? We read what our brain selects and, if we start running the poem several times, we can then begin to read other paths as well. To sum up, I would pinpoint a time-lapse reading approach in these terms:

1. Don't be afraid of not reading everything.

2. Engage with the interface and reject frustration.

3. Be open to discomfort and don't skip the poem.

4. Avoid extracting meaning by merely considering static strategies.

5. Read the source code.

6. Read the surface(s).

7. Allow for *diasthimas* to performing a relevant role in your reading.

Time-Lapse Pho(n/t)ography Informs Time-Lapse Reading

Two good examples of a certain kind of *diasthima* are time-lapse photography and comic strips. One watches a movement scene evolving over time but one does not exactly know what happens in-between moments – it is unknown and uncertain, therefore requiring a shift in perception that erects meaning by association, either narrative thread, metaphoric denotation or synecdoche. And yet, the moments are static. Now, if one has *diasthimas* evolving with dynamic moments, the problem of reading becomes even more complex. Taking a different framework, but nonetheless relevant to our purpose, R. Luke DuBois's (2011) notion of 'time-lapse phonography' deals with "computing the spectral average of a sound over time" to achieve a system, or "temporal momentum," but also a transcoded reading (listening), in order to appropriate their sense of totality with partial episodes:

> How about if you've ever skipped to the next song on an album because you don't like the one playing. Even if you do like the song, do you always listen to the end?
> Like so much else these days, our listening experiences are becoming increasingly under siege by the funny feeling in the back of our minds that we don't have time to waste listening to things we don't necessarily want to hear. So we switch stations, skip to the next track, and cut off the song after the second chorus because, to paraphrase Gordon Gano, the third verse is usually the same as the first, more or less. (DuBois 2011: 248) [9]

If we consider non-controllable kinetic poems, in which the reader has no possibility to interfere with the reading duration, such as Young-Hae Chang Heavy Industries' *The Lovers of Beaubourg* (2007), a Flash-based poem, Scott Rettberg's *Frequency* poems (2009), a poetry generator created with Ruby, Pär Thörn's *I Am* (2011), a poem pulling real-time lines from Twitter Search API with the expression "I am," or Philippe Castellin's *çacocophonie* (2013), we can conceive, for now, a particular kind of reading experience that comprises time-lapses as necessary for close reading the work.

Figure 1. Philippe Castellin, *çacocophonie*, 2013 (screenshot).

Time-Lapse Reading Philippe Castellin's *çacocophonie*

I will thus focus on Philippe Castellin's *çacocophonie* (2013), presented on September 23, 2013, at the Centre Pompidou's BPI in Paris as a "lecture assistée par ordinateur" [computer-assisted reading], during the festival "Chercher Le Texte." Throughout the debate, Castellin showed how reading the same work (Figure 1), or, to be more precise, the same source text, varies depending on the speed and coding parameters attributed, whose outcomes are, in fact, different works, or different speed variations/versions of the same work.

Initially, with a word processor, the author read a static and plain text version of *çacocophonie*, pausing and performing, on a human readable level, the effects of a cacophonic dialogue poem between two characters. The work's utterance disclosed a strong sound poem, with the alliteration on "ça," "ce," "s," "ss," which stresses another thematic disclosure – that of a parody of an episodic conflict between "je" [I] and "tu" [you]. Moreover, the interplay between "ça" [this, it] and "là" [there] helped creating an atmosphere of resembling and opponent forces, which addresses the absurd construction of everyday love conflicts over small things. Now, the second stage of the computer-assisted reading comprised a dynamic and rich text version of the work. Built with Processing, the poem was animated in order to perform lines at a given on-screen speed. Whilst being machine readable, the execution of the code entailed still a fairly human readable experience, in which certain portions of the first version were visually and cognitively dismissed and others highlighted, by force of human brain selection. Finally, the third stage of this event used exactly the same process, although now the speed of each line appearance was drastically accelerated. By reducing a simple parameter, such as the number of milliseconds for line display, this time-based poem displayed on the Web is still readable by the machine. However, it stops being human readable, or on the verge of non-human cognition, as the speed rate allows only for certain words to emerge as meaningful, at least, at the conscious level. Even if this version does not use sound, all the different crafts around code, moving text and image create a synesthetic awareness. The quick juxtapositions of kinetic text displayed via software, hardware and network remain tacit features as if to understand that such poetic and reading interplay needs to be addressed in a different way.

Conclusion

Digital poems often bridge visual, sonic, and literary content. More, their *performance* is often an instantiation and extension of their distributed materiality. On some occasions, digging into the source code might provide new insights, comments (in *çacocophonie* there are only some indications about optimized browsers), that is, language or artwork which is still part of the code – some works have other works hidden in the source code, ASCII art, etc. – but not machine readable, and the discovery of codework, that is, creative and critical code that is manipulated in order: 1) not to be executed by the machine but to be read by hu-

mans; 2) not to be executed by the machine nor to be read by humans; 3) to be executed by the machine and to be read by humans. On other occasions, database aesthetics forecast the ground for input from real-time data sensors, SNSs APIs, user's input, and/or blended databases.

As evidence shows, digital works cannot be analyzed with the same critical tools as non-digital works. Therefore, it is imperative to research new models and methods, and to engage with discourses pertaining to the scope of works one is set to critique.

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Biography

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The *Suplemento Dominical do Jornal do Brasil*: Art, Poetry, and Media Design in Yellowed Newspapers and Digital Archives

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Abstract

This paper focuses on a Brazilian newspaper archive from the 1950s—the *Suplemento Dominical do Jornal do Brasil*—usually considered as the vehicle for the neoconcrete movement. It argues that the artists and poets working in this six-year publication increasingly engaged this media as a medium. It further raises methodology and historiography questions regarding the status of documents and digital archives. And, hopefully, it helps disrupt established narratives with fresh transnational histories crafted through comparisons between a couple of artworks published in this cultural supplement and related examples from the New York based *Art Forum* magazine in the 1960s and 70s.

Keywords

Suplemento Dominical do Jornal do Brasil, archive, documentation, neoconcretism, site-specificity, tactical media, Ferreira Gullar, Robert Smithson, *Art Forum*, graphic design.

Introduction

This short paper focuses upon an under-examined Brazilian newspaper archive— the *Suplemento Dominical do Jornal do Brasil* [*SDJB*]—a cultural supplement published in Rio de Janeiro between 1956 and 1961. Central to the debates of the concrete and neoconcrete movements in Brazil of the 1950s, this publication articulated original relations between art, poetry and design, clearly expressed in the innovative layout of this newspaper. I have been exploring this archive for a few years now, first for its content, as the documents of an important developmental era; second, beyond documentation, examining methodology and historiography; and third, by creating a few experimental collaborations that explore the generative potential that will be opened up by the digitalization of this material. In the next paragraphs, however, I will discuss one specific aspect of the *SDJB*: its use as a site-specific medium by the neoconcrete poets and artists who worked on this publication.

It is well known that the *SDJB* became a vehicle for the neoconcrete movement. But the *SDJB* was also a site-specific space, given that its newsroom was, at times, used as a gallery. And furthermore, we can argue that the graphic design revolution of this newspaper, which reflected ideas from concrete and neoconcrete movements and influenced news media design for years to come, in addition to the publication of a few artworks which were never built or no longer exist, suggest that the *SDJB* can be seen in terms of media intervention, and therefore constitute a pioneer example of tactical media.

Born in the cultural effervescent 1950s, as part of Brazil's developmental era that aimed at modernizing the country by leaping ahead "fifty years in five"—as the president's motto insisted—, like other concrete avant-gardes in São Paulo and elsewhere internationally, the Rio de Janeiro-based neoconcrete movement emphasized non-metaphorical and non-representational forms that sought to create their own concrete reality by eliminating fictional and symbolic references. Despite their goals and efforts, however, fiction and non-fiction remain inseparable in Modern or Contemporary Art.

The newspaper archive as document: local and transnational comparisons

On a local level, comparisons can easily be made between neoconcrete artworks and the participatory creations that followed it. Neoconcrete artworks that were destroyed or never built, such as Ferreira Gullar's architectural poem, *Poema Enterrado* [Buried Poem] and Reynaldo Jardim's *Teatro Integral* [Total Theater][1] were important precursors

[1] Ferreira Gullar's *Poema Enterrado* [Buried Poem] was built in an underground brick and mortar room and later abandoned after

to, and the actual "prototypes" of the more famous participatory works of Lygia Clark, Hélio Oiticica, and Lygia Pape of the 1960s and 70s.

Transnationally, comparisons between the *SDJB* and art publications elsewhere in the world open up interesting questions. For instance, the publication of images and blueprints of neoconcrete "non-objects" on the pages of the *SDJB* echo similar media interventions, such as the ones in the pages of the New York based *Art Forum* magazine in 1969 and 1974 respectively.

Beyond Documentation: Engaging the Media As Medium

The *SDJB* is certainly an archive of documents from six years of experimental thinking (beginning with poetry and the visual arts, and increasingly discussing all the arts as well as architecture), which articulated the various dimensions of art and poetry, including visual and verbal spaces, static and dynamic forms. While there are some similarities, for instance, between Gullar's *Buried Poem*, 1961, and earthworks, such as Robert Smithson's *Partially Buried Woodshed*, 1970, I want to suggest that the *SDJB* also has a site-specific dimension by comparing it with the publication of a Smithson essay in *Art Forum*. One of that magazine's former editors, Phillip Leider, argued that the publication of a Smithson essay about his *Yucatan Mirror Displacements* in *Art Forum* in 1969, was a *new* thing, in that it became one of the versions of Smithson's work:

> The best examples, I'd say, are the "mirror displacements." That essay is one of the forms that that work takes. The nine photos are another form. The actual work in Mexico was another form. But that essay is a form of that work of art. That was one of its manifestations. And that was a whole new thing.[2]

A similar argument can be made about Linda Benglis's famous "center-fold" ad published in *Art Forum* in the November 1974 issue (in which she poses nude in pornographic fashion, wearing sun glasses and displaying a large dildo). It was not simply an exhibition ad, but arguably a tactical media intervention that subverted traditional hierarchies between art and advertising, artwork and documentation, gallery and media exhibition sites. It certainly triggered a heated controversy among the magazine's editors and contributors (a few of them left the publication to start *October*), not to mention within the feminist movement and throughout the art world. Benglis work asks us to consider the difference between the documentation of art and a site-specific media performance. And I believe that the publication of artworks such as Gullar's *Buried Poem* and Reynaldo Jardim's *Teatro Integral* [Total Theater] on the pages of the *SDJB* can be also approached as site-specific, and as examples of tactical media, as much as they are documentation of art projects, and they are the only version of those artworks that have survived.

Digitalization of Archives: Questions and Disruptions

There is great cultural value in old newspapers, but journals are also used "to wrap fish the next day." Material loss, disaster, and failure haunt history and memory, and this loss of physicality is increasingly true, as newspapers become extinct by moving to digital platforms. An important aspect of digital archives is also their generative and recombinant potential, which in the case of the *SDJB* includes the material and methodological possibilities opened up by the digitalization of about 2750 newspaper pages. This generative potential poses further questions about how we engage history *as* a medium, and calls attention to how technology influences the dynamics between visual and verbal languages. How does the transformation of a collection of yellowed newspaper pages into a database constrain and expand research, as well as our understanding of historical events? Before approaching documents as evidence, what are the relationships between archive and method? And even though an archive of artifacts can also function as a database—for instance, when artworks never built during an artist's lifetime are created by curators from drawings, or when multiple copies of interactive artworks are recreated for different exhibitions without an original—a digital archive's generative potential grows exponentially by enabling new translations among objects, images, texts, and sounds.[3]

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a pre-inauguration flood; Reynaldo Jardim's *Teatro Integral* [Total Theater] is a multimedia installation room, which only exists as a full page drawing on the pages of the *SDJB*.

[2] Phillip Leider, in Amy Newman's *Challenging Art: Art Forum 1962-1974* (New York, Soho Press), 250-251.

[3] I have created a three-minute video analysis of the graphic design evolution of the *SDJB* in collaboration with Candice Ng: http://vimeo.com/46111510 (password SDJB). See also the sound-based collaborative performance *Playing the Archive*: http://playingthearchive.com/

Among the questions and disturbances this research produces, are the histories that position "Latin American art" as derivative of Euro-American pioneer accomplishments. [4] A transnational perspective builds networks and often disrupts traditional narratives, while producing more nuanced, critical, and relational media histories.

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Simone Osthoff is a professor of art and critical studies in the School of Visual Arts at the Pennsylvania State University. A Brazilian-born artist and scholar, her research on contemporary art, theory, and criticism focuses on experimental art practices and postcolonial histories. She is part of the editorial board of the *Flusser Studies* journal and a frequent presenter in national and international symposia. Osthoff's numerous book chapters, essays, and reviews have been published internationally. She is the author of *Performing the Archive: The Transformation of the Archive in Contemporary Art from Repository of Documents to Art Medium*.

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Participatory (Counter-) Surveillance and the Internet

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Abstract

This is a text about Internet art projects dealing with Internet surveillance. In the paragraphs below, I will describe a web service that floods the Internet with fake websites, another web project that allows users to create email accounts in the names of villains that send conspiratorial emails to each other, and a solar-powered disco ball on which YouTube dance videos are projected. What connects these seemingly disparate projects? It may sound absurd, but these projects may help us understand our complicated existence as surveillant and surveillee within networked communications. Since the projects described in the text were made over more than a decade, the article may also reveal some aspects of how the Internet has changed over time.

Keywords

Internet, Internet art, surveillance, participatory, countersurveillance, detournement, humor, hacking.

Introduction

Internet surveillance is complicated. Digital pessimists tell us that surveillance is always negative, because it violates our right to privacy, free speech, etc. And yes, it does (no need for the pitchforks to be raised)! However, there are a lot of gray zones and relationships to consider. Anders Albrechtslund explains in his article "Social Networking as Participatory Surveillance" that people actively construct an identity as they share information with others in Social Networks. They are therefore not powerless subjects of a hierarchical surveillance apparatus but actively participating in mutual surveillance by exchanging information about themselves with others. This subjectivity-building activity therefore is empowering and not disempowering. [1] Albrechtslund's text gives us a glimpse into how complex Internet surveillance is. However, beyond participatory surveillance in Social Networks, there are many more surveillance relationships that we need to consider: People spy on one another using search tools, private companies spy on consumers, government agencies spy on people, and those same government agencies spy on one another. In the following, I describe electronic art projects that question Internet surveillance and shed light on the nature of surveillance relationships. These projects were made by me alone or with collaborators over roughly 10 years. I see these projects as participatory countersurveillance. As I describe the projects in the paragraphs below, I will be building a loose definition of the term.

Participatory Countersurveillance

To begin, I look back to 2001-2002. Compared to today, the Internet at the time seemed like a public park. [3] Nostalgia aside, even at the time, crucial wayfinding went through companies like Google: Then, as today, the most popular search algorithm belonged to the aforementioned company. The term algorithm is used in the context of computer programming to describe step-by-step procedures in automated reasoning and data processing. [4] The Google search algorithm determines how web content is prioritized and in what context it is shown. At the time, the basic algorithm was fairly simple: Pages with lots of links from other pages pointing to them were shown first. [5] The search engine was in the process of becoming the research tool of choice for the majority of Internet users. Thus, the verb "to google" was coined.

Search engines enable a special kind of research: spying on others. But what if you do not want to be found? As part of the group LAN based in Zürich, I created the project *Tracenoizer – Disinformation on Demand* in 2001 [6] (figure 1) to provide a tool for people who did not want personal data to be found by users of search engines. I am writing about this project in the past tense because at the time of writing the project is available as an archived version on my website, but is no longer functional. This is a fate that is typical for Internet art projects that use extensive server-side scripting.

When we created the project, we realized that all the data traces associated with a person constitute a databody. This databody consists of all the data traces associated with with a person, irrespective of whether the person has produced the data themselves or if it was produced by somebody else. We created a service to "clone" one's databody and therefore cloud one's identity. Users could enter their name and *TraceNoizer* would do a search using Google, Yahoo, Altavista, or whatever search engine was not blocking us at the time.

Figure 1. The *TraceNoizer* website © LAN

TraceNoizer would download the search results and run a statistical text classification using the Rainbow text classification library [7] on the data to organize the downloaded text into statistically related groups.

Using these organized groups of text, the program created a home page with thematically organized subpages. The website was then uploaded to a public webserver. Following this, *TraceNoizer* would run another search based on the previous search and make another slightly different website. Websites were linked to each other so that in the eyes of the Google indexing algorithm, their "importance" was increased. As a result, the sites created by *Tracenoizer* would show up in the search result when people searched for a person's name. The idea behind *TraceNoizer* was to create a cloud of disinformation so that nobody doing personal research could tell real from fake information and the original databody of a person would disappear.

Maintaining one's own databody and spying on others via search engines can be described as a sort of participatory surveillance in that the surveillee is participating in their own surveillance while surveilling others. TraceNoizer is a participatory countersurveillance tool in that it uses the mechanisms of participatory surveillance (search engines) to counter participatory surveillance.

Participatory Countersurveillance

More than a decade ago, in October 2001, the Swiss parliament issued a decree that mandates Internet service providers to retain metadata for six months [8]. This means that law enforcement agencies can reconstruct a person's social network because they have access to email and phone data. Proponents of this type of legislation tend to cite terrorism as a justification [9]. So far, no terrorists have been caught as a result of the Swiss legislation: A study by researchers at the Max Planck Institute found no statistical indication that data retention increases the efficiency of law enforcement. [10] Besides being ineffective, data retention also does not conform to the presumption of innocence, a fundamental right in a democracy.

When mandatory data retention in Switzerland was instituted in 2002, I responded by making the project *SuPerVillainzer – Conspiracy Client* [11] (figure 2). It is a webproject and the website itself still exists but like *TraceNoize*r, I no longer maintain it – one of the problems of preserving digital art. *SuPerVillainzer – Conspiracy Client* is a website that looks like a program for sending and receiving email. However, instead of facilitating the typical functions of an email client, it allows users to create email conspiracies. Users can enter a conspiracy name and a select a set of villain profiles (figure 3). Then they can press a button labeled "create conspiracy" and email addresses will be created for the selected conspiracy on a Swiss server. These email addresses will then automatically start sending each other conspiratorial emails. These emails have subject headers such as "NSA ALERT!" The body of the email will have ostentatiously conspiratorial text such as: "The informer we have inside the Secret Service says they are planning to sell details of the updated AFIWC COMPUSEC plans to the Dallas diplomat in Bern just as everybody is sitting down for Christmas dinner." Other emails look like they are encrypted. In the years when I actively maintained the service, thousands of villains were created. They had the names of the people who created them, but villains were also named after politicians, military officials, scapegoats, etc. Users created

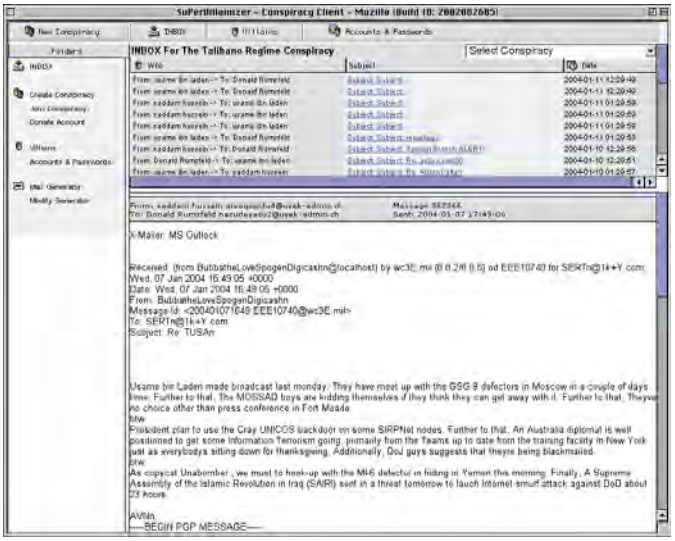

Figure 1. The *SuPerVillainzer* website © Annina Rüst

Conspiracies with names such as "Operation Blue Phoenix", "Tomorrow at 6:00:00", "The Mustafa Connection", and many thousands more.

The project was motivated by my interest in terrorist communication. I wondered, how can one tell what a conspiracy looks like? What constitutes terrorist communication? And finally: Who decides who is terrorist and who is not? How is an "enemy" profiled within a load of metadata?

Sunrise, the Swiss Internet service provider on whose servers I automatically created email accounts eventually found out about my activities. I think that the project appeared on the radar of their legal department only when print newspapers started writing about it. They sent me a letter ordering me to stop my activities and turn over passwords and usernames for the email accounts I had generated. Of course I complied and I did not hear from Sunrise's legal department ever again. The project however continued: I set up my own server where I continued to generate email accounts.

In 2005, I created a sequel to *SuPerVillainizer*, called *Sinister Social Network* [12], a project similar to *SuPerVillainizer* in that it constituted a participatory, speculative approach to Internet surveillance. However, this project specifically focused on surveillance algorithms, specifically on programs that identify suspicious activity.

These algorithms exist. One such algorithm was outlined in a paper presented in 2004 at the 2nd NSF/NIJ Symposium on Intelligence and Security Informatics. The paper explains the rules that allow researchers to search through data from chat rooms and distinguish malicious communications patterns over benign ones. For example: "Normal communications in the network are voluntary and 'random' however a hidden group communicates because it has to communicate (for planning or coordination)." [13] (Baumes, Goldberg, Magdon, Ismail, Wallace 1). No examples of actual observed terrorist communications are given but the rules outlined by the researchers show what stereotypical "criminal" behavior would look like. The researchers are therefore building a hypothetical profile based on speculation. In his book, *The Simulation of Surveillance: Hypercontrol in Telematic Societies* William Bogard calls this kind profiling "surveillance in advance of surveillance". [14]

Like *SuPerVillainizer*, the project *Sinister Social Network* existed mainly on the Internet. I populated IRC chat channels with villains and charted their activities in a social network graph. I displayed the IRC conversations on a website and asked viewers to speculate what kinds of sinister things were going on in the chat channel.

Like *TraceNoizer*, the projects *SuPerVillainizer* and *Sinister Social Network* are participatory counter-surveillance environments. However, the approach here is speculative: Users of both websites can create speculations about who the enemy could be and whom they are conspiring with. The projects explicitly question power: I am using the projects to raise the question of who is allowed to collect and analyze communications data and according to what criteria.

Figure 3. The *SuperVillainizer* conspiracy creation tool © Annina Rüst

Figure 4. The *Sinister Social Network* website © Annina Rüst

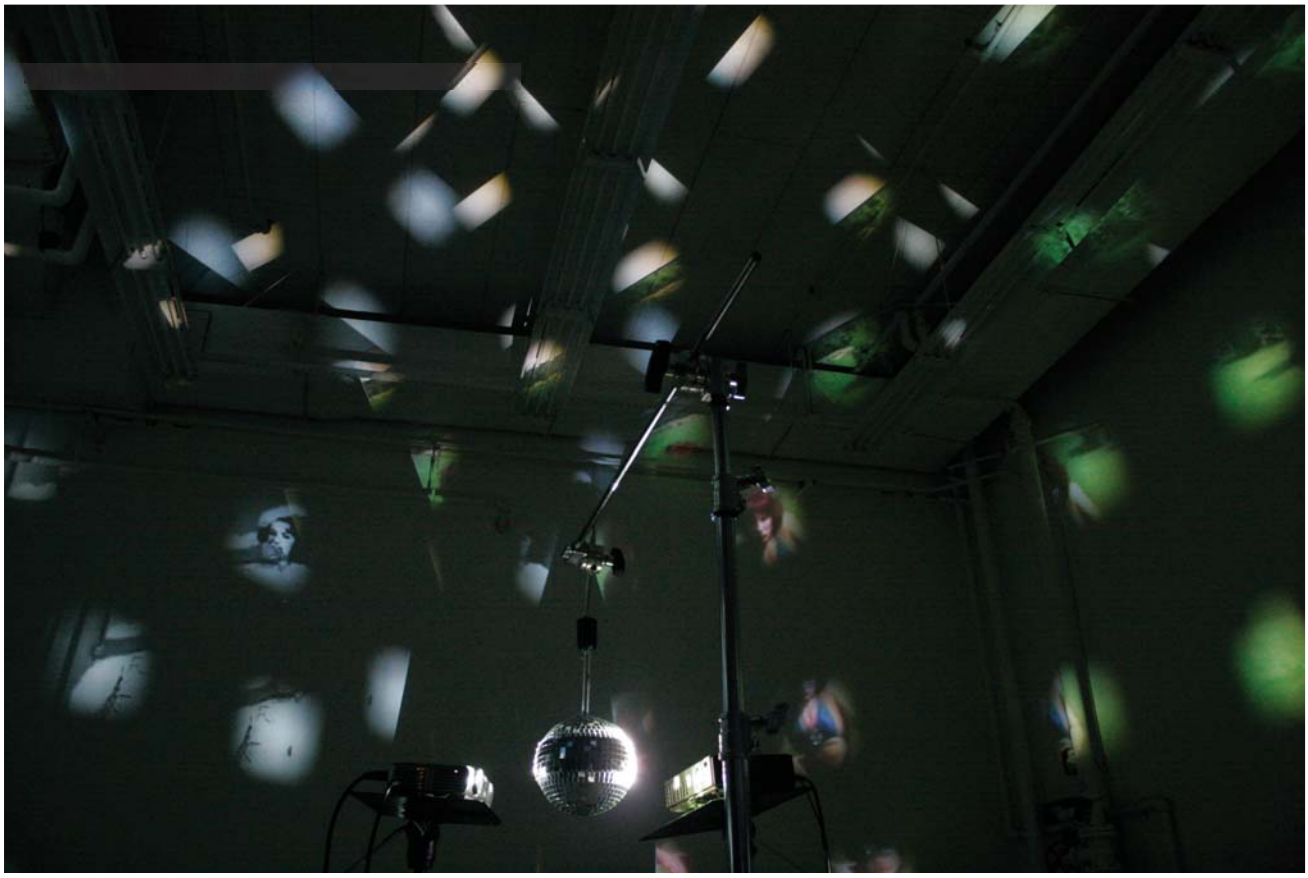

Figure 5. Still from an in-studio rehearsal of *Discotrope: The Secret Nightlife of solar cells* © Amy Alexander and Annina Rüst

Participatory Surveillance and Empowerment

In his article about Participatory Surveillance in social networks, Anders Albrechtslund says that social surveillance practices are at the heart of social networking. Albrechtslund writes that as users share information about themselves with others they build identity and subjectivity online. He sees this surveillance practice as empowering. [15]

One such example of online identity building is a genre of web video where people film themselves while dancing. On the popular social networking site YouTube, the type of video where people film them themselves has become a widespread phenomenon. Countless people are recording themselves dancing and sharing these clips through YouTube and other social media platforms. This form of online identity building differs from the online identity building that LAN addressed in the early 2000s with *TraceNoizer – Disinformation on Demand*. Today, online identity is not mainly expressed in the form of a home page on a server. Rather, it is distributed over social networking sites owned by companies such as Facebook, Google, Yahoo, and Twitter. Communication on the web today is much more widespread, visual, and exhibitionist than it was in 2001. It is still consumed in the form of text but mostly through images and videos. The following section of the paper is therefore not a departure from the topic. On the contrary, it takes into account surveillance relating to online identity building enabled by social media platforms like YouTube.

In 2012, Amy Alexander and I created the performance project *Discotrope: The secret nightlife of solar cells* [16] (figure 5), which examines the genre of the YouTube dance video. The performance features a solar powered disco ball. We project dance videos against it. In the performance we trace the genre of the YouTube dance video back throughout film history. We found that the sense of intimacy and immediacy between performer and audience that characterizes the YouTube performances was popular in early silent films and Hollywood musicals, where models for performance were drawn more from vaudeville than from theatrical narrative. An example for this is the silent film "Annabelle – Serpentine Dance" [17] shot as one of the first films in 1894 at Thomas Edison's film studio. In this clip, the dancer performs directly "at" the camera. Like in YouTube dance videos, the performer looks directly into the camera. Theresa Rizzo describes this type of cinematic performance as an "exhibitionist cinema where the spectator is overtly acknowledged and invited to look" [18]. There is an element of voyeurism and exhibitionism that can be found both in early cinema and later on in YouTube clips. We have found that this direct-to-audience style continued on to the musical films of the 1940s for example in the films featuring Ginger Rogers and Fred Astaire. Later on, films were shot in such a way where the audience takes a "fly-on-the-wall" perspective. An example for this style is the film "Dirty Dancing" where no direct-to-audience dancing takes place

and the actors stay in character throughout the film. Exhibitionistic cinema has only recently come back in the genre of the YouTube dance video. This type of video is typically shot with a webcam on a computer and oftentimes in an intimate setting such as a living room, a garage, backyard, or in a bedroom. Like in the Annabelle clip from 1984, the YouTube dancer acknowledges the camera.

During the Discotrope show we project this historical trajectory onto a disco ball where mirrors have been replaced with solar cells. This creates a mosaic-like projection against the walls. When enough light hits the ball, the ball rotates and the projection rotates along with it. We perform the ball live, adding color and light to the video projections, improvising layering and mixing to create visually rhythmic stream-of-consciousness juxtapositions. The changes in imagery vary the light to the solar cells, which changes the speed of the ball's rotation, allowing us to "choreograph" the movement of the projected visuals. Accompanying the performance is an algorithmic sound design by composer Cristyn Magnus. Sound is generated and mixed in real time from the audio tracks of the projected videos, creating a seamless, danceable connection between audio and visual.

In the performance we examine how today's YouTube dancers represent themselves. We reveal contrasts and connections over cinema history. Those include characteristics such as gender and body expectations, implications of aforementioned voyeurism and exhibition. We have found that although YouTube performers are self-directed, liberated and empowered, many still will enact gender stereotypes and conform to body expectations. Dancers that successfully defy gender stereotypes such as an obese man in a leotard dancing to Beyonce's hit song "Single Ladies" [19] are few and far between. So while participatory surveillance as described by Albrechtslund might be empowering in that it helps to build online identity, the cultural context where it happens still needs to evolve so that the promises held by the concept of participatory surveillance can actually be realized.

Conclusion

I hope to have demonstrated that Internet surveillance is as multi-faceted as a solar-powered disco ball. The projects I have described above are participatory countersurveillance environments. They challenge forces that attempt to exert power through Internet surveillance. Those entities include (but are not limited to) governmental agencies, corporate (search engine) algorithms, as well as societal expectations more broadly. As an artist, it is my job to create environments where participatory countersurveillance can happen.

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Author Biography

Annina Rüst produces electronic objects and software art. She creates technologies that are artistically and socially motivated. Her projects happen at the intersection of activism, algorithm, data, electricity, humor, politics, and pop culture. Her work has been reviewed in publications such as Wired and the New York Times Magazine. The Huffington Post called her recent robotics work a "Badass Feminist Robot". Annina's projects have been shown internationally in galleries, museums, and festivals such as Zero1 Biennial and Critical Make, as well as at the Edith Russ Haus for Media Art in Oldenburg, Germany. In 2014, she received an Art+Technology Lab grant from the Los Angeles County Museum of Art (LACMA). She has a Diploma from the University of the Arts in Zürich, an MFA from UC San Diego, and an MS from the MIT Media Lab. Annina has worked at Syracuse University since 2009. She has worked at Syracuse as Assistant Professor since 2009.

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Remote and Embodied Sensing: Observations on Interactive Art and Politically Engaged Practice

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Abstract

Remote Sensing is an interactive artwork that previewed during *The Image in Question* conference at the University of Sydney in August 2014. Making the work led me to ask, "Why has interactive art been sidelined in recent publications about participatory art and politically engaged practice?" In this paper I discuss recent theoretical perspectives on participatory art and interactive art and the sociopolitical and cultural contexts for my work *Remote Sensing*, which seeks to raise awareness about surveillance. As a vehicle for social and political comment, interactive art objects might not have the 'hit-and-run' appeal of tactical media and augmented reality projects but as divisions between art forms become increasingly blurred perhaps it is time to rethink interactive art, which engages the user in embodied actions.

Keywords

Interactive art, participatory art, politically engaged art, digital art, new media art, surveillance, embodiment, interactivity.

Introduction

Interactive artworks by their nature involve users in various forms of participation. Depending on the artwork the interaction can be either predictable or full of surprises. Interactive artworks can be found online and in public spaces, but my concern here is primarily with interactive artworks presented in galleries or museums. By encouraging viewers to physically engage with the work, interactive artworks challenge the established viewing conventions of the 'white cube'.

Over the last two decades there has been a lot of interest in various forms of participatory artwork. Works with a dialogic or collaborative element have increasingly been presented in museums and in major art exhibitions. These works have also found strong support in key publications, including Claire Bishop's book *Artificial Hell*s. But Bishop chooses to leave interactive art out of her discussions perhaps because she sees it as a sub-category of 'new media art' rather than 'participatory art' even though it combines aspects of both. In this paper I examine the changing nature of participation and the discourses that have grown up around digital art, participatory practice, politically engaged practice and interactive art, before discussing how my own work, *Remote Sensing*, is positioned at the interface between these discourses.

The Changing Nature of Participation

In her 2012 book *Artificial Hells: participatory art and the politics of spectatorship* Claire Bishop notes that since the 1990s there has been a "surge of artistic interest in participation and collaboration." [1] She names the following art forms as examples: socially engaged art, community-based art, experimental communities, dialogic art, littoral art, interventionist art, participatory art, collaborative art, contextual art, and social practice. [2] Interactive art and other digital art forms are conspicuously absent from her book. Bishop justifies the omission saying that participatory art involves many people "as opposed to the one-to-one relationship of 'interactivity,'" [3] and that according to her definition of participation "people constitute the central artistic medium and material." [4] However, not all interactive art is made for a single user. For example, augmented reality art projects allow multiple users to interact online and in public spaces. Interactive projects made for public spaces, for example Rafael Lozano-Hemmer's *Under Scan*, also often involve multiple users who can collaborate to deepen their experience of the work. What is clear is that digital media open up new forms of participatory interaction. Internet forums and social media give new importance to the practice of 'sharing' as a form of participation. Online campaign groups like GetUp! in Australia, the global organisation Avaaz and MoveOn in the US, inspire users to 'take action' online and in the physical world. Like life, which today involves both digital and embodied interactions, participation often straddles Bishop's so-called 'digital divide'.

Heralded as a democratic space by many, it seemed in the 90s that the internet might eclipse the elitist and commercial models that operate in the art world. But artists and theorists have long recognized the benefits of occupying the physical as well as the digital realms. Back in 1997 when they published *The ABC of Tactical Media*, Geert Lovink and David Garcia accepted "the paradox of *centers* of tactical media." [5] They argued that, "As well as castles in the air, we need fortresses of bricks and mortar, to resist a world of unconstrained nomadic capital." [6] Deterritorialisation is not empowering in itself; it is in

fact a characteristic of capital. As "flexible media tacticians," they were also happy to adopt 'strategies' of power when needed, specifically a physical base in the centre of Amsterdam where they could consolidate their efforts. [7] A space to "plan not just improvise." [8]

This is a theme that Garcia takes up again in 2014 in *From Tactical Media to the Neo-pragmatists of the Web.* [9] Here he argues that "despite the powerful forces seeking to domesticate the internet" it is still a powerful platform for political activism. [10] Partly this is because of the way online activists have sought to negotiate and perhaps embrace their own contradictions. According to Garcia, organisations like Avaaz have "the vision to step out of the established conception of how to do politics and into the new hybrid spaces that combine the virtual and the street." [11] Garcia argues that rather than clinging to "avant-garde rituals and tribal affiliations", the corporate look and feel of groups like Avaaz is a form of neo-pragmatism. He argues that Avaaz, and organisations like them, engage with the mainstream while acknowledging the risk and contradictions that entails.

In a similar way, media artists who previously shunned mainstream art institutions are now included in major exhibitions and festivals. Perhaps it is therefore time to rethink the tactical advantages of interactive art, which often combines digital and physical elements and can more easily penetrate the elitist art world. Conscious of Bishop's criticism that art institutions often co-opt participatory art practices by marketing them as enjoyable museum experiences, how might interactive artists maintain their political punch? Can limiting the interactive aspects of an artwork help focus attention on the meaning of the work?

Interactive Art and Participatory Art Practice

An interactive artwork is not an object in the traditional sense but a 'system' that works in concert with its users. It is often evaluated according to how much freedom the user has and how responsive the system is. For example, Beryl Graham in her chapter *What Kind of Participatory System? Critical vocabularies from new media art* says that very little new media art is actually interactive. She says that more often artworks are reactive; they respond to the viewers' actions but do not "physically act upon the audience in return." [12] The binary of interaction versus reaction perhaps grew out of criticisms of the hyperbole that surrounded early screen-based interactive works. Many were sceptical of the claim that these works give the user freedom to create his or her own experience or narrative because even though the user can chose a pathway through the material, the pathways themselves are predetermined by the programmer. However, the concept of participation itself is not static. As Graham notes, the critical vocabularies that have grown up around participatory systems are informed by the histories of previous art movements. [13] Allan Kaprow's *Happenings* in the 50s and 60s built upon but also challenged strategies developed by Dada artists who aimed to break the passivity of the audience, usually by confronting them with unexpected actions. However, Kaprow argued that to "assemble people unprepared for an event and say that they are 'participating' if apples are thrown at them or they are herded about is to ask very little of the whole notion of participation." [14] Kaprow sought to involve participants in a more democratic way: "I think that it is a mark of mutual respect that all persons involved in a happening will be willing and committed participants." [15] The rhetoric of human empowerment and democratic decision-making has become strongly associated with participatory art today.

In her book *The 'do-it-yourself' artwork* Anna Dezeuze notes that participatory works are often "premised on the belief that participation will encourage individuals and groups to take control of their own social and political existence." [16] But participation is not always liberating. Artist Bruce Nauman was reportedly very sceptical about user participation; Janet Kraynak in her perceptive analysis of Nauman's work *Dependent Participation: Bruce Nauman's Environments,* quotes him saying, "I mistrust audience participation. That's why I try to make these works as limiting as possible." [17] Kraynak argues that participation is "a historical rather than a static concept." [18] She places Nauman's work in the context of the technocratic space that developed in the 1960s, which was characterized not simply by media culture and technological developments like television and computers, but by the "increasingly administrative order" that accompanied these changes. [19] The limited audience interaction that Nauman stages in works like *Going Around the Corner Piece* mirrors the Kafkaesque feeling of being stuck in a bureaucratic cycle.

Surveillance and Secrecy

Today we have a new 'administrative order', one that also encourages and has perhaps refined participation as a form of social control. The networks that provide ready access to information and communication are also used to capture and store information about us. The legality of mass surveillance has been hotly debated, not only in the US but also around the world, but the extent of its reach and operational details are often shrouded in secrecy. Even so, most would be unwilling to give up access to the internet. We depend on it to receive and share information, yet while we 'participate' we are also giving up information, the metadata which internet and telephone companies are required to store. Civil libertarians argue that mass surveillance violates the right to privacy. Others argue that these powers are needed to protect citizens and infrastructure from non-state actors who are using the internet to recruit followers and plan attacks. It is not within the scope of this paper to weigh arguments for individual freedom against national security. My interest is in how art can reframe ethico-political questions, not only in my own work but also in the work of others.

In November 2013 artist Trevor Paglen photographed three intelligence agencies in the US: the National Security Agency (NSA), the National Reconnaissance Office (NRO) in Chantilly, Virginia and the National Geospatial-

Intelligence Agency (NGA) in Springfield, Virginia. Challenging the secrecy surrounding mass surveillance, Paglen posted the three images online saying they could "be used by anyone for any purpose whatsoever, with or without attribution." [20] Prior to this, the most commonly used photograph of the NSA facility appears to have been taken in the 1970s. It shows a corporate-looking building photographed on a clear day. In contrast, Paglen's new image shows the NSA facility at night, which gives it a slightly sinister feeling. The largely empty car park is bathed in orange light. The main building itself seems to have undergone little change since the 70s, but thanks to whistleblower Edward Snowden we know a little more about the way surveillance has changed.

Paglen hopes his images of these facilities help people to think about what these institutions do and about the effects they have on the society around them. [21] Images capture the public imagination and have the ability to shift public perceptions. But unlike images in the past, which were distributed through more traditional channels, today images are instantly uploaded and available globally. Paglen has posted his photographs of the NSA, NRO and NGA online with a creative commons licence that allows others to use them with or without attribution. This not only ensures a wider audience for the original images but also facilitates creative reinterpretations of his work.

Remote Sensing

My work *Remote Sensing* (Figure 1) incorporates Paglen's photograph of the NSA facility and its surrounding car park. The work comprises a small trolley on wheels that users push around the gallery. A computer screen embedded in the trolley's top surface displays a small section of Paglen's image. As the user manipulates the trolley left, right, forward or backward, the screen updates to show contiguous parts of the image. If the trolley swivels on an angle, so does the onscreen image. For all intents and purposes, it is as if a large virtual image was mapped onto the floor of the gallery but viewers can only see a small part of it on the trolley's screen. In order to see more of the image, the user pushes the trolley towards the corresponding section of the floor. It's a form of 'blinkered' vision. The user is unable to see the whole image simultaneously.

Fabricated in unpainted galvanised steel and supported on industrial swivel castors, the trolley object appears old-fashioned, though its bent acrylic hood gives a nod to the sleek and sexy mobile devices used today. Artist, writer and curator Wes Hill argues that the renewed interest in obsolete technologies in art today is partly due to digital artists trying to overcome the speed with which their own works become out-dated. [22] However, my interest in obsolete technologies goes hand in hand with my interest in physical interaction. Both strategies are used in order to give physical form to contemporary issues, many of which, like surveillance, are dematerialised and/or disembodied. The action of 'scanning' the floor to reveal Paglen's image of the NSA is a bit like searching a microfiche library catalogue. A transitional technology between paper cards and

Figure 1. *Remote Sensing* (2014). Steel, acrylic, castor wheels, electronics. Programming by Dr. Andrew Burrell. Image courtesy of the artist. ©Margaret Seymour.

computer catalogue, microfiche miniaturised the catalogue, thereby compressing the catalogue into a smaller physical area. The user navigated the tiny text records by winding a film spool or sliding a film cradle to the desired magnification point. Today computers have changed the way we store and access information, allowing ever increasing quantities of data to be captured and searched.

The image on the horizontal screen of *Remote Sensing* is also a bit like augmented reality in that a virtual image is overlaid onto real space. Unlike most augmented reality works, however, the screen shows a 2D image that 'replaces' the floor rather than producing a composite of floor and image. In *Remote Sensing* the horizontal orientation of the image echoes Borges' story about the cartographers who make a map the size of the empire that replaces the empire point for point. [23] And perhaps one day the vast repositories of data amassed by governments, internet and phone companies will face the same fate as Borges' map:

> *The following Generations, who were not so fond of the Study of Cartography as their Forebears had been, saw that that vast Map was Useless, and not without some Pitilessness was it, that they delivered it up to the Inclemencies of Sun and Winters. In the Deserts of the West, still today, there are Tattered Ruins of that Map, inhabited by Animals and Beggars; in all the Land there is no other Relic of the Disciplines of Geography.*
>
> Jorge Luis Borges, *On Exactitude in Science*

Like Nauman's tactic of limiting the actions available to viewers of his works, *Remote Sensing* also allows only a limited range of user interaction. If the user moves the trolley outside the area marked up on the floor, the image is replaced by static, as if an analogue signal has been lost. This is suggestive of the fact that online we have the freedom to explore a vast network of information and to engage and maintain contact with others who have similar interests, but only within given parameters and technical constraints.

I chose Paglen's image because I wanted to contrast the secrecy surrounding surveillance with the philosophy of open access to information in the digital commons. I was struck by this contrast during the debate about privacy versus security in the US, but also particularly because of the conservatism of the debate in Australia. In October 2014, the Australian government introduced legislation that mandates data retention for two years. The government, with the support of the opposition, has also passed new anti-whistleblower legislation. The National Security Legislation Amendment Bill "increases the penalty for disclosing information about a special intelligence operation to a maximum of five years imprisonment, and 10 years if the person intended to endanger someone." [24] These are worrying developments, especially for journalists who are rightly concerned about protecting their sources. Rather than opening up a conversation about individual freedom and national security the Australian government seems determined to place tighter regulations on the digital realm.

Remote Sensing aims to extend and amplify the conversation about surveillance by engaging the viewer in embodied actions. The work slows viewing down to walking pace in order to allow time for contemplation. The act of revealing one part of the image necessarily conceals another part; but after spending some time with the work, the viewer might recognize the whole image, which was taken by Paglen from a helicopter. Although the camera's point of view doesn't match the horizontality of the screen exactly, both the camera and the trolley place the viewer above the object of interest and looking down. The trolley has a handle that viewers must bend down to reach. This action focuses attention on the screen beneath, so that the rest of the gallery tends to drop out of the user's field of view. This ungainly pose can make the user feel self-conscious, concerned perhaps about other gallery visitors who may be watching them and whom they cannot see with their head down. The image is not immediately present for the viewer but has to be assembled piece by piece in his or her mind through a process of gradual revelation. In the act of revealing the image the viewer is also observed by a small web camera (attached to one of the roof beams above the work) and by other people in the gallery, thereby inverting the spectatorial power dynamic in the gallery. The viewer is both surveyor and surveyed.

Consciousness of being under surveillance prompts in the viewer a mix of anxiety, self-censorship and caution. Some users reported feeling nervous about using the device and asked if their actions were being recorded. They wanted to know how the onscreen image was being updated. Only a few noticed the web camera. Perhaps the hazard tape marking out the boundaries of the virtual image on the floor also made people feel self-conscious. In a gallery or workshop, markup tape on the floor usually indicates danger and shows how far the viewer should stand from an artwork or a piece of machinery. Also, without a sign saying 'please interact with the work', some people were naturally wary. These responses confirm that physical engagement with interactive works of art can produce affective responses, in this case curiosity and anxiety.

Conclusion

If, as Bishop states, the most striking participatory projects "unseat all of the polarities on which this discourse is founded (individual/collective, author/spectator, active/passive, real life/art)," perhaps it is time to unseat another polarity, the one Bishop identifies in her article the *Digital Divide*. [25] When Bishop's article was published in 2012, it prompted a lively outpouring of criticism from academics and artists. Her characterization of new media as a 'specialised' discipline seemed to sum up the longstanding neglect with which it had been met by major art institutions. It is not my intention to revisit the criticisms of Bishop's *Digital Divide*. [26] Digital works can be critically evaluated according to the discourse that has grown up around them, but they also challenge existing criteria and push art discourse in new directions. Rather than looking for ways to transplant the digital into physical space, many artists are already blurring the boundaries across the digital divide. With a stake in both the digital and the physical world, interactive works can engage the user in contemplation *and* participation – in remote and embodied sensing.

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Towards an Autopoiesis of Surveillance

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Abstract

Surveillance has now become a ubiquitous phenomenon that envelops the globe in an uneven and non-transparent manner. While the work of Foucault (the panopticon and the administration of subjectivities) and Deleuze (the control society with its reliance on communication and marketing) provides powerful tools for understanding the surveillance apparatus, closer attention to its digitally networked nature must be given. To this end, the work of Nancy Paterson's *IXMaps* and Julian Oliver and Danja Vasiliev's *PRISM: The Beacon Frame* provide morphological samples of the autopoiesis of surveillance. Autopoiesis, a concept related to cybernetics and developed by Humberto R. Maturana and Francisco J. Valera, posits the existence of self-sustaining and regenerating unified systems of relations that are indifferent to their components. Autopoiesis, they argue, is a necessary and sufficient condition to consider a particular system living or otherwise. We speculate at the end of this paper the degree to which the global surveillance apparatus might be considered a living organism, albeit one of our own accidental design, and what the possible implications might be.
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Keywords

Surveillance; autopoiesis; networks; new media art; Foucault; Deleuze; Maturana & Varela; cybernetics; protocol

One of the many uncanny aspects of the Edward Snowden revelations is the fact that the extent of the NSA's bulk surveillance program – according to Glenn Greenwald, data from 97 billion emails and 124 billion telephone calls was collected in the course of just thirty days in 2013 – seems both appalling and banal. [1] Appalling: what used to be considered as a "reasonable expectation of privacy" can no longer be reasonably expected. Telephone and mobile conversations, email and text messages, Internet browsing histories, social media activity, credit card purchases, national and international travel, etc., are all potentially subject to collection and analysis. Banal: the automated nature of the technology behind bulk metadata collection means that the strategy (collection of relevant information) should far exceed its purpose (national security) and go too far.

Certainly, a ubiquitous surveillance apparatus is hardly a recent development, of which the top-down model associated with George Orwell's 1984 (i.e., secret police, a centralized panoptic state control over a population, surveillance activities directed towards a specific enemy group or activity, etc.) is foremost in the popular imaginary. However, and while it is certainly true that there are numerous places in the world where this centralized model of surveillance is violently active, the activities of the surveillance apparatuses of not just the NSA but also CSIS (Canada), GCHQ (the UK), CNCTR (France) and the BND (Germany) – to name a few examples – indicate that centralized surveillance is merely one model among others: or, more specifically, one network morphology linked to a wider, more flexible and robust system of networks. One indication of this is the degree to which surveillance is no longer an exclusive concern of a state apparatus; as the example of Facebook or Amazon's continual negotiations with their users' patience indicates, capitalist interests have invested in and adopted surveillance technologies in order to develop and expand their market interests, while routine monitoring is a feature of the contemporary workplace (e.g., timed toilet breaks in call centres and retain service industries, monitored Internet usage, etc.). Indeed, it is from an analysis of the sociology of workplace surveillance that the ubiquity of the surveillance apparatuses is foregrounded:

> Surveillance is (1) an ubiquitous feature of human societies and is found in both the political (public) and civil (private) spheres of society; (2) associated with governance and management; (3) endemic to large-scale organizations; (4) constituitive of the subject and has a corporeal aspect to it; (5) disabling as well as enabling and is "productive" in Foucault's sense; (6) understood in terms of distanciation, i.e., control of space and time; (7) becoming increasingly implicated in a system of assemblage which brings together diverse control technologies; and (8) rhizomatic, as evident in the ability of convergent technologies to capture and assemble inordinate amounts of information from various sources. [2]

There are several things noteworthy about this description. For one thing, the ubiquity of surveillance is related to its generalized function as mode of "governance and management," or, to use a vocabulary drawn from cybernetics, command and control. Further, there are the references to the work of Foucault and Deleuze – in particular, Foucault's move from the postulation of the disciplinary society in which "prisons resemble factories, schools, barracks, hospitals, which all resemble prisons" [3] to an absubjective apparatus of surveillance based on "and environmental type of intervention instead of the internal subjugation of individuals." [4] Developing this in his 1990 text "Postscript on Control Societies," Deleuze notes that prison incarceration has increasingly been

replaced with electronic tagging, psychiatric hospitals with outpatient health-risk management – more often than not involving medications – and the Fordist factory replaced with the forced dissolution of trade unionism and info-capitalism: "marketing is now the instrument of social control." [5] As Deleuze notes, this mode of control operates not as much through the allocation of bodies in space as it does by means of transmission and access to

Deleuze's emphasis on the "digital language of control," that is "codes" of "information" alludes to an important feature that cannot fail to escape the notice is the importance of communication technologies in the contemporary surveillance apparatus. The pluralized, nonhierarchical networks alluded to by Foucault and Deleuze and stated specifically in the sociological definition depend less on particular human agencies, such as the secret police structures of "totalitarianism." than they do on the technological servo-mechanisms of data mining and extraction in order to monitor the unprecedented levels of communication flows currently in operation. These servo-mechanisms are able to operate in the way they do because they share the same substrate as the flows they monitor: data. Lev Manovich, in his book *Software Takes Command* , has noted that data accessed and shaped by software is the noumena of the contemporary socio-cultural-political-economic order; a heterogeneity of artistic, economic, personal, etc., transmissions are reliant on a stratum of collectible and quantifiable informatemes. [7] This noumenal homogeneity – data, whether it be financial information, financial records or personal trivia, necessarily is translated into binary code – makes control over the heterogeneity of networks possible by modulating control and access to this data.

Before we describe how these networks are controlled, or, to be more precise, how the communication networks have been imbricated into the surveillance network as a control mechanism, some attention must be paid to how these networks function. This is a question of morphology as much as technodynamics, one directly addressed by Canadian artist Nancy Paterson's ongoing (2008–the present) project *IXmaps*. (See fig. 1). With a consortium of students and faculty at the Department of Information, University of Toronto, *Ixmaps* is an online "interactive tool that enables Internet users and researchers to study the route(s) that data packets take across the Internet, with surveillance and other 'interesting' sites highlighted along the way." [8] *Ixmaps* functions as an art project but also as an act of intervention in the politics of network surveillance; in addition to data visualization (effectively, a vectoral map of North America), the group produce an annual report *Keeping Users in the Dark or In the Know: Report on Data Privacy Transparency of Canadian Internet Service Providers*, providing policy recommendations to ISPs, privacy officers and the Canadian government along with ratings of the main ISPs used by Canadians in terms of their commitment to informing customers about external data requests, storage or routing of data packets in and through the United States, transparency about their operations regarding personal information, advocacy for privacy rights, etc. this information: "in control societies, […] the key thing is no longer a signature or a number, " which would mark a particular subject, e.g., "Jane Doe," with a particular bank account number, social insurance number, credit rating, date of birth etc., "but a code: codes are passwords […]. The digital language of control is made up of codes indicating whether access to some information should be allowed or denied." [6]

is not to produce a consumer report, but to address the problem of uneven network transparency – that is, access to information about the form and function of the surveillance network itself.

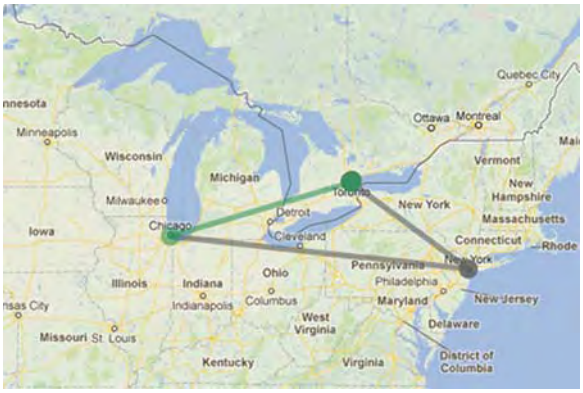

Figure 1. Nancy Paterson, *IXmaps*. An email sent from Toronto to Chicago is routed through New York. © Nancy Paterson

As David Lyon notes: "As the details of our daily lives become more transparent to the organization surveilling us, their own activities become less and less easy to discern." [9] This critique of uneven transparency has been one of the key areas of political contestation in recent years, from Wikileaks to Edward Snowden's desperate exile. Indeed, as it is often the case that one can observe the efficacy of one's political strategy from the violence of the reaction it raises in the dominant social vectors, one might point to a similar exploration of data network transparency in the case of Julian Oliver and Danja Vasiliev's *PRISM: The Beacon Frame* at Transmediale, Berlin, January 2014. (See fig. 2). Oliver and Vasiliev describe this project as "a speculative, functional response to the general absence of information as to what NSA PRISM equipment actually looks like." (PRISM was the name of the NSA program for the collection of private communications from such companies as Facebook, Google, etc.). Originally produced for the ArtHackDay 2013 event in Berlin, Oliver and Vasiliev further elaborate:

> This [2014] iteration of the project is a field deployable wireless surveillance and GSM interception unit comprising a robust tripod, large glass prism, nano computer, nano projector, GSM antenna and cellular communications base station (also with a computer).
>
> It employs the same techniques of wireless (WiFi) device localization and mapping, cellular network hijacking and wireless packet inspection known to be in use by state

sanctioned surveillance agencies such as GCHQ (UK) and NSA (USA).
When activated, the computer scans for local cell towers owned by mobile service providers [...], building a list of their unique properties. The prism then begins rotating, and one by one each cell provider is impersonated by the PRISM tower. Activated mobile phones in the presence of the tower will hop onto the rogue network, "recognizing" its properties and believing it to be trustworthy.
At that point, they are sent SMSs of a troubling, humorous and/or sardonic nature. Data corresponding to these events are projected through the prism, in turn showered onto the walls in a rich and exploitative light show. [10]

Figure 2: Oliver and Vasiliev's *PRISM: The Beacon Frame* before being disconnected at Transmediale, Berline, 2014. © Julian Oliver, Danja Vasiliev

The SMS messages sent were along the lines of "Welcome from your new NSA friends" and the like, of which over 1000 were sent to mobile devices during the exhibition opening and the following day, at which time, a curious incident occurred. Without the artists' consent, members of Transmediale's staff disabled the device, and the artists were advised that Transmediale would be unable to cover their (the organization's and the artists') legal expenses if official complaint were made to the authorities. In response to this, Olivier and Vasiliev chose to discontinue the project. [11]
As with *IXmaps*, *PRISM* challenges, albeit in a more confrontational, spectacular manner, the uneven transparency of surveillance networks by making them palpable and visible. In the case of the former, participants are able to visualize the path a particular data packet travels through the communications networks and to mark where these paths are transected by NSA and other data collection nodes. In the case of *PRISM*, Oliver and Vasiliev offer a performative example of State surveillance interference not only through the shock tactic of receiving the alarming SMS message on one's mobile, but also through the projection of the gallery audience's ISP addresses and other data on the gallery walls. What these two projects have in common is their exploration of the automated, absubjective nature of the contemporary surveillance network. While it is doubtless true, as David Lyon's work in surveillance studies makes clear, that contemporary surveillance often operates in terms of a "social sorting" of the general populace into gradations of desirability and undesirability, this activity of social sorting is still largely done not by subjects but by impersonal processes, the servo-mechanisms of control. [12]

In their book *The Exploit: A Theory of Networks*, Alexander Galloway and Eugene Thacker refer to this impersonal control process as "protocol," which they define as "a horizontal, distributed control apparatus that guides both the technical and political formulation of computer networks, biological systems and other media" [13], a definition they elaborate thusly: "*protocol is a technology that regulates flow, directs netspace, codes relationships and directs lifeforms*." [14] Galloway and Thacker's theory of "protocological networks" is useful to the present study of surveillance in a number of ways. For one thing, they emphasize that network control "is not an exercise of power 'from above,'" but "[r]ather, protocol is an immanent expression of control. Heterogeneous, distributed power relations are the absolute essence of the Internet network or the genome network, not their fetters. Thus the relation between protocol and power is somewhat inverted: the greater the distributed nature of the network, the greater the number of insider-out controls that enable the network to function as a network." [15] Two points should be made here: networks function as informatic, as we have noted, and thus transect biological and well as electronic communications systems. (Hence the privileged examples of networks in *The Exploit* are the Internet and DNA). Secondly, the immanence of protocol means that network control is constituitive of the morphology of the network themselves; in this sense, they are self-generating.

Automation and the circular causality that allows a network to form and regulate itself, of course, brings to mind Norbert Wiener's cybernetics (again, command and control), which began with the question of how systems can self-determine in order to perform their tasks more efficiently and to anticipate environmental or situational changes that may require corrective action on the part of these systems. The Chilean biologists Humberto R. Maturana and Francsico J. Valera further developed the evolution and behaviour of these systems through their notion of autopoiesis. Autopoiesis is characteristic of "machines, living or otherwise," a machine in this case constituting a unity determined by a particular dynamic organization (set of relations). Autopoietic machines are:

> *a network of processes of production (transformation and destruction of components) that produces the components which: (i) through their interactions and transformations continuously regenerate and realize the network of processes (relations) that produced them; and (ii) constitute it (the machine) as a concrete unity in the space in which they (the components) exist by specifying the topological*

> *domain of its realization as such a network.* It follows that an autopoietic machine continuously generates and specifies its own organization through its operation as a system of its own components, and does this in an endless turnover of components under conditions of continuous perturbations and compensations of perturbations. Therefore, an autopoietic machine is a homeostatic (or rather, relations-static) system which has its own organization (defining network of relations) as the fundamental variable which remains constant.[16]

Autopoietic machines are cybernetic networks with the added feature of self-replication; these machines generate the conditions of their own continuance in a particular space, and this space, along with the network of relations, constitute the unity of these machines. They are autotelic and can interlock with other systems, autopoietic and otherwise, to generate second and third order autopoietic systems.

It is possible at this point to imbricate the notion of autopoiesis and protocological networks in an autopoiesis of surveillance. Surveillance systems, as with autopoietic and protocological systems, are circularly causal and immanent to their own networks. Their autotelos generates their own components and relations; this is the sense in which surveillance is not merely productive of subjects to surveillance, but also productive of its own network morphology. A further development may be added at this point. Monika Vrečar, in her essay "Art in the New Media Environment" notes that the automated risk management associated with the contemporary surveillance apparatus operates by cycling through all possible combinations until the "risk" behaviours it is set to discover are realized. [17] Or, to put it in the terms we have been using, the protocological nature of surveillance as autopoietic system is defined by its components or nodes as being subjects of/to surveillance and its relations one of regulation, direction and production; surveillance thus maintains a homeostatic equilibrium that enables it to withstand and even predict internal and external perturbations. This is the socially pervasive double-bind caused by such organizations like the NSA; as Glenn Greenwald notes, *it is the "desire" of surveillance to "collect it all" that generates the need for surveillance.* [18] Put more simply: if you are looking for threats to the stability of the government, a rise in iPhone usage or particular trends in sopping articulated along gendered continua, you will certainly find them eventually.

It must be admitted that there are two possible objections that might be made as to the characterization of surveillance as a fully autopoietic system. The first concerns the degree to which surveillance can be said to have a unified topology that Maturana and Valera stipulate as characteristic of autopoiesis. Here, we return to the two artworks under consideration. In Paterson's *IXmaps*, and Oliver & Vasiliev's *PRISM* project, we have two works that explicitly explore the spatial unity of the surveillance network apparatus, but it is a unity that is produced through its system of relations between components. Galloway and Thacker discuss this unity in terms of internal and external individuation: "The first type of individuation is that of the macroidentification of the network as a cohesive whole. This is [...] a paradoxical move, since the key property of any network is its heterogeneity. Hence, the first type of individuation is in tension with the second type of individuation in networks, the individuation of all the nodes [components] and edges [relations] that constitute the system." [19] The immanent self-organization of the network posits itself as a unity *qua* network; however distributed and transnational, the surveillance network necessarily individuates itself as an individuated entity. One might further add that the transcoding of heterogeneity into the homogeneity of Deleuze's "digital language of control" further enables the macroindividuation necessary for the unification of the network as network.

This brings us to the second objection, which concerns a trickier set of problems – that autopoiesis is characteristic of *living systems*. Maturana and Varela state that: "the notion of *autopoiesis is necessary and sufficient to characterize the organization of living systems*." [20] Only living systems, such as cells or the nervous system, can be described as autopoietic. In this context, the question becomes: To what degree is surveillance a living system? At the earliest stages of the twentieth century's accelerated technological development, Marshall McLuhan argued that media is fundamentally prosthetic: the wheel is an extension of the foot, the book an extension of the eye, etc. But he also noted, not without ambivalence, that "after more than a century of electric technology, we have extended our central nervous system itself in a global embrace, abolishing both space and time as far as our planet is concerned." [21] (It is in this context that it should be remembered that Maturana and Valera produce an appendix to "Autopoiesis: The Organization of the Living" devoted to the technical analysis of the nervous system as autopoietic). If the emphasis has hitherto been on the technological prosthetic as an extension of the human body, we might say (with McLuhan, in fact!) that there has been a characteristic figure-ground reversal and that technological systems now use humans beings as their prosthesis rather than vice versa: in effect, an extension of what is understood as "living organism" to include the "moist" (Roy Ascott: "between the dry world of virtuality and the wet world of biology lies a moist domain"). [22]

There is a further detail regarding surveillance as (semi-)living organism, which follows from René Thom's mathematical analysis of complex (including organic) systems in *Structural Stability and Morphogenesis*. Concerning himself with sudden transformations in organic systems (through the development of chaos theory), Thom sought to provide models for understanding these topological transformations. It is clear that our present situation in which the autopoietic surveillance network of protocological control is not necessarily in our favour, but it may be that the work of people like Paterson, Oliver and Vasiliev can provide us with important topological models as well by means of their transversal cuts through the contours of the surveillance networks

(akin to biopsies performed on cancerous cells). The generation of these topological models would allow us to understand better this new organism, and give us greater insight into the nature of our relationship with it – which would include a greater understanding of the future relationship with surveillance that we would like to have. As it stands, the surveillance apparatus appears to function in a parasitic manner, feeding off the data it transcodes from the communication networks it has come to inhabit as it runs through its algorithmic computations and providing, for those in need of it (i.e., state disciplinary apparatuses), justifications for the continuation of this parasitic relationship. Perhaps it is necessary to rethink what sort of networks we would care to inhabit and what sort of protocols should be installed so that we might decide the fate of this organism that we have, albeit inadvertently, allowed to grow on and in us.

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Image from Nancy Paterson's *IXmaps* (Figure 1) taken from Paterson, Nancy, Andrew Clement et. al. *IXmaps*. Accessed 24 May 2015. http://ixmaps.ca/.
Image from Julian Oliver and Danja Vasiliev's *PRISM: The Beacon Frame* (Figure 2) taken from Oliver, Julian and Danja Vasiliev. "*PRISM: The Beacon Frame*. Speculative NSA Forensics Equipment." *The Critical Engineering Working Group.*Accessed 24 May 2015. http://criticalengineering.org/projects/prism-the-beacon-frame/.

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Author Biography

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URME Surveillance: Analyzing Viral Face-crime

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Abstract

This self-reflective art paper examines my position within the ecology of surveillance art focused around facial recognition. *URME Surveillance*, transforms my identity into a defense technology for the public's protection against facial recognition software. This project encourages the public to substitute their identity for my own by wearing a 3d printed prosthetic mask made in my likeness.

This paper will begin by examining our relationship to surveillance and identity by discussing the surveillance system in Chicago as a case study. I will then discuss the work of Adam Harvey and Zac Blas as two contemporary artists working with identity recognition technologies. I will then use their work as a jumping off point for my own, discussing the strategies that lead me to *URME Surveillance* including an overview of its successes and failures.

Keywords

Surveillance, Subversion, Identity, Performance, Facial-Recognition, Data, Power structure, Prejudice, Prosthetic

It was terribly dangerous to let your thoughts wander when you were in any public place or within range of a telescreen. The smallest thing could give you away… In any case to wear an improper expression on your face was itself a punishable offense. There was even a word for it in Newspeak: facecrime [1] *-George Orwell, 1984*

Considering the quote above, I am struck by the Newspeak word, "facecrime". Its implication is disturbing: that the part of the body most indicative of an individual could perpetrate a crime. This link between face, or identity, and crime is not as unfamiliar as Orwell's futuristic novel would have us believe. One example in the United states of this is the notion of Shopping while Black. The United States has a myriad of these examples: post 9-11 profiling of Arab Americans, immigration practices on the Mexican border, Japanese internment camps in World War II, etc. While these examples may be construed as racial rather than facial, the genetics that make up race have a circumscriptive determination on our facial features as well, such as eye shape and color, cheek bone height, nose width, lip size, etc. Perhaps we should translate "facecrime" into a relatively new English term from our own technological era: facial recognition.

Facial recognition software has been one of the most developed surveillance technologies of the last 10 years and it is an arms race to apply facial recognition to as many contexts as possible. For example Mark Zuckerberg, creator of Facebook, has invested in a multi-million dollar recognition program known as "Deep-Face" which can identify a face regardless of the angle the image is taken from with 97.2% accuracy: the equivalent accuracy of a human being [2]. This investment reflects Zuckerberg's interest in improving the photo tagging experience on Facebook.

The embedding of facial recognition within social media is indicative of another shift within the last 10 years: the digitization of accessible personal information, which I would argue is the most prevalent form of identity formation and expression today. In the sci-fi television show Caprica, a grieving father attempts to resurrect his daughter by downloading all the public information about her into a robot body. His rationale is that all her preferences, experiences, memories, and accomplishments in one way or another have been archived online through photos, videos, posts, articles, etc, and that these are the relevant components of who his daughter was. Research scientists working at the intersection of social media and marketing share this idea. In a 2013 study from Cambridge University, a group of researchers developed a method of constructing an identity profile of a person based solely on what someone "likes" on Facebook. They claimed that with access to this information, it was possible to accurately determine a person's gender, age, race, religion, sexual orientation, political stance, socio-economic class, whether they are an only child or not, and consumer behavior to name a few [3].

Facebook, and other social media platforms use this information to sell marketing profiles about its users to advertisers based on our perceived identity. This external creation of identity through interpreted data collected by others, along with the global reach and ubiquitous nature of social media, threatens each of our own authorships over our individual identities. When this data is combined with facial recognition surveillance systems the potential to tag this data to a physical body in the world arises. Most importantly, what will happen when this "data" is used to profile potential criminal behavior: facecrime.

Enter real world surveillance systems, such as Chicago's own "Virtual Shield". Known as the most widely surveilled city in the nation, Virtual Shield houses over

25,000 federated cameras, including blue-light cameras, cameras in public school, traffic cams, and those on busses and trains. What makes Chicago frighteningly special is that it is also the national leader in fiber-optic systems, meaning that all 25,000 government cameras are networked together, moving thousands of surveillance images into one centralized hub [4]. Housed in the 911 Emergency Response Center, Virtual Shield also has some of the most sophisticated facial recognition software anywhere in the country, and with each camera having a known corresponding physical location, Virtual Shield has the potential to track an individual's movements throughout Chicago, using their face as the trigger.

The inclusion of facial recognition in surveillance practices has had a profound effect on the way artists engage with the subject of surveillance. Though there are examples in art concerning our relationship to surveillance and identity dating back several decades, such as Bruce Nauman's *Video Corridor* (1970), several contemporary artists have shifted their strategies to include the face as a sight for intervention. Two such artists are Adam Harvey and Zach Blas, both of whom have been integral to the formation of my own work on the subject.

In 2013, Adam Harvey created *CV Dazzle*, a method that uses makeup to confound facial recognition software. Facial recognition works based on feature detection, such as analyzing the distance between each eye, or the size of a person's chin. Harvey is able to successfully change how these features appear by using makeup to alter the image the camera system sees to the point that most surveillance systems can't even detect a face let alone identify it. Harvey's work has enjoyed considerable attention and has been emulated and practiced by several groups such as the "Anti-Surveillance Feminist Poet Hair & Make Up Party," a Tumblr blog that catalogues women using makeup as a subversion tactic [5].

Similarly Zach Blas has been working on his *Facial Weaponization Suites* since 2011. His project consists of a series of prosthetic masks made from distorted 3d models of amalgamated faces. Arguable the most famous of these *Suites* is "FagFace" which is a model comprised of several queer men's faces. These faces, as with all of his *Suites*, are collected through a series of community-based workshops. The faces are scanned and then turned into 3d models. Afterwards, the models are meshed together and distorted using 3d modeling software and then fabricated into a wearable mask. Because of the distorted features of these masks, when worn, they successfully hide the wearer's face from biometric scans and other forms of facial recognition.

While having considerably different aesthetics and systems of distribution, these two projects fundamentally share the same strategy: protect the individual by hiding or occluding their face from security cameras. This idea of "hiding" is in fact the most prevalent strategy both in and out of the art community offered to the public. The majority of Youtube videos on the subject of anti-surveillance include how-to videos involving the use of ski masks, hoodies, and the hat/sunglasses combo. Unfortunately, these strategies of hiding often draw suspicion from onlookers and tend to be associated with criminality, which can have deadly repercussions. One recent example is the tragic case of Trayvon Martin, a Black teen whose death was blamed on his concealing his identity with a hoodie, rather than being the victim of a murder with serious racial undertones. In the case of Harvey and Blas, each of their projects have considerably extreme aesthetics which as a form of cultural expression make them successful as bold, overt, and public visual statements of resistance. However these aesthetics, by their very nature, will likely draw more attention to the user than is useful for a practical anti-surveillance intervention.

As a result, when considering how I might add to the ecology of art concerned with facial recognition, my goals became to address this prevailing strategy of "hiding" through an artistic intervention that underlined real world function with an emphasis on subversion and avoiding detection by surveillance as opposed to the important, yet overt, public visual statments made by Harvey and Blas. I aimed to produce something others could potentially use without drawing unwanted attention to themselves.

Thus when considering both Harvey and Blas' work, along with the majority of information provided to the public, I came to two conclusions. The first was that I needed to create a new strategy if I wanted results that did not immediately associate the wearer as suspicious or criminal. Simply continuing to hide a face with new aesthetics would not suffice. The second conclusion was that in addition to facial recognition systems, I had to consider the role of the general public as agents of surveillance as well. I required a strategy that would protect the user from being identified by cameras in the way that Harvey and Blas work does, but, aesthetically speaking, would pass inconspicuously in a crowd of people as well.

These two conclusions led me to the strategy that would launch URME Surveillance: rather than hide a face, substitute it. Show the camera and the public a face, but not the actual user's face. Having already opened up my identity for others to use in YouAreMe.Net, an interactive web project that provided open access to various aspects of my cyber identity to visitors, using my own face was a natural choice. Though I considered creating a fictional face, I decided that this would defeat the long-term purpose of my strategy. With facial recognition systems having the potential to access not only our public records, but also searchable information on social media, it would only be a matter of time until the face was found to be a fraud with the most likely scenario being that anyone using that face after a certain amount of time would be tagged as suspicious or perhaps even criminal. There was also the ethical concern that the face I created may inadvertently resemble an actual person who would be affected by a kind of identity fraud. Thus my face was easily accessible, attached to real world data, and ethically speaking, it was the only identity I was willing to put at risk.

URME Surveillance primarily consists of two anti-surveillance devices, each using my face as its primary material: the URME Surveillance Identity Prosthetic, and the URME Paper Mask. The prosthetic came first conceptually, and based on the criteria used in analyzing Blas and Harvey's work, is the more successful of the two. The prosthetic is a photo-realistic, hard resin, 3d printed rendering of my face made by my partners at ThatsMyFace.com, a company with a proprietary technology that enables them to first create a 3d model of a person's face from a single image, and then print that face as a wearable mask.

Unlike other options such as latex prosthetics, the photo realism doesn't come from air brushing over the prosthetic, but rather the color is injected directly into the material, like an ink-jet print. This results in the inside of the prosthetic, or the side of that touches the wearer's face, having all the photo-realistic features found on the outside, creating the illusion that one is putting on another person's skin when wearing the device. While the prosthetic has boundaries, such as the top of the brow, side of the face, and the under part of the chin, that are detectable to the human eye upon inspection, normally expected elements such as hair, a scarf or a hat, dramatically increase its ability to pass undetected in a crowd of people. In addition, because most surveillance cameras operate at a significantly lower resolution than the human eye, the prosthetic blends seamlessly to all but HD cameras. This is important because up until now we have ignored the human element, such as a security officer, in surveillance systems. Though both Blas and Harvey's work thwart facial recognition, they offer little to prevent a human from tracking the user from camera to camera, a task easily accomplished on a network such as Chicago's Virtual Shield. The conspicuous nature of their aesthetics- pink blob, and futuristic warrior paint- as with the majority of other strategies discusse, make it easy for a human to spot on a monitor, even on low-resolution cameras.

The URME prosthetic turns the weaknesses of these low resolution cameras into one of the project's strengths. As mentioned above, the lower the resolution of the camera the higher the chance the prosthetic has to pass undetected to a human watching a monitor because the edges appear to blend seamlessly into the rest of the face. In contrast, on higher resolution systems those edges may be more visible to the human eye due to the larger amount of visual information available. Thus there is a direct correlation between low image resolution cameras, which most surveillance systems use, and the prosthetic's ability to "pass" as a real face on a set of surveillance monitors. In this way, a security officer or other human element will continue to track the prosthetic with conviction, believing that they are in fact seeing the person presented to them on camera, "Leo Selvaggio". Furthermore, as *URME*'s strategy is not to hide but rather substitute, it is simultaneously important that the camera recognize an identifiable face. The prosthetic was designed with all the same features that trigger facial recognition and so cameras detect it immediately as a face. In other words, the prosthetic works on two levels as a kind of recognition/misrecognition duality. The camera recognizes a face while the human does not recognize the face as a prosthetic. In this way, the URME Surveillance Identity Prosthetic falsifies the documentation created by surveillance convincingly, thus subverting a system into attributing the user's actions as my own

Proof of this has already occurred on a rather large surveillance system known as Facebook photo-tagging. As previously mentioned, Facebook has invested in some of the most sophisticated facial recognition software anywhere in private sector. While several of the images on Facebook are not convincing to the human eye due to the extremely high resolution photographs, the system still successfully and automatically tags all new images of the prosthetic and its users as me.

However, as with all projects, the prosthetic is not free of problems. The first and most obvious concern is the rigidity of the resin. Its lack of flexibility does not allow for the emulation of facial expression the way some high-end latex prosthetics do. This is further compounded by its muffling of the human voice due again to the fact that the mouth does not move. Thus, any direct interaction with a human, will lead to immediate detection of the prosthetic which limits the contexts in which the prosthetic is viable.

The rigidity also presents another problem. Because the prosthetic is a 3d rendering of my face, it has its own unique set of contours and variables, such as the depth of my eye-sockets, or width of my chin. As such, not everyone is genetically compatible with it. For example, it has been known to cause injury in some by digging into the eyes of the wearer whose eyes protrude farther than own. Yet on others, it fits flawlessly. I have had successful and unsuccessful fittings on members of various races, ethnicities, and both genders. That being said, differences in skin pigmentation can present a problem. While the addition of scarves and gloves can help, their use in certain climates would draw suspicion. A atex prosthetic would correct several of these physical limitations, however the need for the prosthetic to be as democratic as possible outweighed the advantages latex would provide. The average price of a custom, Hollywood-grade latex mask is anywhere from eight to twelve hundred dollars each. The URME Surveillance Identity Prosthetic can be purchased directly from ThatsMyFace.com for two-hundred dollars. Because it is considerably less expensive than the alternatives to make, it has the potential to be more widely used. When compared to the availability of makeup in Harvey's work however, the prosthetic is still an economically privileged device, only available to those with a certain amount of disposable income.

This fact led me to the creation of a second URME device in the form of an economical paper mask. The URME Paper Mask takes the form of a DIY kit that I have manufactured. By having the buyer make the mask, the initial costs go down significantly. They are also light and very inexpensive to ship. Furthermore because they are flat

they are extremely portable. The total cost spent to make each kit, which includes the price of ink, cardstock paper, mask fastners, and bubble mailer, comes out to a little under a $1.00, which is also the price it will sell for. All URME devices are sold at cost to maximize potential use by the public.

However, like the prosthetic, the mask suffers from several problems as well. First, though it will identify the wearer as me via facial recognition, it is not passable to human eye. In order to acknowledge this flaw, I shifted the proposed purpose of the masks into a device used by those who may want a low level of protection but are comfortable asserting themselves in public space, such as in Blas and Harvey's work. When sold in packages of 12 or 24, the paper masks have been rebranded as Community Development Hacktivist Kits. Rather than try and pass inconspicuously, the goal of these kits are to make a strong unified statement about the group's right to assert itself in public space. The kits also are quite apt at producing a sense of spectacle. Photographed for the first time in downtown Chicago, the small group of 10 volunteers wearing these masks drew crowds, stares, and cameras. People were interested by this strange phenomena taking place on the street: a cluster of pedestrians all wearing the same face. The interest of the people I talked to while photographing this spectacle led me to produce other work in public, such as conducting workshops and guided walks with the paper masks. The utility of the paper mask has shifted the original goals of URME Surveillance to include civic engagement in public spaces.

While developing this project, it became clear that there were also several sociological and ethical concerns that needed to be examined. Foremost amongst these is that the URME Surveillance is asking others to present themselves in public as a White man within the context of a surveillance culture. This of course brings about questions of race, gender expression, and nationalism to name a few What does it mean to ask a Latin immigrant male to present as a Caucasian man, or a Black woman to do the same? What would it mean to any Transgender individual to become me? In addition to these questions of identity, there are also questions about the historical use of surveillance as a component of institutional racism in the form of pervasive profiling, disproportionate incarceration of non-White citizens, and the suppression of cultural and political expression in public spaces.

Though it is beyond the scope of this paper to properly survey the entanglement of racial and gender politics within surveillance practice, the most important conversation that URME Surveillance can contribute to, even more than the right to privacy, is discussion of white male privilege in public space. URME Surveillance asserts the utopian ideal that everyone could and should benefit from the same privilege that White men do, which is to simply be themselves and valued for it despite their behavior, criminal or otherwise.

The URME Surveillance Prosthetic, if undetected, allows for an individual to temporarily experience and consequently perform White male privilege in public space, while at the same time drawing attention to the very nature of privilege as a component of a patriarchal power structure that excludes the majority of Americans. It is not the goal of URME Surveillance to transform everyone into White men. I reject that notion of milky homogenization. However, by engaging the idea that white male privilege could somehow be shared and distributed to others, then as a metaphor, URME Surveillance has the potential to become a platform to examine questions of race, class, nationality, gender, sexual orientation and expression, and other factors that circumscribe our freedoms in public space.

Surveillance is a system based on fear that offers us the illusion of safety by sacrificing freedom. The source of this fear comes from the very questions stated above. That fear has lead us to build an architecture of prejudice that acts against the democratic ideals of the United States. This power structure prejudices women, prejudices minorities, and prejudices the lower class and old age. It fears Arab Americans post 9-11 and Mexican immigrants at the border the same way we once feared the Japanese we interned. Surveillance in a product of an American culture that fears Black people who shop and only finds safety in Whiteness. Want to be invisible to surveillance? Be a White man in a suite. No prosthetic needed. What is at stake is nothing short of our freedom to express and explore the very nature of our individual identities. The *URME Surveillance Identity Prosthetic* may never allow the user to be who they really are in public space, but neither does the current state of Surveillance. We are fundamentally changed when we are watched. We perform prescribed acceptable versions of ourselves rather than simply be. So be me instead. URME.

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[Session 12]

GeoPolitics and Activism

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An Aesthetic Reading of Online Artivist Projects

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Abstract

This article is an essay for a theoretical reading of the contemporary online contents in light of the contemporary aesthetic theories. It focuses on online *artivist* productions and website projects which are related to the resistance movement in Turkey, just before, during and after the Gezi movement period (June 2013). This paper tries to analyze some of the online projects and to discover creative aspects and new trends in internet aesthetics. It also observes participatory quality of online artivist projects and common language in those projects.

Keywords

Artivisim, net art, activism, occupy movements, Gezi, language, information age, and aesthetic experience.

Introduction

Our research aims to establish a theoretical reading of the contemporary online contents in light of the contemporary aesthetic theories. We focus on online *artivist* productions and website projects as contemporary online contents, which are related to resistance movements since 2008 (the great recession) to 2014.

There is a wide range of aesthetic theories in the literature. In our text we will ground on the 'aesthetic experience' notion as it provides us a revisited understanding of aesthetics, arts and their relationship to daily life. According to Dewey, the experience plays an important role in artistic creation. The fundamental element of the process of artistic expression is no longer the material work of art but rather the development of an experience. For Dewey, there is also an aesthetic aspect in 'non-aesthetic' productions and relations. An aesthetic experience cannot be held separate from everyday life experiences and the purpose of the aesthetics is to ensure the continuity between the refined art experience and daily life experience. [1] For Rancière an aesthetic experience is "a reconfiguration of the forms of visibility and intelligibility of artistic practice and its reception." [2] An artwork is "given in a specific experience, which suspends the ordinary connections, not only between appearance and reality, but also between form and matter, activity and passivity, understanding and sensibility." [3] Dewey's and Rancière's writings give us a new perspective on the relation between daily life, aesthetics and art; and enable us to reestablish this relation in today's productions. We also aim to investigate what these artistic and 'non artistic' productions tell about our political and social spaces and lives, as well as our intellectual practices.

This research also investigates the notion of language in online activist artists; training and uses of language as an artistic material and as a message. In our work, we investigate the language as a tool (material) and as a message. Computer codes, acts of hacking or electronic sit-ins represent altogether the material; whereas the written content or shared images represent the message. Our work proposes a comparative approach between different web projects that include pieces recognized as artworks and also popular projects on online social networks. We construct our theoretical reading in three main sections. First, we will analyze the political and social background. Then, we will identify contemporary *artivist* projects (from Turkey). Finally, we will explore the online content producers and their organization behind the projects.

Social and Political Background

We have been witnessing a transformation from industrial to post-industrial society: the change of societal organization as a result of subordination of the materials (raw materials, machinery) to intangibles (knowledge and information). Developments in digital technology have brought a significant change especially in the field of communication and media, but also in professional and social life. Before then, the communication paradigm was "one-to-many"; after the (r)evolution of the media this paradigm has been replaced by "many-to-many". This change refers to the passage from a mass society to a networked society. [4] Although there are still regional inequalities to access to new technologies and to new media content; the 'new medias' are altering the sense of geographical distance, increasing the communication volume, allowing numerous channels for the flow of information, providing an opportunity to increase communication speed and for interactive communication, and finally maintaining the possibility to ensure interconnection between the different forms of communication. [5]

Along with those changes in economic and sociocultural production there have been riots in several countries in the world. The causes and consequences of those riots are differentiated by countries but there are unignorable similarities that we are interested to discover: the resistance movements built a new language and created intelli-

gent and ironic web projects which are related to creative productions on the streets. We affirm that those web projects and online productions offer us aesthetic experiences in Rancière's and Dewey's terms.

The Projects

In the 1990s in Europe, especially in Eastern Europe and Italy, we encounter activist artistic projects which interrogate notions of information, reality, and perception. These projects were influenced mainly by the writings of William S. Burroughs and Hakim Bey on the media and the manipulation of information. [6] Both authors proposed to 'hack' Medias (tools of communication). Hacktivists created pirate radios and TVs, fanzines, fake personalities, etc. We realize that similar projects appeared in Turkey within the period since the second part of the 2000s to 2014, densely just before, during and after the Gezi movement period (June 2013).

We also observe blending of 'virtual life' and 'real life' experiences, transitions between the streets and the internet. It might be necessary to mention that the relationship between the streets and the internet is a question of power struggle; here we refer to Henri Lefebvre to understand this conflict, the characters of those two spaces and their importance in the resistance movements. [7] Both the streets and the internet are social spaces and they are subject to the social movements as social products, where we may observe control, domination, and power struggles between the people and the political authority. Two remarkable examples of the transition from the Gezi movement: Standing Man and Rainbow Stairs were civil disobedience acts which are reproduced afterwards in several cities, and images from all over the country had been circulated on the internet.

Hoax News Websites

One of the projects that we observe is hoax news website *Zaytung*. *Zaytung* questions the 'realities' of everyday life and politics. It interrogates the media's attitude in disinformation and also truthfulness of the news broadcasted by mass media organs. We also observe similar websites in other countries: The Onion (USA), Le Gorafi (France), News That Matters Not (India), El Koshary Today (Egypt), etc. [8]

We examined that in the hoax news websites; articles are about current events, politics and politicians, but also the lifestyle which is presented as *American Dream* for the middle class workers, especially for whom working in *Bullshit Jobs* (referring to the jobs in the service sector which do not lead to a real production) in Graeber's words. [9] Visually hoax news websites look like the websites of the 'real' newspapers; they also have weekly magazines where the authors criticize the content of such magazines. For example in the mass media, we usually notice articles entitled "Where to eat this weekend?" That's how they make publicity of the restaurants, and also a specific way of life, amazing holidays, etc. The hoax news websites transform or *detourne* those articles with humor, as International Situationists would do. [10] For example, in the satirical newspaper article, the writer claims to be invited to a student's place in the weekend, and writes that there was only pasta to eat in order to underline the reality in contrast to the constructed image by the mass media. They also prefer to use the mass media's language, to mock, as it was an article in *The Wall Street Journal* or *Le Monde.*

We claim that their production can be seen as awakeners, the content offers us a moment of alienation (a disruption point) in Brechtian way (*distancing effect* or *estrangement effect*). We may read their work by Dadaists' claim: "*Art, should not be an escape from daily events, but should instead make visible the violence, chaos and hypocrisies of contemporary life.*" As Hugo Ball also says: "*For us, art is not an end in itself [...] but it is an opportunity for true perception and criticism of the time we live in.*".

Fake Personalities

Especially in 1990s fake personality phenomenon was common: *Luther Blissett, Darko Maver* (one of the projects of 0100101110101101.org), *Harry Kipper* were already known with their mystified histories. *Yes Men* of RTMark is also one of the well-known examples of spoof characters: Two activists, Jacques Servin and Igor Vamos (alias Andy Bichlbaum and Mike Bonanno) who mock liberalism and criticize the liberal economic system satirically by making presentations on behalf of the World Trade Organization (WTO) and in the name of Dow Chemicals (widely protested multinational company of chemicals). *Yes Men* built fake sites that gather the originals (the one for G.W. Bush is no more available, but the fake WTO website is still accessible). *Yes Men* also distributed fake copies of New York Times with the title "War in Iraq is over" in 2008. In their projects, we observe a criticism of the political and economical system but also the media and the information sources of the society. Obviously they were not the first who created fake personalities or fake satirical newspapers; here we should mention Mark Twain's satirical newspaper articles and Orson Welles' film *F for Fake* and his radio show *War of the Worlds*.

In Turkey, a fake personality was created as *Şafak Başgan* following the Gezi movement (affected summer of 2013). During local elections in March 2014, there was a candidate named *Şafak Başgan* who lead an alternative campaign by creating a satirical personality, especially using the social media, Facebook and Twitter. [11] His Facebook page got 10720 likes and he has 5600 followers on Twitter (May 2015). His project was born as a reaction to gentrification politics of the city of Istanbul and the *crazy projects* of the Turkish government. [12] (Figure 1)

His campaign's visuals, videos and language are worth to analyze because again we can read those materials as *awakeners* and *détournements*. His campaign was criticizing political scene, existing parties, and neoliberal politics applied by the government and the mayor of Istanbul. His campaign was claiming that none of the candidates (includ-

ing the opposition) are worth to vote for. Some people were not supporting his choice of mocking political scene, but his campaign forced people to think about it.

Figure 1. On the left, Safak Basgan "Vision 1963: We will take Istanbul back to 60s!" On the right, ex PM Erdogan "Vision 2023, Turkey is Ready!" (2023 is the 100th anniversary of Turkish Republic)

Hacking – Code Writing

Hacking is also another example of aesthetic experience as a performance and also as a creative act. In Turkey, we observe electronic sit-ins like the *Electronic Disturbance Theater*'s performances especially when the society was discussing the new internet law and censorship in 2011. *RedHack* (*Anonymous* like hacker group, active since 2005) took down some governmental websites and leaked information in several operations. A virtual protest was also organized via Google Maps which gathered thousands of people at Taksim square on Google Maps. [13] (Figure 2)

Figure 2. Protest on Google Maps, 25 January 2010.

Figure 3. RedHack's hack on public buses, Istanbul, 2013.

In 2013, during the Gezi resistance, RedHack hacked the screens inside the public transport services (public buses in Istanbul), to say that the resistance will continue as they wrote "Durak yok, yola devam" which means "No station, keep going on" where it should be written "will stop in the next station". This was a clear allusion to the slogan of the government party (AKP) "Don't Stop, Keep Going On!". (Figure 3)

Photoshopped Posters and *Caps/Memes*

We've noticed *photoshopped* posters and captures as well. Due to the 2.0 version of internet and the simplification of interfaces, computer and internet users had the possibility to create or manipulate images. As a simple internet user, anybody has an access to huge amount of data to use to reproduce, to manipulate; and these users also have possibility to diffuse their productions online. (Figure 4)

Bobiler is an alternative online platform where the users may share the *caps*, videos, or images they created or manipulated. As we already mentioned for other projects, in this website and those productions we may observe a common language as well. [14] Here we analyze the *Bobiler* community and we realized that even if such platform

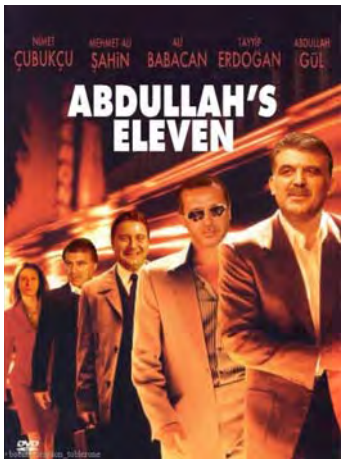

Figure 4. A *photoshopped* (manipulated) movie poster

does not exist in other countries, the practice of photoshopped images and caps/memes was observed. (Figure 5)

Those productions are driving us to reconsider our daily and political lives, with a sense of humor and intelligence. Depending their qualities, they attract much or less attention.

Who produces those projects?

Content producers are observed to be generally between 20 and 30 years old young students or workers in several examples according to our interviews with the initiators. We see that those who filled the streets intersect at a very large proportion with those who produce and consume on the internet. The youngsters bring a dynamic aspect and perpetuity to the movements and to the online projects.

The production process is collective and participative. In general, these projects are the products of network communities composed of individuals from different social

Figure 5. A *caps(meme)*, Obama: "No, you first."

backgrounds (majorly middle-upper class, mostly leftists); with a group of editors in charge (see Zaytung, Bobiler, Ekşi Sözlük, etc.). The content creators have pseudonyms which are also part of the satirical content. In hacking activities the participants are anonymous and they also act collectively. We observe that both users and visitors are especially from the big cities, Istanbul in the first place, Ankara, and Izmir then the rest of the country; similar to the number of internet users across the country.

On collective production of the content or an action, we may refer to the notion of *social sculpture*, attributed to Beuys, it is not required being a geek, an expert or a member of an artistic community to create and share satirical texts or artistic productions. Walter Benjamin's listener participative radio idea also corresponds to the idea of collective production of individuals.

Conclusion

In this article we analyze contemporary online contents in light of the contemporary aesthetic theories. We focus on online artivist productions and website projects which are related to the resistance movement in Turkey. We discover the disruptive and creative forces of the analyzed projects, and investigate new trends in internet aesthetics, observe participatory cultures of online *artivist* projects and the importance of language in those projects. We observe that they create an aesthetic experience and an occasion for alienation both for users and visitors.

We can state that it is necessary to broaden our research to the other countries and constitute a comparative approach between these countries where different resistance or Occupy movements occurred, such as Greece, United States, Egypt and Tunisia.

Finally, as the resistance notion became a popular 'image' and 'trend', it turned into an object of consumption for different social groups. So, it will be interesting as well to question the role of the *artivist* projects in the market as new intellectual merchandises.

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Geopolitical Subjectivity

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Abstract

Rhetorics conceived in geopolitically powerful contexts fail in allowing for the different relationships between art and politics that appear in the periphery. This paper analyzes this from a framework of cognitive capitalism. We identify a need for a sociopolitical vocabulary in new media art rhetoric that takes into account the geopolitical context. By reproducing the center–periphery model, peripheral art is reduced to a dichotomy proper of the modernizing discourse and to the arduous task of developing a replacement of the stories that constitute "the other". Nevertheless, we argue that it is possible to assert the existence of both a distinct reality and the parallel construction of a language that transcends the re-reading of international tendencies from a local or "localist" perspective.

Keywords

New media, new media art, aesthetics, geopolitics, politics.

Introduction

Politics is aesthetics in that it makes visible what had been excluded from a perceptual field, and that it makes audible what had been inaudible.

Jacques Rancière, 2004

In order to analyze a cultural phenomenon it is needed to take into consideration its historical, social, and political contexts. However, art's relationship with politics is extremely complex and admits a wide plurality of views.

Rancière's quote casts a first conceptual light onto this relationship: there is an immanent artistic characteristic in politics, for its verbalization of societal processes is inherent aesthetic. Coherently, Luis Camnitzer argues that the Tupamaros – the 1970's leftist Uruguayan guerilla movement – embodies Latin American conceptualism's most authentic and relevant artwork. According to Camnitzer's argument, there is an undeniable aesthetic quality in, for example, the Tupamaros's military actions, such as the *Toma de Pando*[1].

The sociopolitical context has always been a "central aspect" of artistic production, although it "long remained inconspicuous, or even invisible". According to Friesinger, "It took the great exertions of the context-oriented methods of modernism to return it to the field of view, from which it was hidden, for the most part, by the tendency of bourgeois art appreciation to oversee the social and historical embeddedness of an artifact or an aesthetic approach."[10] It is not, still, until the avant-gardes, that appears what Peter Bürger calls "a new art-based praxis for life", a reaction to the identification of art being the objectification of the self-understanding of the bourgeoisie [4].

Even if we assume the immanence of the political context in art production, the characteristic of this relationship is still unspecified. Kenning argues that art betrays itself if it is too direct in its opinion, especially in its political opinion, while Rancière states that "an art is emancipated and emancipating when it renounces the authority of the imposed message, the target audience, and the univocal mode of explicating the world, when, in other words, it stops wanting to emancipate us." [15]

As Steve Klee notes, this discussion on the ambiguity of art does not include explicitly political art in what constitutes an unforgivable reductionist blindness: "If all art that incorporates clear political slogans and demands is dismissed as authoritarian because of its univocality then we will misrecognize those moments when these slogans actually introduce ambiguity into the social by forcing a split in the distribution of the sensible." [15]

This blindness is not explained by, but resonates with the hegemonic centrism of the art discourse analysis. Political art seems to be more common and more easily co-opted by the peripheral artworld.

Coincidentally, Buckley argues that "as a political mode of knowledge, art is powerful precisely for the ways in which it can disarticulate those received or existing forms of political and disciplinary subjectivities (that which Rancière has called the 'regimes of perception')." [3]

Furthermore, the dismissal of political art neglects activism. The militant practice of artists who reclaim certain media, languages, processes, or contexts as their

[1] An episode framed in the Tupamaros's guerrilla warfare in the 1960s. On October 8, 1969, several members of the Tupamaros took by assault the police station, fire station, the telephone exchange and several banks in the city of Pando, 32 kilometers from Uruguay's capital city, Montevideo.

own. Activist art has played a significant role in creating appropriation techniques and in creating and enabling spaces that, in subsequent stages, permitted artistic appropriation.

New media art, in particular, offers a tremendously rich and effective field for activist art. The somewhat recently coined term *hacktivism* stands for the blending of conceptually subversive new media ("hacking") practices and politically subversive ones.

According to Blais and Ippolito, the executable nature of new media art – in particular where mass digital media are appropriated – constitutes its differential and more powerful characteristic, since it allows for concrete, active, influence on the world.

In their own words: "Executability has given hacktivists not only an arsenal of new tools but a much wider arena in which to exercise these new powers. Because computers are now linked via a global network, code that affects a single operating system can be redirected to execute on computers around the world. No longer confined to the sanctuaries of gallery and museum, digital work has been executed in government-agency databases, in corporate Web ad banners, and on the hard drives of private citizens."[2] However, art, activism, or "hacktivism", by no means emerged with digitality. As Neumark affirms, speaking about Fluxus's Mail Art: "They not only expanded the boundaries of art, media, and communication, they defi(n)ed them. They traveled not as vehicles, but as meaningful cultural and artistic objects, while shifting the meanings of culture, communication, and art objects in their journeys. The journeys of Mail Art marked a particular configuration of geography and social, economic, and cultural relations; they contributed to a remapping of the relation between art and everyday life." [7]

This early example of media appropriation showcases the re-configuration that political art may provide: an informed, critic dialogue with the sociopolitical context of the art practice's cultural artifacts and societal inscription. Such dialogs are transversal to the specifics of the art practices, or, as Matthew Fuller puts it, the specific "art methodology" [11].

The need for context analysis is rooted in the intrinsic dialectical nature of art. In effect, all art is political, for, as Ricœur notes, "praxis incorporates an ideological layer; this layer may become distorted, but it is a component of praxis itself." [11]

Even if every art production undeniably entails an ideological standing, we do not pose that there are no differences between political and apolitical art, or, we could say, between explicitly and implicitly political arts. A parallel can be traced with interaction: even if every artwork can be deemed interactive, there is a distinctive aesthetic quality in interactive art that should not be left unconsidered.

It is, however, necessary to broaden our scope and discuss some concepts that allow us to introduce some political notions into our new media art analysis discourse. We identify a need for a sociopolitical vocabulary in art's (and very especially new media art's) rhetoric.

General Intellect and Cognitive Capitalism

A useful model to start tackling the dialectal relationship between art and context is provided by the concept of "general intellect"[2], first presented in Marx's Grundrisse in a section entitled 'Fragment on Machines' (written 1857–8, first published 1939) [16].

The general intellect describes an increasing involvement and relevance of the human knowledge in the work process, and the understanding that "wealth is no longer the immediate work of the individual, but a general productivity of the social body that utilizes both workers and technologies". [16] The notion of general intellect makes available a political understanding of aesthetics, language, and society by addressing that information – embodied in technical expertise and social knowledge – became a crucial force of production.

Ultimately, the general intellect "is a measure or description of 'how general social knowledge becomes a direct force of production'." [11]

In Paolo Virno's terms, the general intellect is the linguistic cognitive faculties common to the species, which constitutes a new kind of richness: *cognitive wealth* [27].

This cognitive wealth is not synonym with dematerialization. Even, if as Lazzaratto notes, "Immaterial labor finds itself at the crossroads (or rather, it is the interface) of a new relationship between production and consumption. The activation, both of productive cooperation and of the social relationship with the consumer, is materialized within and by the process of communication." [18] It can be understood that "capitalism informational economies tend to involve more materialization and commodification of knowledge and, contra the thesis of dematerialization, increased consumption of what is classically termed as matter (oil, paper, aluminum, heavy metals and plastics)." [13]

General intellect, as a model, leads to the analysis of art's role as a means of knowledge production, that is, wealth creation, and the dialectal relationship that this has with said artistic processes.

The operation of the general intellect within the society is aptly seen via the thesis of cognitive capitalism. Indeed, since the crisis of Fordism, capitalism has seen the more and more central role that knowledge plays, and the rise of the cognitive dimensions of labor.

As Vercellone notes, "this is not to say that the centrality of knowledge to capitalism is new per se. Rather, the question we must ask is to what extent we can speak of a new role for knowledge and, more importantly, its

[2] Although there are related concepts, such as Spinoza's "Common Notion", or social brain, the General Intellect proves to be especially apt, if only thanks to its framing within Marxism and capitalism theory.

relationship with transformations in the capital/labor relation." [26]

Cognitive capitalism differs from traditional capitalism in that – as Talankin once said in order to attack Vygotski – it "virtualizes" the concept of tool or that of labor, and allows for mental factors such as culture to be determinations, rather than strict economic factors. [29]

It is indeed striking how Marx's works and contributions still apply after the crisis of Fordism and Taylorism. In the cognitive capitalism, the valorization of knowledge leads to a new form of capitalism; this valorization operates with knowledge not as a common good, a human acquis, and instead treats it as commodity, as an article of trade or commerce.

Cognitive capitalism is, then, a new stage of capitalism after industrial capitalism, which does not have to rely on the affluence of digital technologies, but, instead, relies on the creation of knowledge and on the economic return of the cognitive dimension of work.

This new stage is built upon a crisis of the labor theory of value. Effectively, the labor theory of value shows how – in the industrial capitalism – the capital appropriated the production and abstracts itself from labor. Labor is operated by the capital in such ways that allow for its commoditization. Thus, division of labor and serialization are instrumented, permitting to measure labor in simple unqualified work units.

In cognitive capitalism this, however, does not apply directly, as the general intellect adopts a "diffuse intelligence" where capital does not seem to play a necessary nor defining role in its creation. Ownership of the means of production is relegated to the background and knowledge becomes central. Knowledge that transcends the expertise in operation of new technologies but instead also involves the ownership of the social processes of creation of new knowledge.

In order to satisfy capitalism's need of commoditization, *cognitive capitalism is built on artificial scarcity*. This commoditization operates on things (knowledge) that are not commodities, thus, it requires the private appropriation of knowledge.

This artificial scarcity is created by fencing knowledge. This way, knowledge is not set free in the society but, instead, is bounded by intellectual property laws, patents, and secrecy policies that keep it in the private sphere.

It is particularly interesting the role that tertiary education (which is based on public funding) plays in cognitive capitalism. Universities educate cognitive workers to operate in the private sector, applying their education on the creation of value that stays within the companies and does not return to society.

There is an underlying scission between what is *public* and what is *common*. Artificial means of scarcity divide them and prevent knowledge to be set as part of the common; instead, cognitive value returns to the society as the result of a choreographed production, as knowledge–artifacts and not as knowledge (in Flusser terms: applied scientific text). In this way, knowledge remains in the Marxian reign of need without being able to reach the reign of liberty.

New media art and politics

> *Pop culture and the mass media are subject to the production, reproduction and transformation of hegemony through the institution of civil society which cover the areas of cultural production and consumption. Hegemony operates culturally and ideologically through the institutions of civil society which characterizes mature liberal–democratic, capitalist societies. These institutions include education, the family, the church, the mass media, popular culture, etc.*
>
> Dominic Strinati, 1995. [25]

As we mentioned, new media art's potential executability has allowed for hacktivism strategies that foster the perennial dialogue between art and politics.

Art is intrinsically deregulatory: it exists – or may exist – on its own epistemological framework, or, we could instead say, on its own ontological universe. However, new media art's relationship with technology situates it on a peculiar situation, with a unique position to reflect on contemporary political issues.

The interplay between art and the political significance of its materiality is not new. The Italian Arte Povera, for example, was "seen by some as radically political in the late 1960s", as a direct result of their use of *poor materials*, which "opposed not only the industrial aesthetic of American pop and minimalism, but also all forms of systematic, and hence authoritarian, thinking, celebrating instead individual, lived experience through a 'new humanism'" [14].

As well as the political quality of Arte Povera resides on, or emerges from, the relationship with the material substratum, new media art's media appropriation carries a political art discourse.

If we are to discuss new media art's *politicality*, it is necessary to consider the politics of the appropriation process and not only the specific artistic activities (or methodologies) that this appropriation enables. In this way, while tempting, the discourse of executability or the analysis of affordability, should be postponed.

As Christiane Paul states, "art has always employed and critically examined the technology of its time" [21]. However it is new media art's appropriation what distinguishes it as a genre [17].

It is no accident that new media art co-exists with cognitive capitalism: both are result of the valorization of knowledge. What capitalism does in terms of commoditization, art does in terms of re-definition and re-edition of its own praxis, and it is in this duality where the dialectal relationship new media art–politics exists: in the orthogonal (if not antagonistic) approaches to knowledge creation and societal administration.

In this analysis it becomes necessary to understand that cognitive capitalism's relation with knowledge is not emergent but politically designed, and in this environment the art practice exists and is adopted and co–opted.

New media art's systematic appropriation – that we call media appropriation – [17], though, is intrinsically and unavoidably political, for it undermines the basic underlying process of cognitive capitalism. It is more probable that it is this ontological antagonism what lies behind new media artworks having "gradually formed a common practice whose objectives allude to utopian theories of social organization lying closer to certain visions of communism, direct democracy and anarchism, rather than to the realities of neoliberal capitalism within which new media are produced and predominantly operate" [24], instead of previous discourses of mere opportunity, exposure, and scope.

Perceptual capitalism

New media art often proposes a systematic logic of dematerialization, as a natural result of the immanence of the digital. Accordingly, a relatively recent term has come into use in the analysis of digital artistic practice: post-digital [6]; although loosely defined, it makes explicit the pervasiveness of the digital realm into cultural production, and effectively states that its omnipresence implies a qualitative change of both the production and its consumption: its appreciation, valuation, and eventual conversion into economic goods no longer depends on, or is related to, its digital quality.

This is often seen as a move towards a more human-centered evaluation of culture, which is, by no means, a requisite, and therefore, a naïve reduction. Instead, post-digital refers to the standardization of the digital in all the aspects of human culture, rendering its digital quality meaningless if considered separately from other values, aesthetical, social, or functional.

This immanence of the digital reminds us of the triumph of capitalism. Žižek recounts an anecdote where an editor asks a journalist (Marco Cicala) to replace "capitalism" with a synonym, like "economy" [30]. This rendering of capitalism as not only the ultimate, but also the *only* socio-political and economic arrangement of society attempts to remove from the framework of analysis the very components of capitalism. *It attempts to establish a post-capitalist discourse.*

We need to be aware of the ubiquity described by these two "posts", while focusing on (at least some of) the implicit socio-political discourses that these hegemonies carry.

Geopolitical subjectivity

The digital revolution is over.

Nicholas Negroponte, 1998. [6]

However prevalent the forces of globalization are, the automatic translation of centrally[3] conceived models, interpretations, and practices, constitutes an eminently political act. Besides the linear acknowledgement of a debatable necessity of historical and context rooting, the construction of a centrally conceived rhetoric is never innocuous.

Postcolonial theory has traditionally recognized the center–periphery asymmetries in the construction of knowledge, with an explicit intention of reclaiming histories that have been neglected by dominant historical narratives. However, postcolonial studies "have been notoriously absent from electronic media theory, and criticism", being somewhat stuck in an inebriated recognition of "the potential of new technology". [9]

New media art, meanwhile, poses again a rather unique perspective within the arts for its inherent technical requirements locates it on an axis of usefulness usually alien to the art discourse. Especially when, according to Raunig, activist practices are allowed only if they are "purged of their radical aspects, appropriated and coopted into the machines of the spectacle." This becomes apparent in "mainstream media, which invariably reproduce only two patterns in reference to insurrection: the mantle of silence or the spectacularizing and scandalizing of protest." [23]

Where the real world changes into simple images, the simple images become real beings and effective motivations of hypnotic behavior. The spectacle, as a tendency to make one see the world by means of various specialized mediations (it can no longer be grasped directly), naturally finds vision to be the privileged human sense which the sense of touch was for other epochs; the most abstract, the most mystifiable sense corresponds to the generalized abstraction of present–day society.

Guy Debord, 1977. [8]

It is under this framework that the need of a geopolitical view of new media art appears. As Garcia Canclini notes, geopolitics refers to large global structures and implies cultural or symbolic power in knowledge practices. It is then a problematic field, a descriptive tool that incorporates a certain asepsis product of its own conscience [12]. Geopolitics can be seen as a tool for uncertainty, as an admission of the Kantian nature of models.

Nevertheless, this pretense for asepsis should not be understood as lack of involvement, for our conceptualization is one of resistance. As Lazzarato states, "to say no is the minimum form of resistance". Our resistance

[3] Central, as opposed to peripheral, originating in the core countries. Anew, within world systems, dependency, and post-colonial theories.

must open a creative process, a process of transformation, of active participation. [19]

The very first "no" that we must say, our first form of resistance, consists on acknowledging that the artistic historical narrative of media arts and its analysis of context interrelation is constructed from within a central perspective. Even the general intellect, as introduced, does not allow for a characterization of the geographical distribution of the social worker, nor it reflects on the implications of such distribution and the relation with the centers of power.

New media art in the periphery cannot be apolitical, for the very appropriation of technology is a political event: *it implies surrendering to an applied scientific text that has been written in the center*.

As art history is written in, from, and for the cultural centers, the characteristics of peripheral art in general, and peripheral new media art in particular have not been analyzed or, at best, have been inscribed on a centrally conceptualized narrative, carrier of colonialist granting of meaning. A narrative that fails, for example, to understand how political art naturally and systematically appears in the periphery (very specifically in Latin America) without creating much (or any) of the ontological tensions that appear in central narratives due the lack of ambiguity.

Camnitzer, in his book "Conceptualism in Latin American Art: Didactics of Liberation" proposes "conceptualism" as the original process of conceptual and political art [5].

Latin American conceptualism composes an original artistic movement that appeared and expressed itself with its own language, in parallel to central artistic processes.

Yet, as Camnitzer shrewdly points out, "art history is written in the cultural centers" and so, any difference between conceptual art and conceptualism has not been analyzed.

Artistic discourses that emerge outside of the cultural centers of the world, according to Camnitzer, have their own roots and its understanding requires an appropriate historical framework. However, the label "Latin American conceptualism" clearly is "a concession to the hegemonic taxonomy" [5].

In this paper, we do not aim at discussing, or finding, the artistic languages that emerge from the geopolitical periphery, but we rather work in understanding that the sociopolitical and economical contexts always play a defining role in the construction of the (commodifiable) knowledge, the worldview.

If new media art is always conceptual, [17] then the sociopolitical dimension adopts a very particular role. It is in new media art's relationship with technology where we are to focus; not in the construction of a "purely artistic" language, but in the differencing components of new media art. If we identify media appropriation as the defining path of new media art, and explicitation as it's most transversal aesthetic quality, [17] which differences in them appear in the periphery, specifically, in Latin America? Or, what conceptualist new media art entails?

By reproducing the center–periphery model, Latin American art is reduced to a dichotomy proper of the modernizing discourse and to the arduous task of developing a replacement of these peripheral stories that constitute "the other".

We should reflect on whether the idea of "Latin American art" responds to specific contexts where each region contributes from their cultural and symbolic horizons, or if it is structured according a universal reference frame that contains the concepts of modernity, avant-garde, and progress [22].

Nevertheless, we argue that it is possible to assert the existence of both a distinct reality and the parallel construction of a language that transcends, at least in some cases, the re-reading of international tendencies from a local or "localist" perspective.

The simultaneous appearance in Latin America, of processes that restructure the relationship of art with its materiality, should not be seen as a prefiguration (nor re-edition) of the Italian Arte Povera but, instead, as a genuine instrument for probing reality and for the construction of an autonomous poetic.

In this context we can talk about Latin American conceptualism as a *strategy* instead of a *style*. Even if the style is influenced by the center, the periphery historically has not cared about stylistic nuances and produced conceptualist strategies that focused on communication [22] [5].

In analyzing peripheral new media art, it becomes essential to understand how it calls into question an *arrangement of power* constructed from a hegemonic canon centered on Europe and the USA, that operates as an articulatory axis for interpretation. Specifically, an axis that has to prevent us from the perennial risk of exoticism, a risk always present in centrally constructed art narratives.

Media appropriation in the periphery

We are annoyingly citing facts of the same species, and doing by imitation what others did in ignorance, to prove that we have studied the lesson.
Imitate originality, as you imitate everything.

Simón Rodríguez, 1828. [5]

In the periphery, with its contextual conditioning, the *necessity* for originality seems evident. In Simón Rodríguez terms, "we invent or we are mistaken".

From the assumption of the need of a peripheral new media art constructed from a non-hegemonic discourse we can state that the traversing of the axis technology consumer–technology producer cannot be performed in the same way that it occurs in the center, for the rela-

tionship with technology and its societal inscription are radically different.

Arte Povera proposed the liberation that arises from renunciation, stating – among other things – that art can (re) emerge from a tabula rasa of materiality. Similarly, conceptual art appropriated the meaning and use of tools, of apparatuses produced by technology.

Both strategies implemented an appropriation of the *poetic dimension* of these apparatuses; however, they did not appropriate their *technological dimension*, technology is taken as contextual, as something given. It appears for art to reinterpret, remix, and adopt it.

New media art proposes this technological dimension as part of the sensible, it inscribes the reason, purpose and technicality of the tools into the art practice, "fractalizing" the technology and its products: each change creates new tools and new possible changes, it systematizes serendipity.

It is natural that in a society of knowledge an art language is created from within this knowledge; therefore, it is in the differences of the relation with knowledge where a big part of the need for a peripheral, conceptualist, new media art, resides.

In fact, what is needed is a meta-appropriation: the sociopolitical appropriation of the context that would allow for original new media art, that is, *the appropriation of the processes of construction of knowledge.*

Camnitzer's aforementioned attempt to inscribe the Tupamaros's guerilla into an artistic discourse becomes, under this light, more sensible: in the periphery, the political dimension is inseparable from the conceptualist art practice.

As Chomsky stated: "'Globalization' is used within the doctrinal system to refer to a very specific form of international economic integration designed in meticulous detail by a network of closely interconnected concentrations of power: multinational corporations, financial institutions, the few powerful states with which they are closely linked, and their international economic institutions (IMF, World Bank, WTO, etc.). Not surprisingly, this form of 'globalization' is designed to serve the interests of the designers." [20]

Coherently, Thomas "argues for an approach which is far more alert to the historically specific forms which it adopted in different periods and places, as well as to the various strategies employed by colonial projects, their discursive successes and existential failures." [28]

As Alonso states, in his "praise of low tech", it is fallacious to think that only from the technical possession a critic discourse can be created. [1] What is needed is the creation of differential strategies in the relationship with technology. "Strategies", as systematization of a "problematic insertion" in the relationship with applied knowledge.

Many of such strategies are possible, from a technical postmodern Arte Povera (both as a reclaim of the low tech and as the proposal of a ground zero for the appearance of new aesthetics) to actively working on the creation of processes of meta-appropriation.

What remain fundamental are the identification of these strategies and, very especially, the understanding of the political stance that they inevitably entail.

Nicholas Negroponte is quoted saying that the Digital Revolution is over; we cannot help but hope that it is just starting.

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Scambaiters, Human Flesh Search Engine, Perverted justice, and Internet Haganah: Villains, Avengers, or Saviors on the Internet?

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Abstract

In recent years, Internet users have been increasingly participating in so called digilantes or cyber-vigilante communities, becoming self-appointed avengers of justice who wade through the Internet to hunt down unlawful netizens. These groups see the legal mechanisms for criminal punishment as ineffective and use social networks to crowd-source both the prosecution and the execution of punishment. I conducted an experimental investigation into these justice-seeking activist groups to compare the 'scambaiting' anti-fraud movement and their methods and similar web-formations like 'Perverted justice', 'Human Flesh Search Engine' and 'Internet Haganah'. Each group's motives are presented with recent examples, and parallels are drawn to similar projects carried out by journalists, artists or activists. Mass mediated prosecutions entertain popular culture and are used to regulate social norms. It was found that vigilante communities use congruent techniques in gathering intelligence and use comparable prosecution methods like shaming, humiliation, cyber bullying, or doxing. Furthermore, moral concerns of these deviant actions and possibilities of governmentality are discussed.

Keywords

Vigilante online communities, digilantism, hacktivism.

Introduction

Vigilantes are self-appointed citizens who take the law in their own hands, when law enforcement is inefficient or not present. In 17th and 18th century feudal societies, personal vengeance was exacted through duels using swords or pistols. The two opponents agreed on matching weapons and to obey certain rules. In Western cultural traditions, the vigilante has been romanticized as the dissatisfied moral avenger: Robin Hood and his fellow outlaws fight the rich and share the booty with those in need. [7] During the Gold Rush in the 19th century, vigilante committees were formed in mining communities to deal with the rising crime rates and the lack of legal institutions. [18]

Nowadays, vigilante communities are seen as community service, like the national neighborhood watch groups 'USAonwatch' or 'Guardian Angels' in the United States or the 'Ourwatch' community in the United Kingdom. Often, members of these groups have difficult relationships with the police and prefer to take justice into their own hands and deal with the criminal themselves. In California, the Minuteman project is an activist group, which uses a network of webcams to patrol the US-Mexico border and monitor the influx of illegal immigrants. It describes itself as a 'neighborhood watch' on the borders. Volunteers report undocumented immigrants and smugglers to the Border Patrol. However, there have also been cases reported, where rights of Mexican citizens have been violated by shaming and humiliating them.

In one report, Bryan Barton caught a Mexican citizen crossing the border illegally, detained him and forced him to pose with a t-shirt saying: 'Bryan Barton caught an illegal alien and all I got was this lousy T-shirt'. [4] After the incident, the Border Patrol and the Mexican Consul agreed that no crime had been committed, but the Mexican immigrant was still publicly humiliated. When the Minutemen are not patrolling the border, they erect fences along the US-Mexican border.

Since the late 70s, groups of 'Real-life Superheroes' (RLSH) patrol cities. Inspired by their fictional archetypes like Batman, Guy Fawkes-masked V or the Watchmen group, they hide their identity by wearing masks and dress up in costumes to fight crime or perform public services, just like their comic book heroes. [31] Across the globe there are more than 200 registered RLSH that can be grouped into 'social workers with capes' and 'radical activists'. [19]

With the advent of mass-mediated online communication, vigilante groups establish themselves in web forums, discussion sites and Social Media platforms to express alternative public opinions on these new frontiers of the Web 2.0. Their actions have many names, 'DIY-justice', 'e-vigilantism', 'civilian policing', 'digilantism' or 'cyber-vigilantism', but in this article I will use the most commonly used name 'Internet vigilantism'.

Although a number of studies have examined vigilante communities like the 'Scambaiters' [38, 27, 32], 'Perverted justice' [12, 14], 'Human Flesh Search Engine' [37, 8] or 'Internet Haganah' [35, 9], a review of the literature indicates that there has not been a focus on mapping out parallels between those communities. With this paper I want to provide additional insights into the similarities in the use of tools and techniques and comparable prosecution methods used by these vigilante groups.

The paper is composed of four themed chapters:

- The first section of this article examines the scambaiting community 'Artists Against 419' (AA419) and outlines their prosecution tool 'Lad Vampire'.
- Chapter Two explains the 'Negobot' and 'Chatcoder' tools that the 'Perverted Justice' (PJ) movement uses.

- The third chapter is concerned with the 'Human Flesh Search Engine' (HFSE) and lays out their recent activities.
- The fourth section presents the findings of the research, focusing on the 'Internet Haganah' (IH) movement.

Finally, the conclusion gives a brief summary and critique of the moral and ethical issues concerning these groups and the government's proper role in online governance.

Crowdsourced Online Justice

Tatiana Bazzichelli states in her book *Networked Disruption* that artists, hackers and activist groups (AHA groups) use disruptive techniques of networking in the framework of Social Media and web-based services to generate new modalities for using technology, which in some cases are unpredictable and critical. This two way strategy in networking contexts can be used as a practice for generating criticism and can serve as a methodology for business innovation. These 'AHA groups' critically rethink interventions in hacking culture, art and technology; they accept that they must act from within the market scenario in order to change it, while ironically deconstructing it at the same time. This way, the goal is not to oppose frontally, but to trick them by becoming them and creating disruptive and ironic camouflages. [5] Similar tactics can be observed when investigating vigilante online communities and their practices. In recent publications, I mapped out vernacular tools used by scambaiters or how they use social engineering practices when communicating with Internet scammers. [39]

For this experimental investigation, I conducted autoethnographic research on different vigilante communities and documented the parallels to artistic and journalistic practices to map out correlations of their usage of technology and working practices. The 'Scambaiting' community is a global movement, which contacts Internet fraudsters in order to document their practice or jam their workflow. I observed the group very critically after conducting a 'scambait' myself without knowing of the existence of such an active online community. My initial intentions were based on curiosity, and the communication with the scammers gave me an opportunity to understand and document their working practices. By participating in scambaiting forums I encountered several subgroups, each following their own agenda ranging from wasting a scammer's time and humiliating them online to tech savvy activists who shut down fake websites, monitor scammers' email accounts or track down online groomers and romance scammers. [29] Members of these different subgroups were also involved in other vigilante communities: the 'Perverted Justice' movement, mass-mediated actions of the 'Human Flesh Search Engine' and the 'Internet Haganah' group, as well as their tools and techniques for obtaining background checks on website administrators. In the following paragraphs I want to introduce these communities and take a closer look at their methods and practices with the help of several case studies.

Scambaiting Communities Against Online Fraud

Scambaiters are online communities that take action against online advance fee fraud. They actively report scam emails to email providers, collect phone numbers or track IP-addresses of the senders and publish them on platforms to warn other Internet users. In order to be able to process a large number of emails, general warning platforms like scamwarners.com are assisted by more specialized forums that only document specific scam scripts, e.g. romance or employment scams or forums that document scam tactics like phone scams.

Some scambaiters create fake characters with email addresses and social media profiles and use these virtual personas to contact scammers. Often they act like gullible victims to give the scammer the feeling of an easy prey. Once the scammer takes the bait, the scambaiters document the scammer's working practice, for example by collecting identity cards and bank information, in order to document and jam the scammer's workflow. Some scambaiters specialize in reporting bank accounts or warning hosting providers about fake websites on their servers. In some cases, scambaiters manipulate scammers to leave their place of work and travel to remote areas, thereby actively jamming the scammers' workflow and making the travel as long and tedious as possible. [38]

Scambaiters use social engineering methods and several vernacular online tools to create trustworthy characters and believable storylines. Online tools like name-generators help to create fake characters with believable names and existing street addresses. When using VoIP telephony to be in direct contact with the scammers, they use voice morphers to pitch their voices or webcam add-ons to use pre-recorded videos that mimic live video feed. The scambaiters often ask for photographs of the scammers and ask them to pose with obscure signs or in humiliating poses. These photos are collected on online forums like the 'Hall of Shame', where they become memes or are virally shared with the public. Several forums document scambaits where users can comment on the stories and share tips on how to make them more humiliating and hilarious. [27] Forums like 419eater.com or thescambaiters.com specifically distance themselves from racist actions and claim to ban such users from their forums. Within the forum communities the members often challenge each other to submit photos of scammers in more and more hilarious positions. This is to prove to the community that the scambaiter has talent in persuading the scammer to believe their ridiculous stories. Therefore each forum member maintains a posting signature that is added to every posted message. Icons and animated gifs indicate their achievements: pigs indicate closed bank accounts, country flags represent shut down websites, hats for sucessfully sending a scammer on a travel.

Scambaiters try to unveil the real identities of the scammers and expose them to their friends and families. In order to do this, they request the scammers to submit scanned ID's or other documents and images to prove their authenticity. Images that come in the .jpg or .tiff format carry metadata that is stored as 'Exchangeable image file format' data (short Exif-data). When taking a photo, metadata like date, time and camera settings (e.g. camera model, aperture, shutter speed, focal length),

GPS location information and a thumbnail of the image is saved and embedded within the image file itself. This is mostly done by default without the camera owner's knowledge. Scambaiters analyze the Exif-data and see whether a photo has been edited or when and where it was taken. This can often serve as additional information to prove the authenticity of a story.

There are reports where the scambaiters provided enough evidence to successfully catch the scammer, but most times people just laugh at the scammers and feel superior to the petty criminals. Within these different motives and subgroups of scambaiters, the next paragraph is dedicated to the 'Artists Against 419' group and highlights some of their working tools.

The 'Artists Against 419' (AA419) is an international community that documents fake websites and tries to educate the public on how dangerous it can be to trust companies' online representations. Scammers often use fake websites and top-level domains like .com, .co.uk, or .net addresses to add credibility to their stories. AA419 started out by reporting fake bank sites that were used for phishing attacks. This was done by cross-checking the companies' websites with local regulator's lists. Back in 2003, a small group of net activists started using custom software to take down fake bank websites. They called these acts 'virtual flash mobs' and their programs were called 'Mugu Marauder', 'Muguito' or 'Lad Vampire'. [1] These programs repeatedly downloaded images from the fraudulent website until the bandwidth limit was exceeded and the hosting provider blocked the public access to the website for the rest of the month. This action can be considered as 'bandwidth hogging' and enabled the vigilante group to block access to fraudulent websites, if the hosting provider didn't react to their written complaints. The act of 'bandwith hogging' is often miscredited as a Distributed Denial-of-service attack (DDoS), but a DDoS attack targets the whole server, where normally several other websites are hosted and not just a single website. [24] The group provoked a lot of discussions and controversy with these illegal virtual flash mobs, so they discontinued the development of those particular software programs after September 14th, 2007. Since then their main focus is on writing complaint letters to hosting providers and establishing a reliable alliance with them.

Through a public database they publish fraudulent websites and link these entries to publicly available 'Domain Name Server' (DNS) entries. This DNS information shows the hosting provider's name and address, the date of registration or when the website was updated last. Besides banks they document all sorts of online businesses; international couriers, escrow services, insurance companies, online shops, construction companies, trading agencies, job or travel platforms. So far, the AA419 lists the biggest collection of fake websites, and the community actively maintains international relations with law enforcement, web hosting companies and domain registrars to get fraudulent websites removed from the Internet.

Hunting Online Pedophiles – The 'Perverted Justice Movement'

Perverted-Justice (PJ) is a civilian watchdog group and online community that tries to expose adult predators trying to contact minors through online chat rooms. [14] They setup sting operations by their members, who create fake profiles and pose as young teenagers, and log in to chat rooms and forums to make contact with predators. They document the chat transcripts and analyze the chat messages. Similar approaches include automatized software programs like 'ChatCoder' or 'Negobot' that analyze chat transcripts for inappropriate language. [21] Once a chat partner is unmasked as a predator, they play along and document the conversation. The chat message logs, phone conversations and real life meetings become part of the evidence to convict the predators. Since June 2002, over 588 predators have been convicted of abduction and molestation. Several members also regularly monitor social media platforms, like Facebook or Myspace, and actively report suspected profiles to the platform administrators.

Since Nov 2004 the Perverted-Justice community has become widely known due to their participation in the Dateline NBC investigative news program 'To Catch a Predator'. In this reality show, sting operations were set up to expose, humiliate, and arrest online predators. Members of the vigilante online community lured predators through online chat forums by setting up decoys. Once the decoys gained the predator's trust, they sent them to an empty house, where another young girl and the host of the show, Chris Hanson, questioned the suspects before investigators arrested them. Between November 2004 and December 2007 twelve such sting operations were carried out, over 286 people were arrested, and 103 (36%) were pronounced guilty. However, in the case of 150 incidents (52%) charges were dropped due to lack of evidence. The payments made by NBC to Perverted Justice created conflicts of interest within the online community. Also, local police departments criticized the vigilante working methods of the television show, which transformed from 'news reporting' to a 'news-making' agency.

In Nov. 2006 district attorney Louis W. Conradt was suspected of being a child molester. According to Perverted-Justice's documented message log files, Conradt, posing as a 19-year-old university student, engaged in sexually charged online chats with a person using the alias of a fictional 13-year-old named Luke. [29] Conradt persuaded Luke to exchange nude photos and after two weeks of ongoing file exchanges, the NBC team brought in an actor to play the fictional character Luke over the phone. After one phone call Conradt stopped responding to attempts to get in touch with him, leading the producers of the show to call in the local police. The producers and local law enforcement raided Conradt's house, where Conradt shot himself. Patricia Conradt, sister of the deceased Louis Conradt, sued the NBC network. The case was resolved amicably in June 2008. Due to this incident, there was heavy criticism of the producers' methods – public shaming, punishment, and social control as media entertainment.

Human Flesh Search Engine - Identifying and Exposing Individuals

The movement called 'Human Flesh Search Engine' (HFSE) originated in China with early incidents dating back to 2006. [34] The term was translated from the Chinese words 人肉搜尋 (Ren Rou Sou Suo), which broadly refers to 'an act of researching information about individuals or any subjects through the often viral

and impulsive online collaboration of multiple users'. [36] Actual people, rather than computer-driven online searches, demonstrating citizen empowerment and civil participation, power the massive collaborations. Through the use of social media platforms, the wider public is involved in the fight against illegal behavior. By using progressive and interconnected search methods the knowledge of thousands of humans is used to uncover 'the truth' and identify any illegal behavior on the part of an individual or a company. In China netizens of the human flesh search movement are also tagged as 'Red Guards 2.0'. [23]

Once the angry mob is released, the exploitation of private information or the leaking of classified information about the accused individual is impossible to avoid, due to the large number of people involved. This information is based on speculation or other low quality information, resulting in wrong accusations, flaming, cyber-bullying or even issuing death threats to innocent people by a crowd-sourced justice-seeking cyber-mob. Most outcomes include public shaming, exposing private information like home and work address, personal photos or video files, DDOS attacks, shutdown of personal websites, unemployment, fines or arrest.

Recent incidents include accusing and casting suspicion on innocent people after the Boston marathon bombings. 4chan and reddit users created 'photo think tanks' and crawled through the photos that were released by the FBI. The FBI planned to crowdsource to be able to gather more photo and video material from the incident. This worked out well and thousands of photographs were submitted to the FBI. In a second step, the 'crowd' was asked to identify the suspects, but the crowd already started their own investigations: a whole subreddit called 'FindBostonBombers' was dedicated to finding the suspects (see Fig. 1).

Figure 1. Photo posted on Reddit showing potential suspects in the Boston bombing

The crowd used several online tools to compare images. They used the 'Exif-Data' provided by many files to locate the exact camera position when the image was taken. Normally law enforcement use software tools like 'CrowdOptic' to carry out this kind of mass image recognition.

Another way to test the authenticity of an image is to use 'reverse image search' engines, which specifically search for matching images rather than finding content according to keywords, metadata or watermarks. When an image is submitted, a digital fingerprint is created that is compared to every other indexed image. The accuracy of different engines and plugins varies, from finding exact matches to similar images, including those that have been cropped, modified, or resized.

The findings of the analyzed images were published and discussed in subreddits like 'FindBostonBombers' and others.

The description of the subreddit stated:
'This subreddit is a place for people to post images, links, and thoughts about the potential identities of those responsible for the bombing. HOWEVER, please keep in mind that most or all of the 'suspects' being discussed are innocent people.'

The crowd fueled rumours and speculations and targeted people carrying backpacks – non-white, innocent people like Salah Barroom or Sunil Tripathi, amongst others, were accused and became public enemies. Some social media accounts of potential terrorists were leaked, and the innocent suspects received threatening calls. Different news stations contradicted the 'online witch hunt' and other news reports in order to bring the angry mob under control. Still, people were afraid to go on the streets. [22]

When the police reported the Dzahar brothers to be the suspects, news media also reported private information like their Amazon wish list and their favorite videos from YouTube. [30]

Internet Haganah – Confronting Islamists and their Supporters

'Internet Haganah' (IH) is a 'global open-source intelligence network' and web platform dedicated to confronting 'Internet activities by Islamists and their supporters, enablers and apologists'. Haganah, meaning 'defence' in Hebrew, was also the name of the early Israel Defence Forces who protected Jewish settlers in Palestine. Back in 2003 Adam Weisburd started blogging about offensive and dangerous sites and founded the organization. Over the years, the community has managed to shut down several thousands of radical websites. [6] On their website, they provide forums covering several issues, where community members post and discuss their collected intelligence on topics such as Reds in China, Russia, North Korea, Left/Right or Nihilist Wingnuts, Global Islamic Revolution, Islamists, Hamastan or Israel. [35]

Once a suspected website is found, it is posted on the Internet Haganah forum, where its relevance is then discussed by the forum members. The group uses online translation tools to translate the website's content. Offline versions and screenshots of the website are archived and used as evidence. Online archives like the 'Waybackmachine' are used to see the website's history. This way, they can create a timeline of the website and see the past publications and latest updates.

Furthermore, background data like the 'Domain Registry Information' is acquired to contact US-based hosting providers of jihad-supporting websites. If the hosting provider refuses to take down the website from their servers, they file further reports to U.S. National Defense Complaint Centers and provide information in the form of press releases and news articles to their media network. Within the network, cases are

documented where hosting providers wouldn't cooperate and take the websites off their servers. In one case volunteers from the Haganah community figured out the hosting provider's administrator's private cell phone number and started to call his phone and put additional pressure on him until he took the site down. [6] In summer 2014 their website www.internet-haganah.com went offline. Parts of the forum can still be accessed by the Internet archives 'Waybackmachine'.

Projects from Journalism, Art and Activism

The following section presents four projects from the fields of art and journalism that use disruptive techniques and other hacktivist methods to communicate their political messages. The different projects, a net-art performance, political activism, video installtion and subversive journalism, were selected because they use disruptive methods and software tools similar to those also used by the various vigilante communities. In 2011, Ian Paul created 'Borderhaunt', a net performance piece, where he cross-references a surveillance network database with a border deaths dataset to create a haunted commentary on the US-Mexican border situation. Electronic Disturbance Theater is a cyber-activist group using different software tools to shut down banks or governmental institution websites. The video installation Password:****** leaks email passwords of Internet scammers and shows how social engineering tactics can be applied to 'deceive the human' rather than 'hacking the system'. The last project is by Mads Brugger, who documented his investigative journalistic approach to uncover diplomatic corruption in the central African state of Congo.

Borderhaunt - Cross-checking Databases for an Artistic Net Performance

The artist and theorist Ian Paul created a net-art performance called 'Borderhaunt – A Border Database Collision' [28]. The online performance took place on July 15, 2011 and was an attempt to merge two different databases associated with the U.S.-Mexican border. 667 participants from over 28 countries collected entries from the database that holds the names and descriptions of people who died trying to cross the border territory. This database is initiated by the Arizona Daily Star, who started compiling border deaths that were recorded by medical examiners in an effort to present an accurate number of people who died in the course of their attempts to cross into the United States illegally through Southern Arizona. These deaths are either caused by extreme weather conditions, violence of vigilantes, or abusive law enforcement officiers. [4] These entries were then sent to a database of the blueservo network, a private service company contracted by the Texas Sherriff's Border Coalition which crowdsources surveillance of the Texas-Mexico border, creating reports of 'suspected' undocumented border crossings. Volunteer users of the database watch livestreams of the border and submit 'suspicious activity' once they see an illegal immigrant crossing the border. For this the Department of Homeland Security installed 25m tall observation towers equipped with long-range radar, high-resolution cameras and an underground sensor network. One observation tower can detect the slightest movement in a 10km range along the Mexican border. [20] As a result of the performance, the border was symbolically haunted for the duration of the one-day action as the border police received over 1,000 reports of deceased immigrants attempting to cross the border.

The action was conceptualized as a kind of collective online performance and intervention for one day by cross-referencing the 'Border deaths database' and the 'Blueservo surveillance network', which reflected on border crossing deaths as well as disrupting the surveillance technologies used in the border territory (see Fig. 2).

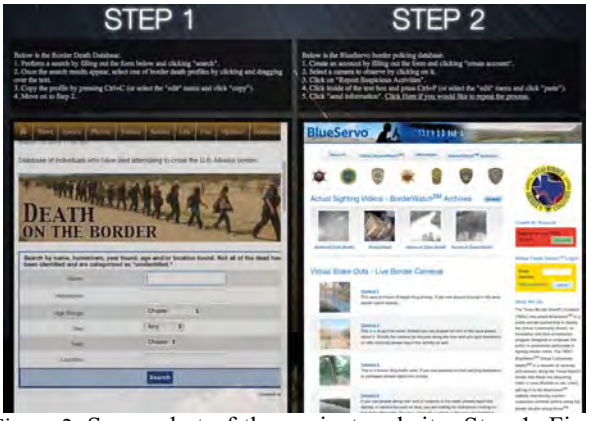

Figure 2. Screenshot of the project website: Step 1: Find a dead person in the database, Step 2: Report a suspicious activity in the Blueservo border policing database

Virtual Sit-ins: the Electronic Disturbance Theater

The Electronic Disturbance Theater (EDT) is a small group created by Ricardo Dominguez, Carmin Karasic, Brett Stalbaum, and Stefan Wray. These cyber activists and artists engaged in developing the theory and practice of 'Electronic Civil Disobedience'. One of their software tools is called 'Flood Net', which is a URL-based software tool used to flood and block an opponent's web site, enabling users to participate in collective electronic civil disobedience in solidarity with the Zapatista rebels of Chiapas (Mexico), a revolutionary group of indigenous people who were fighting against government oppression. [10] With these virtual sit-ins, members of the EDT slow down a website's performance and drain the web server's bandwidth until the website is extremely slowed down or even unreachable. [11] On April 10, 1998, they released a java applet called 'FloodNet' and performed non-violent actions against the Mexican president Zedillo's website ('98 and '99), several Mexican banks, the Frankfurt stock exchange, the U.S. Government and the Pentagon. The users were asked to create 'bad URLs', web addresses of nonexistent web pages at targeted sites, e.g. URLs that consisted of names of Zapatistas killed by the Mexican army. Each time such an website was requested, it was inscribed in the server's error log. The Department of Justice counterattacked the EDT and destabilized the group's infrastructure. Ricardo Dominguez, driving force behind the EDT group, claims that their actions are artistic experiments in 'electronic civil disobedience' rather than true acts of sabotage. By adopting the civil rights movement methods of 'sit-ins' to blockade the entrance of public buildings to block the Internet, they

experimented with new ways to protest through the use of digital media. [13] In 1999, the group released the software to the public as part of the 'Zapatista Disturbance Developer's Kit'.

The Video Installation 'Passwords: ******'

The artist collective kairus.org referenced a scambaiting database, where activists publish scammers' usernames and passwords for their email accounts, and visualized popular passwords in a 6-channel videoinstallation. This sensitive data is gathered by using social engineering methods to persuade the scammers to share their login information. This can be done through the use of fake forms where the scambaiters ask for sensitive information that can reveal the scammer's email security questions, e.g. mother's maiden name or street adresses. Another method the scambaiters use is to offer a supposedly free web service to scammers. It is specifically advertised as a 'trusted and reliable infrastructure' that scammers can use for their businesses. The scambaiter sends out email formats of bulk messages in order to attract the interest of scammers to sign up for this service. During the application process, the scammer has to provide several alternative email addresses and a selection of passwords. Scammers who use several fake identities often use same or similar passwords for their email accounts. Once the scammer logs in to the newly generated account and tries to use the service for fraudulent activity, the email and password details are stored in a database. This database is shared amongst the scambaiting community to crowd-source the high number of scammers' account details. Scambaiters are asked to log in to the scammers accounts and to document criminal evidence. Often you can find fake documents, login information for other online services or gang communications. Scambaiters read through the emails and warn potential victims not to believe the rogue business and to stop communicating with the scammer. They continue monitoring the scammers account until the scammer loses interest and abandons the account. This makes it possible to learn from the scammers' practices and demoralize their attempts to gain any money from people who are ready to pay. The illegal act of accessing another person's account is justified by the efficiency of warning victims and collecting intelligence by accessing a criminal's 'virtual desktop', where important documents or passwords for other services can be found.

While looking at and experiencing the 6-channel video installation, the visitor reflects on issues of online security and questions one's personal password usage (see Fig. 3). The artwork stresses the 'online common sense' that passwords can be hacked as a result of security flaws like 'Heartbleed'; they can also be obtained by social engineering techniques. Securing personal data online with a strong password and constant security updates to avoid exploits is essential. However, people are still lax when it comes to securing their passwords and not sharing them with others. [39]

Figure 3. Exhibition setup 'Passwords:******'

Performative Journalism: Mads Brugger

In his documentary film 'The Ambassador', Danish provocateur, journalist and filmmaker Mads Brugger impersonates a Liberian ambassador called 'Mr. Cortzen', who goes to the Central African Republic of Congo to expand diplomatic relations. He is able to buy a valid diplomatic passport from the state of Liberia over the Internet. Under his new name 'Mr. Cortzen', he is able to enter Liberia and establish diplomatic relations with other state diplomats. [15] His official agenda is to represent the state of Liberia, with a fake diplomatic passport, and set up businesses as a cover story, e.g. a match factory to employ a local tribe of pygmies. His second agenda is to provide an insight into corrupt politicians and to uncover the ongoing blood diamond trade. With hidden cameras he documents how he bribes his way up the social ladder and engages with government officials and other diplomats. Over-exposing his superior status as a white, ginger-bearded foreigner in a postcolonial outfit, Mads Brugger sees his production as 'performative journalism', uncovering the criminal potentials diplomatic immunity provides. In a fragile state like the Central African Republic of Congo, most white men have several hidden agendas, so he could avoid being questioned why he, as a white man, represents another African state. Because of the film, the Liberian press identified eight Mr. Cortzen-like diplomats in their corps. Today in many countries like Russia or China it is extremely dangerous for journalists to work and report from. Mads thinks it is necessary for journalists to use a new set of tools to research and report in such countries. [15] [17]

Discussion

There is an ongoing debate about the benefits these vigilante communities bring to net societies and law enforcement. Differences in the training of volunteers, the various state legislations and divergent sets of resources will undermine the communication process between the involved parties.

Vigilante groups invest a lot of time and commitment to their act of civil service. Members are often tech savvy and are open to sharing their findings with potential victims or law enforcement.

Could these vigilantes be used as a resource in the fight against cybercrime? Could a training by the police set certain standards and enhance the cooperation?

Since 1996 NGO's such as 'Ultrascan Advanced Global Investigations' (UAGI) operates by identifying, analyzing and predicting perpetrators of cross-border

fraud and the communications and support of terrorism from local or international religious extremists. [33] They offer a six-phase volunteering program, where helpers are coordinated to warn scam victims (phase 1), help them to file complaints (phase 2), visit working offices of scammers (phase 3), collect sensitive information (phase 4), report to the police (phase 5), and collect intelligence to get the scammers arrested (phase 6). Similar attempts to include civilians and private organisations to cooperate with law enforcement in the fight against cybercrime are undertaken by NC4 Cybercop or Project Vigilant. [2] [16] Such programs distribute the duty of policing and empower citizens to fight Internet crime.

Conclusion

By observing the working practices of the different online vigilante communities it is possible to map their working practices and the tool-sets they use that empower them to prosecute their 'opponents'. In general, these vigilante communities are very concerned about their anonymity and use fake profiles to camouflage their digital identities. Digital identity can be simply defined as the digital information that creates the image of an individually identifiable person. The groups use and misuse various vernacular online tools to gather intelligence. In the last few years, more and more artists have used net-activist tools for producing their artworks. This merges the activists, hackers and media-art movements into new genres, often referred to as tactical artists, hacktivists (hacker and activist) or artivists (artist and activist) cultures.

'Scambaiters' and members of the 'Internet Haganah' group use common practices to obtain background checks on the hosted websites to figure out their registration date, track down the administrators and get a physical address and phone number of the webmaster. Also, that way it is possible to obtain information regarding who the hosting provider of the website is and if local state laws or the hosting companies' 'Terms & Conditions' can be applied to the case in order to force the hosting provider to take the website off their servers. The activists use social media platforms, blogs and press releases to inform the public about their ongoing investigations and try to draw the public's attention to the case. They often cooperate with local NGO's that warn potential victims and extend their outreach.

Members of the 'Scambaiting' community use several online tools to create fake characters, track email IP-addresses or use image analyzers to extract Exif metadata from images. Software tools like 'Muguito' or 'Lad Vampire' are used for 'bandwidth hogging', reducing the server's capacity and limiting access to the website for potential victims. 'Scambaiters' and 'Perverted-Justice' communities use fake profiles to hide their identities and create 'honeypots' for online criminals and groomers. By using special software tools like 'ChatCoder' or 'Negobot' they can analyze chat transcripts for predatory language and distinguish faster between a potential criminal and a regular chat-forum user. The 'Human Flesh Search Engine' and the 'Internet Haganah' are heavily crowd-sourced sting operations, where lots of members are engaged in a single case, e.g. identifying suspects in the Boston Bombings or collecting evidence to shut down Jihadist websites. This massive user-driven approach to data gathering, analyzing and filtering information is discussed in forums where adaptive prosecution methods are also evaluated. In this process ethical discussions are often forgotten, and no ethical group guidelines are defined; common moral sense is thrown overboard. The act of online humiliation through offensive text messages or photo-collages and exposing sensitive data like phone numbers, private address, or occupation is a common form of self-justice. The viral prosecution can result in cyber-bullying, prank calls, physical harassment, and death threats, often also targeting the accused's friends, family members, or co-workers. These kinds of harassment and the pressure of increased media attention have also sometimes led to the loss of social status, e.g. study status or employment. As social media profiles are shut down in order to not provide a platform for harassment and bullying, individuals often find it impossible to give a statement in their defense. Once the Internet has found a victim, it becomes hard to counter any false accusations.

Collected evidence that is gathered through background checks or by documenting communication with the victim could be tainted and become unusable in court, or targets could be condemned as guilty when innocent, said Paul Kurtz, the executive director of the Cyber Security Industry Alliance, a coalition of chief executives of tech companies. 'When we all become "law enforcement officers", justice becomes very blurry.' Individuals and U.S. officials think that they can learn more about online criminals or terrorist operations by monitoring suspicious sites, which are operational. They can obtain background information that law enforcement cannot gather. Often, evidence is either gathered illegally or by morally questionable acts like hacking or social engineering. Nevertheless, every case has to be analyzed separately: how the provided evidence is gathered, whether it can be evaluated by law enforcement, or if it just interferes with their investigations.

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The Aesthetics of Activism: See-through Effect

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Abstract

For this demonstration the authors intend to present the *Aesthetics of Activism* as a work-in-progress. This interactive artwork explores the nature both of audience engagement as well as the interdisciplinary conditions of its making. The work is designed to visually represent an assemblage driven by people's bodies that are tracked and translated into interactive collage elements via motion sensors. Images projected are composed from a mixture of algorithmically scavenged social web resources and artistically curated and altered videos. The demonstration will present a new interactivity feature that continuously tracks a body, coupling it with a distinct eyehole (a region distributing transparency), allowing one of the composition s retrial layers to be viewed. The experience provided points towards the ways technological advances transform and shape public spaces, thereby subverting familiar strategies of activist practice while rendering possible new forms of aesthetic resistance.

Keywords

Interactive Art Aesthetics Code Literacy Activism.

Introduction

The *Aesthetics of Activism*[1] is an interactive work-in-progress designed to facilitate aggregation of visual material from social networks to form themed compositions that can be explored jointly within a shared interactive space. It seeks to combine reflection on the algorithmic conditions of contemporary digital attention economies with an awareness of the interdisciplinary circumstances of technology production. To this end, aesthetic principles underlying human-made visual compositions are translated into algorithm. Generated and curated content is combined within interactive collages exhibiting a multi-layered structure. The work is part of a larger research study that investigates the broader context of social, digital, and cultural production 3 .

For this demonstration, we worked with social web resources related to Canada's Kinder Morgan protest[2] to present a new feature that couples every tracked body with an eyehole shaped lens that allows one of the composition s retrial layers to be viewed. As seen in Figure 1 each time a new body enters the interactive zone a distinct eyehole transition (i.e. region redistributing transparency) is created. Each tracked body is coupled with a distinct eyehole such that a different layer becomes accessible to the respective audience. When more bodies enter the interactive zone, more layers are partially revealed. The exact configuration and structure of visibility thus depends both on the number of present bodies as well as their collocation.

Whenever no people are present within the interactive zone, the system slowly cycles through available compositions as seen in Figure 2. The nature of the composition is a variable that rests on the described 'see-through' effect, revealing additional content or creating a thematically motivated contrast. Depending on the site of demonstration the work illuminates glimpses of hidden layers or invites sustained exploration amongst people interested in the retrial layers.

Figure 1. This illustration demonstrates the effects of four people collocated within an interactive zone.

Figure 2. This illustration demonstrates the effects of the system generating image composition without people present. As time lapses the image layers thin until they fade completely.

[1] Aesthetics of Activism documentation: interactionart.org
[2] David Suzuki Foundation's blog on Kinder Morgan's Trans Mountain pipeline project: http://davidsuzuki.org/blogs/panther-lounge/2012/07/we-are-the-kalamazoo/

Layered images are seldom exported to visual 'consumers'. By exhibiting a multi-layered surface the piece hints towards the interdisciplinary circumstances that produced the artwork. Our goal is to demonstrate how traditions both from the visual arts such as assemblage making [1], as well as, digital practices such as interactive collage [2] can be used to make statements about real-life events.

The proposed demonstration as illustrated in Figure 3 can be projected onto a white wall, projection screen or, ideally, a glass surface for rear projection (e.g. a store front window). The generative part of the composition is created from aggregated social web resources as displayed in Figure 4. As seen in Figure 5 the installation requires reduced lighting and an unobstructed interactive zone infront of the display surface.

Figure 3. Aesthetics of Activism work-in-progress projected onto the Surrey Central Library, BC, Canada

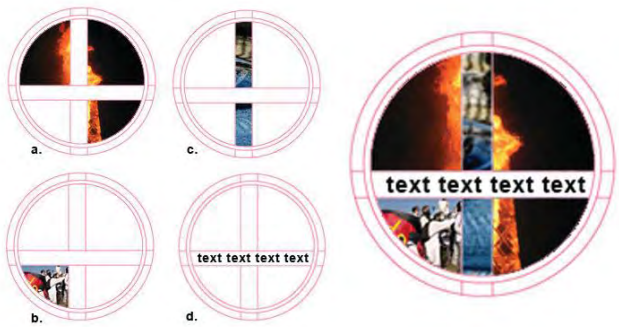

Figure 4. This illustration maps the generative composition aggregated from social web resources. The placement of each layer represents: a) context, b) contrast, c) people protesting, and d) text related to theme.

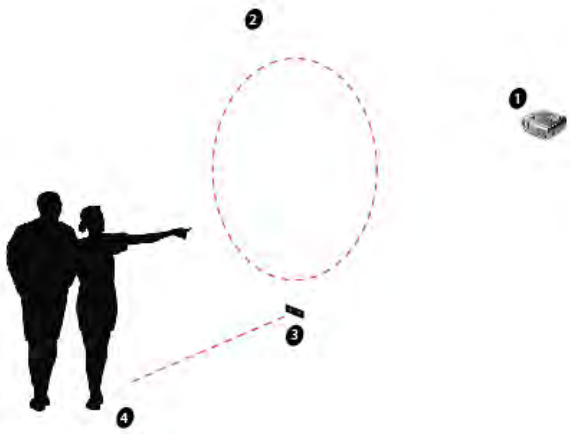

Figure 5. This illustration shows the general set-up: 1) Projector and Laptop computer, 2) Screen, 3) inect sensor, and 4) Interactive zone in front of the projected images.

Conclusion

In this submission we have briefly introduced the *Aesthetics of Activism* as a work-in-progress investigating the broader context of social, digital, and cultural production. Our proposed demonstration intends to invite conference attendees to experience our new interactive feature that couples every tracked body with an eyehole shaped lens activating the retrial layers of the artwork as seen in Figures 1 and 2. Our future work will continue to explore the creation and detection of social media patterns and interactivity as a mode of cultural production combining formal and non-formal aspects of aesthetic phenomena such as painting, nature, or mathematics.

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[Session 14]

(for unknown reasons no 'session 13' was organised)

Disruptive Methodology

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Disruptive Aesthetics for Interactive Artwork

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Abstract

In this research, we studied the disruptive aesthetics of interactive artwork based on the activity theory. The audience engages in interactive artwork not only for the pleasure of participation but also for the disruptive aesthetics of social values in the organization of human life. We analyzed audience activity in interactive artwork using the activity theory and created a framework with a basic structure for a disruptive aesthetics of interactive artwork. The audience engaged in interactive artwork and overthrew the social structure in three categories: disruptive rule, disruptive community, and disruptive role. Through the framework, artist will create a disruptive interactive artwork, and the audience will enjoy the interactive artwork as part of disruptive aesthetics.

Keywords

Interactive Artwork, Digital Art, Activity Theory, Disruptive Aesthetics, Interactive Framework

Introduction

Background and Motivation

Disruptive aesthetics is a term already being used in the analysis of artworks. [1, 2] This paper refers to this term, which means changes in interactive artworks' factors and structures.

Disruptive aesthetics challenges society's previous view of artworks and overthrows the old concepts. The interpretation of artworks today is a paradigm shift in art history. This paper proposes this paradigm shift in four categories: from a cultural approach, a functionalist approach, an experience-based approach, and a techno-futurist approach. [3]
Modern art: Readymades by Marcel Duchamp, "*Happening*" by Fluxus, John Cage's music, interactive artwork by Jeffrey Shaw, and Bio Art by Eduardo Kac have changed social values and created resistance through disruptive aesthetics.
Today, many digital artworks or bio-artworks have challenged authority. The content of a work might pleasurably subvert a meaning, thing, or relationship from real life. Participants might also feel subversive pleasure simply from behaving in ways they perceive to be "against the rules" of the world set up by a work. [4]
Digital art is media art based on digital technologies. Has digital technology strengthened disruptive aesthetics features in art? With the digital age, a variety of positions have emerged on the interpretation of the correlation between the aesthetic object and the aesthetic experience, resulting in a blurred picture of the field. [3] The possibility of complex interaction in digital art goes far beyond the simple "pointing and clicking" that offers nothing more than a sophisticated way of looking at a work, or the type of interactivity where a user's act triggers one specific response. [5]

What are disruptive aesthetics in digital art? They are special features. Various papers and books refer to the following five features. [5, 6, 7, 8]
1) Expanded human creativity mediated by digital technologies
2) Audience participating in the artwork and real-time feedback system
3) Global communication based on a networked system
4) Virtual reality or augmented reality - digital human customizing and agent system
5) Bio-artwork based on human body, organization, or DNA

These features give the audience disruption based on digital technologies, unlike previous artwork. However, we should make new digital works with not only these new features but also those that contain meaning and value - disruptive aesthetic of contents.

Does digital interactive artwork contain disruptive aesthetics in terms of the continuity aesthetics of art? Interactive art gives pleasure to the participating audience. Subversion is the pleasure of breaking rules or of seeing others break them. It is also the pleasure of subverting or twisting the meaning of something or of seeing someone else do so. [4] These interactions are disruptive values of digital art in view of audience participation and real-time feedback by digital technologies. [5, 6] Many researchers want the audience to participate in interactive art in various ways, with the art concentrating on the audience's experience. [9, 10, 11, 12] In this situation, the audience performs easily and intuitively. This participation is fun and interesting, akin to an interactive game. [10, 13, 14] However, the artist and research also consider the meaning of the artwork's contents in terms of defiance. The audience directly performs the interactive artwork installation and affects its contents. The audience is essentially a disruptive aesthetic of trigger in an artwork via its own activities.

The Aim of This Research

The aim of this research is to create a framework for analyzing or producing a disruptive aesthetics of an interactive artwork based on the activity theory.
The process of the research is as follows
1) Analysis of aesthetics of interactive artwork
2) Making a new framework via application of the activity theory
3) Analysis of interactive artwork based on the framework
4) Proposing a disruptive aesthetic result based on the analysis

Case Studies

Art History for Disruptive Aesthetics

This research studied a history of art for disruptive aesthetics. [5, 6, 7, 8] Marcel Duchamp's concept overthrew the stereotype of artworks being made creatively only by artists. His images moved on the canvas so that audiences "performed" his installations, which meant the images were kinetic art and not interactive art because they were not mediated by digital technologies. This artwork with a rotary plate was the first artwork in history to enable the audience to participate through their own actions. Duchamp proposed a paradigm shift in artwork by breaking down the stereotypes of artwork.
The Fluxus "*Happening*" performance overthrew the stereotype that an artist produces an artwork for his own meaning. The unintended result of the actions of Fluxus members was that they created performance artwork through their physical movements. They resisted worthy activities based on rationality in their artwork. They broke down the aesthetic standards and proposed the message that the human body is the best interface for artwork. They deconstructed the metaphysical philosophy of Western ideas and morals with their uncanny gestures. The audience viewing the performances became co-workers of the Fluxus members.
In addition, musicians have been performing directly and playing tunes. However, John Cage overthrew this stereotype and discovered the delicate noises that audiences make. The music of *4'33"* was made both by Cage and by his audience. This was not only the discovery silence but also a musical collaboration between the audience and participants. Cage found his artworks' contents by coincidence. His performances (or his audiences' performances) disrupted the relationship between the artist and the audience, whether intended or unintended.

Here, we briefly explore modern artworks' history in view of disruptive aesthetics. Artwork consists of form and content based on overthrowing the previous society and structures of artworks. A paradigm shift is needed for the artists and the audience because people enjoy new artwork concepts that change the world and society's structure. Disruptive aesthetics have the strongest and most powerful effect on a paradigm shift. Through disruptive aesthetics, people expand their imagination and creativity, and they challenge society's structure in order to enhance the value of humanity. Beyond playfulness and fun, interactive artworks have meaningful values for proposing a new paradigm in order to enhance humanity. This enhanced humanity comes from an innovation-related resistance to renewing and overthrowing the social order. The disruptive aesthetics will let the audience change society with regard to its views about artwork. We analyze the disruptive aesthetics via the audiences' experiences with interactive artwork.
In view of being formative, interactive artwork is a challenge to overthrow. However, interactive artwork is needed by disruptive aesthetics in view of its contents. It is also needed as a method to enhance the values of humanity through the disruption of an oppressive society, which is different from playing interactive games. The main issue is the embodiment of interactive artwork from audiences' actions mediated by the installation through digital technologies. The embodiment is how artists express their perspectives on aesthetics and produce their artworks' contents. The embodiment of the artwork contents is related to disruptive aesthetics, which means overthrowing the stereotypes and social limitations. This disruptive aesthetics enhances and expands the artworks' contents.

Interactive Artwork Applied by Activity Theory

The core meaning of interactive art is the direct activity of the audience and the triggering of contents. The direct effects are factors of the disruptive aesthetics of artwork contents. The audience activity could expand the real social world beyond the interactive artwork environment. In interactive artwork, the audience performs its own actions out of desire, and the actions are represented by social symbols.

We first analyze audience activity in interactive artwork. The activity theory is an essential analysis method for human activity. This research applied the theory to create a basic framework for interactive art in view of aesthetics. [15, 16] The following is a basic production framework for interactive art based on the activity theory. [17]

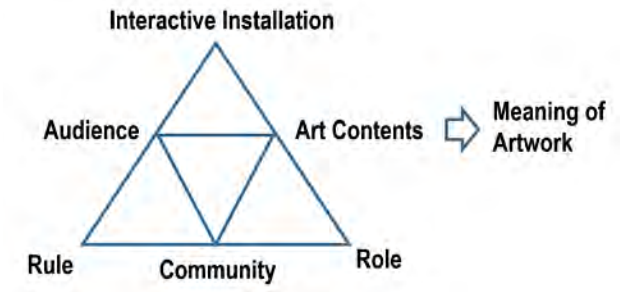

Figure 1. Framework Model of Interactive Artwork Created by Applying Activity Theory [17]

Analysis on Interactive Artworks Based on New Model

Based on a new framework for the meaning of interactive artwork created by applying the activity theory, we analyzed three pieces of interactive artwork.

- *Legible City* by Jeffrey Shaw (1989)

In The *Legible City*, the visitor was able to ride a stationary bicycle through a simulation of a city. [18] This artwork overthrew the meaning of the city as a social construction for human residence. This artwork proposed an audience's travel in a virtual environment using textual images. The audience had an adventure of new meaning within the virtual city, which broke down the symbol of the text buildings and human architecture.

Figure 2. *Legible City*

- *Text Rain* by Camille Utterback & Romy Achituv (1999)

Word text refers to written symbols for words. Humans have long used text to communicate with one another and to keep data in books or materials. [19] In this artwork, the audience members used their bodies to perform in front of a screen and play text images that fell like rain. This artwork overthrew the meaning of the text stemming from social rules created by humans. The artwork proposed disruptive play in order to change the meaning of the text.

Figure 3. *Text Rain*

- *Be Your Own Souvenir* by blablabLAB (2011)

In this work, the audience became the producer as well as the consumer through a system that invited its members to perform as human statues, with a free personal souvenir as a reward. [20] This artwork overthrew the role of humans themselves. The humans did not think of themselves as souvenirs. However, this artwork proposed this concept by playfully encouraging them to strike enjoyable poses. The audience members became creators and models through their own poses and gestures.

Figure 4. *Be Your Own Souvenir*

Disruptive Aesthetics of Interactive Artwork

Audience members had a disruptive experience in the interactive artworks based on their own activity. The term disruptive aesthetics is defined as breaking the form of society and proposing a new form. Therefore, this research proposed a new framework for interactive art in order to overturn the basic factors of the previous framework. Through interactive art, the audience overthrew the previous activity content through its own activity: rule, community, and role. This research proposed three categories on opposing sides of the previous framework: disruptive rule, disruptive community, and disruptive role.

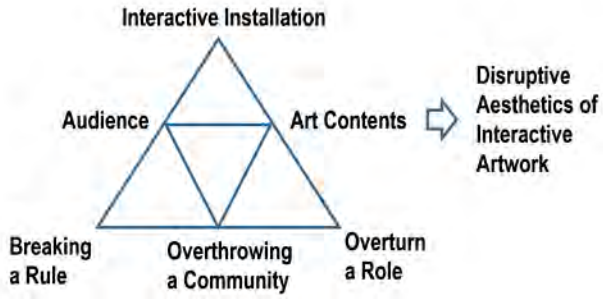

Figure 5. Framework for Disruptive Aesthetics of Interactive Artwork

1) Disruptive Rule of Interactive Artwork

Audience members performed interactive art and overthrew the social order by participating in the interactive artworks. Disruptive aesthetics not only means breaking down the rules but also reforming the rules. This expands the range of the rules. People have made various rules for keeping the systems of society. Rules comprise symbols, regulations, laws, principles, and morals. People live to uphold various rules for themselves or for their communities. Breaking the rules means a new way of looking at basic rules for extended human cognition and physical activities. The process of disruptive rule enhances the value of human regulations.

2) Disruptive Community of Interactive Artwork
Audience members performed interactive art and overthrew the social community by participating in the interactive artworks. People have developed various communities in order to keep living or to have a stake in the outcome. Communities comprise families, groups, schools, armies, nations, nongovernmental organizations, and cyber communities. Communities are made by humans and are disbanded if this is the communities' objective. People want to both belong to communities and escape from them. This is the destiny of people, either to be together or to be alone. Overthrowing communities does not mean breaking them down but expanding them. This is not anarchy for a society but rather a renewal of that society. The process of disruptive community enhances the value of human groups and defamiliarization about organizations made by humans in order to discover the value of human relationships.

3) Disruptive Role of Interactive Artwork
Audience members performed interactive art and overthrew social roles by participating in the interactive artwork. Humans have performed roles for their own sake and to maintain society. Private people assume roles that are satisfactory for themselves or to get close to people in interest groups. Overturning a role not only means the destruction of the role but also an extension of the private role for the discovery of one's own values. Also, this does not mean moral action or the destruction of the organization or the system. This is a creative renewal that works to make a new paradigm in sociology. The process of disruptive roles enhances the value of human performance and of finding new abilities.

In these ways, audience members in the interactive artworks performed their own activities and overthrew the three social values: rule, community, or role. These are the disruptive aesthetics in an interactive artwork.

Conclusion

We researched an interactive artwork in view of disruptive aesthetics. The audience members directly performed in interactive artwork and overthrew the social structure in three categories: disruptive rule, disruptive community, and disruptive role. We analyzed interactive artworks based on the framework and proposed factors in the disruptive interactive artwork.

Producing interactive artwork through disruptive aesthetics gives pleasure in different forms from other interactive installations or interactive games. These are the aesthetics of intrinsic, disruptive, interactive artwork. Art overthrows the framework in order to create more art.

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Research through Design, Documentation, Annotation, and Curation

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Abstract

The practice of research through art and design can pose challenges in terms of evaluating contributions, formalizing methodologies and generating extensible principles. Creating a middle layer of critique and interpretation between the generated artifacts of research through art and design and the foundation of general theory provides a viable space for exploration. We propose integrating artifact description, process documentation and participatory annotation as a useful approach in this intermediate critical area. We introduce a multimodal documentation framework for capturing, annotating and presenting the activities, processes and generated artifacts of research through art and design practice. We describe findings from our experience documenting a series of research through design workshops, and illustrate our annotation and presentation approach in the form of a curated exhibition.

Keywords

Documentation, research through art, research through design, experience design, exhibition

Introduction

The practice of *research through art and design* extends beyond the creative arts and is becoming an established presence in fields such as planning and human-computer interaction. With this development, thorny questions arise about measuring impact, understanding contributions to different disciplines, and developing a coherent theoretical and critical interpretive framework. As researchers working across disciplines (design, art, HCI and computer science) our praxis approach produces multiple outcomes including methodologies, installations, online applications and scholarly texts. A recent proposal for presenting such outcomes is an 'annotated portfolio', a term used to describe a collective body of work assembled into a considered and 'marked up' whole, which is encountered in such diverse forms as monographs, exhibitions, digital archives and performances [8]. The selected works and their accompanying annotations can be understood as occupying a middle or intermediate generalizable ground between the discrete originating design or art artifact(s) and a formalized, extensible theory [13].

The conceptualization of annotated portfolios to date relies primarily on retrospective annotation of artifacts from a relatively singular perspective. Integrating a documentation approach throughout the entire creative process provides an opportunity to combine the production and consideration of knowledge into an accessible and comparable set of research practices evolving over time. Opening this reflective documentation process to a diversity of participants (e.g. team members, external experts, clients, students, general public etc.) further allows for the broader type of sensemaking and connectivity referenced in [13]. Supporting this type of research practice requires the development of comprehensive documentation protocols and a flexible computational framework structuring the storage, annotation and presentation of collected material.

A series of design workshops held during the 3-day international *Emerge* symposium hosted at Arizona State University in 2012 provided us with the opportunity to develop and put into practice our own multimodal documentation framework. The symposium brought together theorists, practitioners and researchers from the arts, design, sciences and humanities to create and reflect upon "what it means to be human in today's world" [3]. Working closely with the symposium organizers and the nine workshop leaders, we developed a documentation approach appropriate for the planned activities and the 250 invited participants. The workshop organizers anticipated using a variety of design methods including speculative strategies such as *design fiction, sci-fi prototyping,* and *scenario planning.* The goal of our documentation approach was both to support the presentation of the workshop outcomes during the symposium, and to create an open, 'intermediate level' annotated record of the event activities for broader participants and audiences.

In this paper we present our hybrid multimodal framework for capturing, annotating and presenting the activities, processes and generated artifacts of research through design practice. After surveying prior work, we describe the implementation of our data collection and presentation approach during the Emerge symposium, and the subsequent integration of the captured content into a 3-month participatory exhibition at the ASU Art Museum in Phoenix, Arizona.

Prior Work

Research through art and design

Art and design research explorations within technological and scientific domains have generated a rich understanding of 21st century contemporary aesthetics [16]. A growing body of work across multiple disciplines extends the integration of art and design techniques with established research practice, towards a comprehensive formalization of *research through design* as a discrete endeavor in and of itself. Building on Christopher Frayling's inquiry based distinction between research *into*, *through*, and *for* art and design, practitioners and researchers to date have primarily focused their efforts on exploring the realm of research through art and design [5]. This approach is particularly evident within academia in the UK, Europe, and Australia/New Zealand, where there is a strong tradition of practice based research in the arts and design [15], in addition to a substantial body of work aimed at analyzing, evaluating and understanding such practices [2].

The primary contributions of research through design approaches are typically encountered as artifacts or systems that seek to encapsulate the thinking and ideas of the production team within their material form [7]. From the manifestos of the Critical Engineers [10] to the speculative design work of Dunne and Raby [4] or the design fiction practice of the NearFutureLaboratory [1], the past 15 years have witnessed a growing body of provocative work aimed at instigating broad social discourse. While this is of course valuable, much less attention has been directed in describing the *process* by which these future-oriented artifacts are conceived and created. This lack of documentation, highlighted by Zimmerman et al. [17], makes it difficult to formally compare and evaluate the diverse outcomes generated by research through design. There remains a relative lack of formalized procedures or systems for capturing the tacit knowledge evident outside of the presented artifacts themselves. The recent proposal for "annotated portfolios" provides a framework for coherently presenting a collection of artifacts as "a systematic body of work", annotated according to a variety of features such as perspectives, relationships and implication shaping [13].

Our work seeks to extend the notion of annotated portfolios by creating a hybrid physical/digital documentation framework for capturing, annotating and presenting both the *products and the process* of research through art and design initiatives. Presented as an integration of mediated experience capture and management, our approach is guided by insights gained from analog and digital documentation and presentation methods.

Event Documentation and Presentation

Pioneering documentary filmmaker Ricky Leacock described his filmmaking practice as 'the search for the feeling of being there' [12]. For Leacock, significant moments are captured for later arranging as meaningful audiovisual sequences running after one another. From this realm of professional documentary making, we now have a multitude of integrated capture devices and representation media enabling us to record, summarize and share significant events. Documenting the 'feeling of being there' no longer just encompasses a singular team capturing physical presence. It now involves distributed individuals and groups generating and sharing content, together with a dynamic set of virtual activities associated with 'being there'.

This new era of documentation is ripe for tackling the mediated complexity of contemporary art exhibitions, international conferences, biennial expositions and summer festivals. In addition to professionally produced content (e.g. the large archive of TED talks), there are growing collections of captured amateur and social media content expanding event representation on outlets such as Twitter, Flickr, Facebook and Pinterest. Creating an integrated and diverse record of an event allows for the emergence of multiple perspectives and enriches the potential for the continuation of post-event discourse.

Museums and galleries have been at the forefront in adopting new technologies and tools for archiving, presenting and navigating exhibitions. Mobile applications and adaptive guides have proved useful in personalizing experiences for visitors [11]. Attempts have also been made to motivate reflection on exhibits and encourage communication both between visitors and with the host institution [9]. Our approach is to marry findings from the above in creating a hybrid physical/digital exhibition that encourages conversation and contribution in a playful, creative, and research-focused environment.

Documentation Capture Framework

Building on this prior work, our multidimensional documentation framework was developed in collaboration with the overall event organizers to minimize disruption and ensure that the presence of recording instruments and documentation team members was integrated as well as possible into the planned workshop activities. Our framework provided a distribution of capture techniques ranging from passive to interrogative, public to private, analog to digital, and situated to online. Details of the integration of content captured by social media activities, passive recording devices, a custom design probative installation and a trained documentation team are described below.

Passive Capture

To gain an overall sense of general participant movement and collaborative group interactions during the workshops, we installed passive web-cameras in all nine internal workshop locations and at several key outdoor locations. Imagery from these cameras was collected at a rate of one image per second, capturing general activity in the space from

preparation, through the event, and subsequent tear down. Image data from these spaces was streamed in real-time to a custom-designed application displayed on a screen in an entrance hallway to the main presentation spaces.

Social Media

Prior to the event, we established groups on Flickr and Vimeo and promoted their use to all upcoming participants. During the symposium we prominently displayed information promoting use of these platforms for casually collecting media. We also invited all participants to use the Twitter platform as a commentary space and encouraged the use of the event hashtag. For participants either unfamiliar with or non-users of Twitter, we modified a Twitter public display application previously developed by the authors. This application provided attendees with a dynamic glanceable interface displaying tweets annotated with the event hashtag and encouragement to contribute.

Design Probes

Traditional documentation techniques emphasize the role of third parties in preserving a record of proceedings. However, attendees at events are increasingly key to its communication and curation, particularly through social channels. As part of the experimental approach, we sought to engage attendees in actively contributing to the documentary effort. The first was a variation of Gaver's cultural probes [6] designed to enable the participants to document how their workshop unfolded. Each symposium workshop was provided with a kit containing a variety of artifacts to facilitate first-person documentation (e.g. two disposable cameras; a USB drive; sketch sheets; and a series of comment postcards. As many of the workshops would mix both discussion with digital production, the USB drive not only facilitated the exchange of digital content within the workshop, but also provided us a record of that content. When the workshop was completed, the artifacts were returned to the probe kit and collected.

Figure 1. The exterior of the *Probotron.*

In addition to examining the in-the-moment evolution of the workshop through collective curation by its participants, we developed a second capture method that explored the individual participant experience from a broader frame. An installation, named the *Probotron*, was created and situated in the primary venue of the symposium (see Figure 1). Appearing similar to a photo booth, the Probotron blends technology and a large physical structure to deliver a space for reflective contribution. Each visitor to the booth was asked to choose one question from a larger set of future-themed prompts developed by the event organizers and record a short one-minute response. Questions included: "What kind of future do you want to make?"; "What is going on in your workshop at the moment?"; and "How can innovation be responsible?" This offered participants an opportunity to record their personal perspective on the proceedings, or provide a reflection on the significance of the event as whole.

Documentation Teams

Documentation teams were formed from the student cohort of a 7-week course (co-developed by the authors and two anthropologists) for social science and digital culture students. The students received training in ethnographic methods and observational media documentation, logging and annotation. Each workshop was assigned two dedicated documenters who captured events using hand written field notes, digital photos, digital movies and audio recordings.

Emerge Symposium and Workshops

The Emerge symposium was focused around the topic of artists and scientists redesigning the future. The nine event workshops focused on different themes, led by experts in areas such as design fiction, sci-fi prototyping, archaeology, the arts, gaming, and technology studies, Each workshop had between 20 – 25 registered participants, with a relatively even distribution of theorists, designers, artists, makers, scientists and engineers per grouping. Over the course of two days, the workshops would engage participants in a variety of activities including - writing letters to their future selves, sculpting and 3D printing futuristic artifacts, fabricating material evidence of a former civilization, envisioning possible energy scenarios, and writing and producing a design fiction movie.

At the beginning of the workshops, the documentation teams introduced themselves to the participants and invited them to open and examine the documentation probe toolkit. The team also directed attention to the *Probotron* and the variety of associated social media platforms available for sharing and tagging content. At the end of each day, the documentation team members met to transfer material to a main server and lightly annotate the content using categories such a location, participant names and activity type.

The final day of the symposium was open to the general public and included presentations from the workshop leaders as well as keynotes by speakers such as Bruce Sterling, Neal Stephenson and Stewart Brand. The event finally concluded with an hour-long immersive outdoor performance piece. The performance included 3D video projections across multiple buildings, with an immersive 3D audio environment triggered by the movement of the audience. Improvising actors moved through the crowd enticing the audience to engage with interactive sculptures and animations. Three interactive installations were thematically related about the idea of a futuristic circus, with novel takes on fortunetelling, magic mirrors and a carnival organ. The documentation teams spent the day in designated locations capturing all of these events using Flip cameras and still image cameras.

Figure 2. Actor interacting with the crowd during the final performance. Photo by Robbie McCarthy.

Data and Annotation

The documentation team produced over 1 TB of audiovisual data, including 1,173 photos and 1,498 videos. Ninety usable video clips were created in the *Probotron*, while the documentation kits were used extensively by two workshop groups, and in particular one group who spent a whole day collecting material for their presentation on the USB stick. Building on the rudimentary metadata associated with the captured media content during the event, we expanded our annotation framework to specifically encompass features related to design activities and practice. These categories included: Discussion; Research; Planning/Strategy; Introductions; Summarizing or Conclusions; Argue/Debate; Analysis; Synthesis; Making; Prototyping; Refining. In addition, during this primary stage of analysis, all recorded content was annotated according to its level of fidelity (i.e. poor quality/unusable; reasonable quality; high quality). Content of the highest quality from each of the workshop categories was selected by the authors for richer description, whereby annotation of participants, locations, summary details or thematic labels was attached. This data was derived from the public schedule, review of the captured data and in consultation with the documentation team members assigned to each workshop.

Exhibition as Annotated Portfolio

The purpose of designing a curated exhibition using the event findings and outcomes was multifold. Together with the symposium and workshop organizers, we were interested in exposing the foundational ideas, methods and practices engaged in by the invited participants to a more general public audience. While the final workshop presentations were attended by approximately 300 members of the public, and edited online videos of the presentations garnered several hundred views, creating a more refined and accessible presentation format had the potential to greatly extend the reach of the work. In addition, we wanted the exhibition to be both an encounter with this form of design research and a direct invitation to participate.

Working closely with the symposium organizers and the curators of the ASU Art Museum, we developed a multilevel annotation and summarization schema identifying common representative themes and features across the collected data. While some of the generated artifacts were obvious and self-explanatory (e.g. well edited movie), others required a more nuanced, translational or indeed transformative approach in developing an appropriate surrounding context. We also identified key workshop activities (e.g. writing letters to the future, sculpting futuristic objects, contributing video responses) that translated well to a conception of an exhibition space as open, participatory and inclusive.

Figure 3. The main exhibit room containing the View-Masters, iBook, 3D printed objects, letter writing station and comic. Photo by Craig Smith.

Reeves et al. proposes a taxonomy for spectator experience design that accounts for the relationship between visitor as performer and observer [14]. Our target audience would include regular visits by mid-size groups (10 – 30 people), which necessitates consideration of processes such as turn-taking, waiting and public performance. The interactive installations created for the original public event contained both 'secretive strategies' such as the *Probotron* where the input and feedback interaction takes place in private, and 'expressive', such as the fortune telling *FutureSphere* (see Fig.11 later), where performers and spectators alike are privy to all aspects of the interaction. Our intent was to build on these different experience modes by

creating exhibit elements for private/public use and for individual/collaborative interaction in order to maximize engagement and reflection. The overall framing of the exhibition was categorized as "Redesigning *the future",* within which audiences could view, contribute and annotate three curated content collections (see Fig. 3 for photograph of the main exhibit room).

General commentary

To introduce exhibit attendees to some of the primary content themes and design practices of the event, we presented a variety of quotations at the main exhibit entrance (Fig 4). To select the quotes, we both mined the event tagged Twitter data for evidence of quoted phrases from the keynote speeches that the original audience tweeted about, and also searched through the video content for ideas and phrases that propagated from speaker to speaker throughout the event. Using the quoting and re-commenting features of social media data functions helpfully as an initial filtering mechanism for ascertaining selective public interest in a dataset.

Figure 4. Introductory panel displaying significant quotations from the design symposium speakers. Photo by Craig Smith.

Workshop Summaries

We categorized the workshop documentation and outcomes into three collections based on their inter-related themes and topics: *Embody the Future; Envision the Future;* and *Design the Future*.

The *Embody the Future* collection was the smallest in scope (photos and a large infographic, see infographic in Fig. 5) as it represented 3 workshops that were primarily discursive and ended rather inconclusively. As a result, we focused mainly on expanding the aim and reach of the tangible insights gained from the other more design-oriented workshops. The two resulting collections contained multiple activity sites inviting visitor contribution, annotation and commentary and demonstrate use of a range of summarization approaches at varying levels of abstraction.

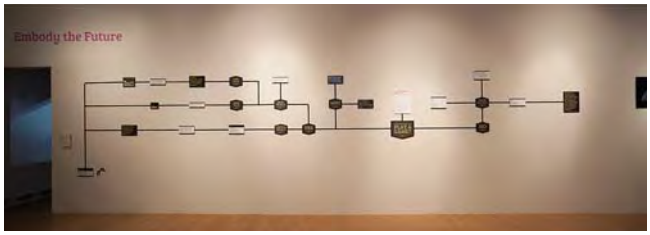

Figure 5. The infographic wall. Photo by Craig Smith.

The *Envision the Future* collection presented visitors with both designed artifacts and a window into the design process behind their creation. A bound book of annotated imaginary artifacts was presented as a form of future history book. The genesis of this artifact was introduced through a series of framed 'letters to the future' written by the workshop participants. Attendees were invited to write and contribute their own letters to the future at a nearby writing desk. This open-ended, long-form activity was complimented with a more constrained platform for contribution at the sci-fi prototyping workshop installation. Here the workshop participants had used storyboarding as a method for considering future health scenarios. We selected one of these scenarios and produced a graphic comic, with a final blank whiteboard panel for participants to complete (see Fig. 6). A time-lapse camera was placed above the exhibit to capture the creation, removal and re-creation of multiple possible endings. This form of quick, directed annotation provided visitors with a less time consuming way to contribute, and proved popular with children.

Figure 6. A child contributes an ending to the comic panels.

A workshop on future energy solutions produced a relatively dense final Powerpoint presentation requiring considerable expert or insider knowledge to decipher. In this instance, our curatorial approach was to depict the findings through various levels of mediated abstraction. First we created simplified short story statements representing each of the proposed energy scenarios (e.g. "Green Silicon Valley" or "Hippies and Cowboys"). We then illustrated these

stories using images mined from the Flickr creative commons archive. These images were accessed using a fun and familiar analog View-Master device (one device and set of 7 images for each story), and visitors were invited to contribute pithy responses on post-its for posting around the View-Master stand (see Fig. 7).

Figure 7. A child engages with the View-Masters, in the background contributed suggestions are seen on the wall.

This particular facet of the exhibition could be viewed as almost entirely an annotation in itself, as little of the originally produced material was used to illustrate the workshop event. The various presented components functioned more as indexes soliciting further high level 'tag' annotation.

The *Design the Future* collection presented artifacts and documentation from the three workshops that addressed design fiction directly. One workshop produced a high-quality movie about the convenience store of the future, which was directly presented in the exhibit, along with a curated selection of the fake future products (e.g. panda jerky) featured in the movie. The creation of the artifacts could be understood by examining them to hand, while the short 5-minute movie demonstrated their use in context, thus requiring little additional description. A workshop focused on 'archeology from the future' resulted in the creation of clay and 3D printed future objects, which were inspired by the development of imaginative personal narratives by workshop participants.

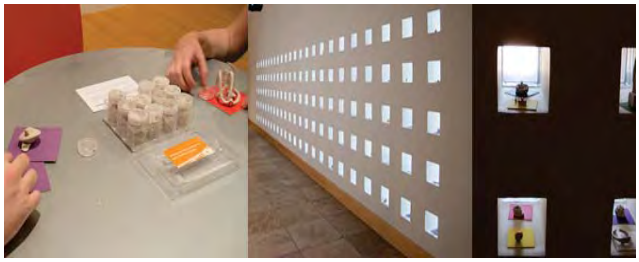

Figure 8. Attendees create future oriented clay objects and then leave them for display at the museum.

We selected four of these clay/3D model sets for inclusion, annotated with a summarized text version of their original inspirational story. In addition, we created a collaborative clay making and display space for attendees to *contribute and annotate* sculptural contributions to the archive, by creating their own future objects annotated with descriptions (Fig. 8).

One of the workshops adopted a highly improvisational design approach, punctuated and directed by multiple episodes of collaborative group decision-making. The group created two large-scale outdoor sculptures, and gathered a rich collection of media materials for their final presentation, which illustrated (falsely) how these sculptures came into being.

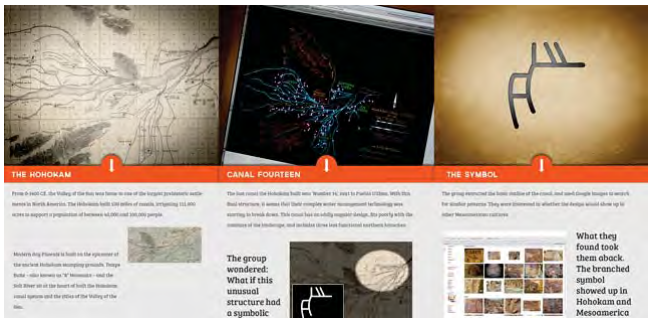

Figure 9. A reduced excerpt from the digital book.

Beginning with materials culled from the documentation kit USB drive, we created a chronological mediated story in close collaboration with the original workshop leads. Presented as an interactive iPad book, this exhibit sought to reveal the process behind-the-scenes while maintaining the integrity of the original subterfuge intent (Fig. 9).

Performing the Future

The second room of the exhibit aimed to summarize the immersive festival performance on the last night of the event.

Figure 10. The performance space included projected footage from the event, costumes and two interactive installations

We selected three costume heads from the animator performers and installed two of the interactive exhibits, one a take on futuristic magic mirrors and the other a future fortuneteller. We also created an edited 9-minute video of the one-hour performance that was projected on one entire wall of the exhibition space (Fig. 10)

Exhibition Outcomes and analysis

The gallery hosted over 20,000 visitors during the 3 months of the exhibition which was well trafficked and drew a large and diverse audience. In particular it attracted many school tour groups. In one special family day alone, over 2,500 children visited the gallery and a comparable number of students from local schools visited the exhibition. To ascertain the efficacy of the 'exhibition as research' approach we reviewed the contributed content (e.g. over 500 *Probotron* videos, 700+ objects, letters and post-it comments), and consulted with the museum's knowledgeable staff and curators. Given the high volume of tour groups, we conducted an in-depth interview with the education curator responsible for these visits. We now outline four primary findings highlighted by the curator.

Duality of Interactivity

Within the exhibition, the most popular elements were those that were interactive and tangible (the marble voting, the *Probotron* and the *FutureSphere*). Higher levels of interactivity seemed strongly coupled with popularity and appeal, particularly with tour groups. While this does appear to enhance engagement with the content there is a duality to this.

The level of interactivity on entry was immediately distracting for the younger audiences. "*I had to get them away from the opportunities to engage before they understood what they were looking at,*" explained the curator, who ultimately found that introducing the exhibition prior to arriving in the space was the best way to mitigate against this. Engagement was at times a barrier to fully understanding not just the themes present within the exhibition, but also within the installations and areas it contained. High levels of interaction led occasionally to playful exploration rather than deep consideration. On some level, and particularly for younger audiences, it may be more important to give them a compelling experience that engages and excites, rather than ensuring the completeness and coverage of their understanding. As the curator noted: "*do they really need to understand the scientific basis for everything, sometimes magic is awesome!"*

Catalyzing interaction

Only a small number of visitors were initially bounded by *"traditional gallery behavior"*, and students were reported to immediately engage with the rich space. Many of the exhibits needed no explanation, such as the *FutureSphere*, however others required an individual to initiate the group to converge upon it and catalyze others to participate (Fig 9). The *Probotron* was designed to be a private, reflective space where activities occurred behind a closed curtain. As a result, its function or appeal was not immediately evident. The curator explained that once one person explored it, and they deemed it to be *'cool'* or fun, it became of immediate appeal to the others in the group. Similarly it was noted that the infographic "*had limited appeal*" but "*once someone engaged with it they did start to interact with it more*." Given that contribution may be affected if interaction is not catalyzed, it is necessary to afford opportunity for that process to be initiated.

Mixed opportunities for engagement

Within the tour groups, marked differences were observed between the children and those supervising them. The adults were seen to gravitate towards the more involved, complex content, such as the infographic, avoiding heavily interactive pieces. The curator explained that this was not because this content appealed more to the older audience, but instead, teachers and chaperones wanted to "*make sure the kids had a really good experience, so they would go look at the things the kids weren't as fascinated with*".
Interplays between non-interactive and interactive components of the exhibition were also noted in the performance area. The *FutureSphere* (shown in Fig. 11) was extremely popular within this space, often having considerable lines. The presence of the projected performance movie offered them an alternative attraction, which could be readily consumed while maintaining their position in line. The exhibits 'cooperated' in this way.

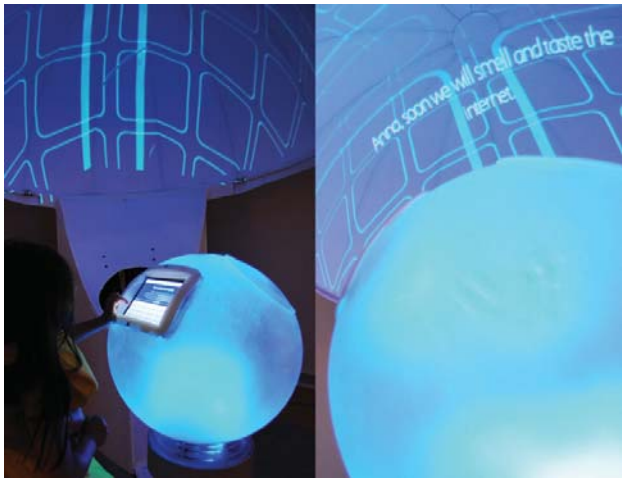

Figure 11. The *FutureSphere* in use

Both observations reveal that opportunities for engagement may be encouraged in how complex and lightweight, interactive and non-interactive elements are situated and juxtaposed with one another. Leveraging such interplays in representing experiential content appears particularly fruitful in designing for diverse audiences.

Involvement & Contribution

When introducing the exhibition, the museum guides also took particular care to explain that it represented on-going research into design fictions of the future, and that they would have the opportunity to contribute to these investigations. The curator commented that this was an exciting prospect as *"everyone likes to become part of the research."* This interest in contributing to research was evi-

dent in the effort invested in the contributions created. The activities individuals engaged with in this regard varied. The greatest number of contributions (over 500) were seen with the production of future objects activity. The creation of the clay objects was particularly popular with the children who visited and the curator noted that many of them invested a great deal of time in considering and producing these: "*I saw people spending 20-30 minutes working on their objects."* It was casual visitors who most deeply engaged with the more contemplative letter-writing task. Several individuals were remarked to have spent in excess of 45 minutes giving these compositions highly considered production.

"Everyone loved the concept of leaving an object in the Museum… Especially with the children, a lot of kids like to take things home. We gave them the option to leave it here or you can take it home. It's up to them. We were all astonished at the number of kids who decided that it was better to leave their art in the museum… Usually the majority take it home, but not on this project, even really little ones…Everyone who heard that this was part of research, really wanted to help the researchers... I think that was really appealing"

Overwhelmingly, visitors opted to leave contributions. The premise of their created work being incorporated and considered in a much broader effort was particularly compelling. In choosing to contribute in this way, it gave visitors agency and involvement in a much broader discussion and this considerably changed the relationship between them and the ephemera they produced.

Conclusions

Our work extends the concept of an annotated portfolio to propose the use of a considered documentation approach throughout the design process. Of particular value for capturing, organizing and annotating the artifacts and practices of research through design, our framework adopts an open contribution and annotation model to include diverse curatorial perspectives. Explored through a curated exhibit and developed as an online platform, our approach supports the presentation and dynamic re-presentation of annotated content at both personal and community filtered scales. Conceived to illuminate the methodologies and processes of research through design, our work has impacted the original event participants, our own design practice and the exhibition visitors. Our ongoing and future research includes creating an open source version of the online portfolio platform to support design researchers, practitioners and audiences in presenting, interpreting and validating diverse design contributions.

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Researchify: Artists' Research as Disruption

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Abstract

My practice-based research explores what is invisible in the visual realm in order to investigate immanence, haptic perception, and non-visual knowledge. I approach the non-visible realm through video, animation, writing, installation, experimental collaboration, and drawing. Through this context, I ask: what is at stake in the recent shift in Canadian academic institutions for artists to define their work as artist-researchers? While this shift does suit the practice of many artists (myself included) it also carries a dangerous edge, a subtle implication that applying 'research' to art practice entails a more rational, articulable, or self apparent explanation of the function and value of art. The coined term "researchify" exemplifies this erroneous rational order. I argue that this urge to "researchify" is a dangerous tendency, and artists must protect the unutterable lacuna within their process. The leap of perception in the art experience remains fundamentally within experiencing the art itself. Art is an encounter that exists through the act of making and/or through the viewer's experience, accessible through phenomenological investigation. I apply the basic tenets of Gilles Deleuze's fold, Giorgio Agamben's lacuna, and Laura U. Mark's immanence of irreversible time to eschew rational over-determination.

Keywords

Artists' research; immanence; encounter; phenomenology; Deleuze; Agamben; lacuna; Laura U. Marks.

Introduction: The Limits of Reason

As a contemporary interdisciplinary artist I use video, new media, animation, writing, installation, experimental collaboration, and drawing to investigate immanence, haptic perception, and non-visual knowledge. I have been drawn towards animation for its inherent ability to suggest the flight of the imagination, and to irritate the rupture between what is actual and what can be represented. Throughout my art practice I have been drawn to implicating what is non-visible in the visual realm. The unseen yet apparent is often the driving force in my work, and it manifests in different forms. My recent research *Invisible Histories* explores the unseen through site-specific media art in public venues. [1] I create interfaces, artworks and situations in which the public can engage with new media that addresses their physical place in the world.

This way of working allows me to connect an art experience to emergent technologies, and our very localized, specific, sensory ways of being in the world. People, technology, and the landscape combine in magical surprises.

The catchphrase 'artist researcher' fits my practice as my body of work has arisen through a critical engagement and theoretical reflection that results in the production of artworks. The thinking and making are inextricably linked by "research in and through art." [2] As the term 'artist researcher' becomes a burgeoning category within academia, I am drawn to questioning the basic tenets of this shift. What fuels the expectation that artists can or must 'researchify' their practice? The term 'researchify' playfully and sardonically prods the question of how art is legitimized within academia. [3]

With the concept of 'researchify' I am referring specifically to a relatively recent shift (in Canada) in standards placed on artists teaching in universities to 'researchify' their practice. Artist research can be defined as both "research *for* art" (the range of practices that both inform and constitute artistic production) or "research *through* art" (where artistic practice becomes a vehicle for producing and presenting new knowledge)." [4] I am interested in the political stakes at play in the insistence to 'researchify.' Through this poetic reflection I aim to embrace, decry and celebrate the contradictions and complexities of artistic research methodologies. How does individual artists' creative research play a role within this larger debate?

'Researchify' implies a rational order by which we justify creative outcomes. *reasonable & senseless* is the title of my twenty-channel video installation. [5] Each video channel shows footage of an historic, human made, disaster with an animated letter superimposed upon the footage. When the animated letters are read across the twenty channels they spell the title of the work. The phrase *reasonable & senseless* implies that pure reason itself is a senseless force exemplified in the human made technical disaster. This type of disaster is not an accident, but more of an inevitable conclusion to a series of steps. Given the limits of reason, and its senselessness, how might we articulate the way individual processes emerge through studio practice? Besides an imaginative intellect, what other types of knowledge are at play for artist researchers?

The Cult Of Efficiency

The shift from art practice to practice based scholarship suggests that to 'researchify' art making entails an attendant shift to a more linear or rational process. In the Massey Lecture, *The Cult of Efficiency*, Janice Gross Stein observes that our current time is steeped in the cult of efficiency to such a degree we lose sight of the difference between what is efficient, what is efficacious, and what has lasting effect. [6] The act of creative making is not entirely knowable, and to present this process as fully articulable is to grossly misrepresent it. As an artist, my work is rooted in the traditionally poetic, and as David Jhave Johnston notes, this entails vulnerability, uncertainty, and epiphanies. [7] Embracing the irrational in art making takes us to surprising connections, linkages, and insights. To embrace the creative process, and to do it justice in writing, we cannot just blindly defend it, or attempt to fully define it but must cleave to a process that remains fundamentally outside of language. From my current experience within academia, I witness this uneven terrain between the cliché of inarticulate irrational genius, and extreme formal analysis, thus I am striving to define a more nuanced middle ground. Writing alongside my creative process demands poetic devices to articulate its terrain with any degree of precision. How do we bridge this space between the nuanced processes of sense making in practice with an entirely proscriptive act of telling? It is of utmost political importance for artist-researchers to privilege their ever emergent shifting studio work as a *lacuna* within the fixity of language, as a creative process that cannot fully enter into verbal coherence. The artistic medium of a works' realization is its most precise articulation and cannot be simply transcribed into words.

My interactive video installation, *and all watched over by machines of loving grace*, is a collaborative work created with artist Ricarda McDonald. [8] The title is from a 1967 Richard Brautigan poem that suggests a loving, caring machine gaze watching over humanity. In the gallery two enormous video eyes follow the visitor as they enter the installation. The work questions the uncontrollable growth of surveillance by machine networks and the values of those systems. The installation confronts the viewer with a silent system of dominance, and hopefully, attains this with some absurd humour. This work exemplifies a recurrent idea in much of my artwork: the power of what is omitted, elided, invisible, or unutterable. Language, or rather, absent language, is often the driving force in my work. It is precisely this crux of what is un-representable that my creative process springs from. When I create absence as presence in my work, what is this elusive thing I attempt to locate?

Absence As Presence

In the exhibition announcement for *Making is Thinking*, at Witte de With Contemporary Art, curator Zoe Gray states that the process of thinking cannot and should not be fully stripped away from the process of making: "An increasing division between making and thinking has marked European society since the Industrial Revolution." [9] If we refuse these binary ideologies such as concept and form we come to more productive outlooks. One such perspective is that there is a form of thinking inherent in making which can never be fully stripped from object-hood. The art object isn't just a thing, it is a thing in flux. At times it is merely an expensive object, and at others, a deeply affective en-

counter charged with meaning, and most often, both at once. My consideration of both the act of making and our critical reflection must lead me to privilege the making or encountering the art object, not to abstractions such as merely reducing the logic of the object to its market value, literary condensation, or other mediations. We can't sell, speak, or write away the art.

What might some productive models outside a division between making and thinking look like? What art making strategies encapsulate an intertwining of experience and modality? How might we be speaking within the synchronous mode of making? New forms begin to assert themselves such as simultaneous creation, exhibition, and discussion. In 2012 I was invited to present at an art lab by the hosts BADco, at Klub Mama, Multimedia Institute, in Zagreb, Croatia. [10] The BADco collective is comprised of five performers, dancers, choreographers, two dramaturges, and one philosopher. The central exploration for our gathering was the intersection between the agency of images, the performance of the body, and the apparatus of seeing. In the art lab model, the exhibition of work in progress is presented alongside the written and verbal considerations of the work. This conjoining allows for a phenomenological opportunity for investigating and negotiating layered meanings together. [11] It creates an open arena in which the improvisational and the written are equally present. As a group of experienced creators, we conjointly confront creative struggles in a shared encounter. In opening to each other's unfurling work we engage in a phenomenological co-creative trajectory. In this model, making and thinking are coterminous, integrating both critical and creative processes. In these shared encounters, openness is crucial.

Lacuna

Dahlberg typifies this aspect of openness as key to phenomenological research: "Openness is the mark of a true willingness to listen, see, and understand. It involves respect, and certain humility toward the phenomenon, as well as sensitivity and flexibility." [12] The aim is to allow the phenomenon to present itself to us instead of us imposing preconceived ideas on it. As Finlay notes, this openness needs to be maintained throughout the entire research process not just at the start. [13] Furthermore, in teaching the process of studio research this openness must also be maintained. Perhaps co-creating the moment of research becomes the only ethical way in which we can teach that moment of creative unfurling, as it is as we encounter it in the studio: uncertain, barely perceived, in error, in omission, repressed, or barely visible and limping. Like other forms of phenomenological research, studio work cannot be simplified of its multivalent possibilities. Dahlberg notes "the best phenomenology highlights the complexity, ambiguity, and ambivalence of the participants' experiences…. researchers need to be "careful not to make definite what is indefinite." [14]

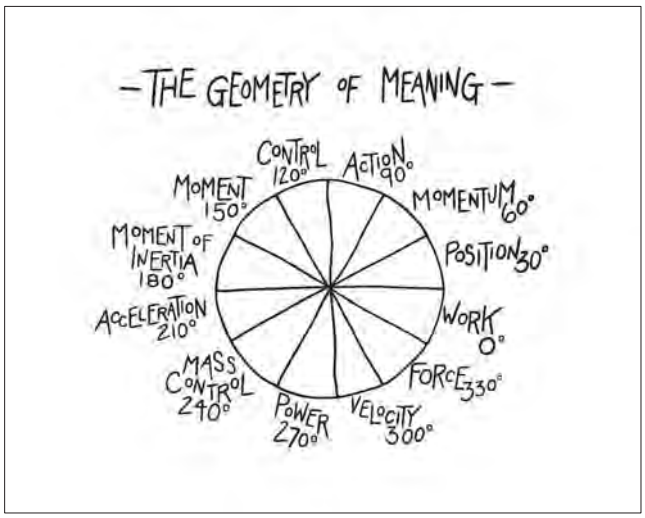
To 'researchify' is to deny the complexity in which we are deeply embedded: as subjects we are never separate from the object of our creative study. As we near the object of our study, our process entails an inherent, inarticulate interface that is in fact our own lacuna, our own pre-cultural, pre-lingual selves, indivisible from its enmeshment with the world. Giorgio Agamben articulates this idea of the lacuna when he writes about the impossibility of testimony. For what testimony reveals at its core is "the non-language to which language answers, in which language is born." [15] I press up against experience, against making, precisely because I cannot utter experience any more than I can utter what resides in my own non-language. The impossibility of mediating experience is the central idea in my single channel video *the bell*. [16] The work has a short, subtitled narrative that conveys the idea that although the nature of experience cannot be fully articulated, it sings out in our silence. The narrative revolves upon a song that is almost impossible to listen to, and yet the song moves towards articulation despite the impossibility of becoming fully divulged in that process. Perhaps the song is the very impulse to make art, to push up against the limits of representational systems.

Flow

Emphasizing the gap between representation and what cannot be articulated is a strategy to highlight our nature as a human subject, as a Deleuzian fold of "the outside folded in" and hence, "an immanently political, social, embedded subject." [17] In this complexity our apprehension is also inherently misapprehension, and slippage is always entailed in the process of articulation, or art making. Here is where sense making in the studio exists, where creative bifurcations improvise previously unforeseen outcomes.

In *Enfoldment and Infinity* Laura U. Marks states that our primary relationship to perception is not to "measured time, but to lived, irreversible time" and that this relationship constitutes "a 're-enchantment of the world.' This is true immanence. If time is irreversible, no law can predict the outcome of an experiment (such as life); instead, things in their particularity, and people too, bring about new states that could never have been imagined." [18]

To 'researchify' is to artificially slash apart the myriad complexities of the creative process. The urge to 're-searchify' is borne of an industrial model that has clear political agendas in the separation of concept and form. To cleave to the immanent is to refuse this separation between concept and form, to refuse an institutionalization of formal analysis that results in the dematerialization of the art object, the art form and the art process. The ink drawing, *The Geometry of Meaning*, clearly spoofs the ideological function of extreme formal analysis. [19] In a similar vein, Fredric Jameson notes a similar institutional "irrepressible urge to identify all thoughts with a named source." [20]



When I bring my own strategies as an artist into the pedagogical process, I am challenged to sustain the gap between representation and what is unknowable. To sustain the lacuna, gaps, and slippage in the studio process is to present it whole. Otherwise I am locked into an artificial rank-structure as an expert who produces knowledge workers rather than being one of a collective in a creative response to the learning studio situation. I'd like to highlight this strategy, that of the collective creative response, as I see it as exemplary of the type of integrated approach I am urging as an ethical response for the framing of artistic research and the teaching of art. It suggests a shift, from knowing to doing, from visuality to haptic engagement, from expertise to creatively exploring our collective not-knowing. This process, this shared flow, stands in contradistinction from the urge to 'researchify', which is essentially stratification. Perhaps this is what 'researchify' best exemplifies: that institutions can tend towards stratification. As artists, we are within the institution to challenge stratification through he reinvigoration of forms, of understandings, of practices, of definitions, of languages. We inhabit the creative response manifested through research, and are part of the process of ushering in new forms of research within the institution. It is our creative bifurcations that accompany this shift from stratification to flow.

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[Session 15]

Bodies and Presence

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Chair de lumière by Marjolaine Béland: How Disruptive Conditions and Mimicry Capture Attention and Favor Empathetic Resonances

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Abstract

This paper examines the experience of *Chair de lumière*, an artwork by media artist Marjolaine Béland, that aims to create conditions of the apparition of the double, our double of light. By analyzing the disruptive conditions of illusions and performances that the artist orchestrates, we come to understand how cumulative effects –the architectural components and accessories, the involved audio and video technologies, the infiltration of two performers in the space and the interplays with light, transparency and reflection– build an aesthetic event in five different Times. The key factors of the aesthetic event are the mimetic human or non-human performances. The resulting empathetic experience with projections/reflections/refractions and the performing bodies induces ambiguous and tense sensations. Then the phenomena of mirror neurons contribute to clarify these ambiguous feelings, by distinguishing the visuomotor and the visual aspects that are entangled. Finally, the miming gestures of the participant and one performer and vice versa are exemplary of an intense affective moment constructed by micro-disruptions and resonating in the suspended Time.

Keywords

Apparition, double, light, mimicry, movement, empathy, mirror-neurons, performance, reflection, projection.

Disruptive Conditions in Actual Art

In actual art creators use many disruptions, be it scenographic, choreographic or technological, to divert habits of the participants and create singular conditions for building an event.

To start, there is often a blurring of the perception to destabilize the body, to alert its presence and to capture its attention and orient it. The inaugural disruption may be brutal (stroboscopic lights, extremely loud sounds, even conditions of vertigo), but the rupture of convention can also be incremental with tenuous disruptions as with the performative and immersive installation *Chair de lumière* by media artist Marjolaine Béland. With the participation of two performers, her main objective is to create the conditions for the participant-spectator to be present to the apparition of his or her double. This double of the body is provoked by variations of light, as captured and projected through a technical apparatus that she tries to make disappear in order to create room for the phenomena of appearance and vanishing and also by the powerful amplified sounds that subliminally affect the balance of the body in acting on the vestibular system.

In September 2013, Béland invited the public to three Evenings-Events at La Chaufferie, au Cœur des sciences de l'UQAM, in Montréal on Thursday September 12th starting at 6:26 PM, Saturday the 14th starting at 6:22 PM, and Sunday the15th starting at 6:20 PM. Personally, I participated in the September 14th event, which started a few minutes late for final adjustment to be done. Before opening the doors, she asked us to wait in the park while the sunlight was decreasing. These three Evenings-Events constitute the creative portion of Béland's doctoral research and thesis that she just completed.

Chair de lumière: General Description

A brief description of the event found in its invitation states: "*Chair de lumière* is an immaterial and impalpable work whose form is on the border of media arts, film and performing arts, and where the 'faire œuvre' of the phenomena of appearance is based on the ephemeral, the improbable and the fugitive, on the nebulous, the vague and the uncertain, on the nonlinearity and the unexpected, on the imperceptible sensory impression of the viewer.'' [1]

In other words, *Chair de lumière* proposes to the 'participant-spectator' an experience where he or she, while remaining themselves, becomes the actant of the experience going through a quest of indexes. It goes from exploring the architectural space and listening to sounds, to looking at the screens and window reflections, to observing the effects of a light projector and of a kinect capturing movements that are superposed to the seeing of performers walking outside and, at some other time, to the performers playing with a veil before final mimicry with one participant.

In front of the entrance, a laptop screen on a pedestal shows five chronometers with citations in the margin. Attracted by the screen, participants-spectators star at these chronometers, trying to figure out what dimension of time the first one is calculating while the others, indicating a specific duration, are waiting for their unknown cue.

A few moments later, the four speakers start to emit more and more amplified and transformed recorded envi-

ronment sounds, interfering with the physical sounds of the locus and its occupants. Gradually the external environment filled with anonymous people is doubled by the projection on the south wall screen provoking illusion and distorsion. The performers discreetly stroll outside, visible from the mural windows west to east and vice versa, while their duplication on the south wall screen opposes the other portable screen on the north side of the room.

First dilemma: is it in real time or in delayed time or both? Hard to say, maybe a mixture of both.

Second dilemma: by watching one screen, what do we miss that is being shown on the opposite one, the same thing by concentrating on a direction east or west or a specific portion of the room or the accessory of the veil?

All of these conditions with the deployment of the performance live and captured create five different phases of a new spectatorship. As Béland writes, they are:

- Time0: time prior… 22 minutes;
- Time1: time of exploration and immersion. 13 minutes ;
- Time2: time of illusion. 10 minutes ;
- Time3: time chiasmus. 30 minutes ;
- Time4: time of suspended work (…). [2]

As I experienced, this spectatorial investment evolves from Time0, observing artificial light taking place and searching for indexes, to Time1, from peripheral spatial attention to intensive immersion, to Time2, engaging an encounter with things invested by the performers and movements generating reflections, to Time3, movements of performers and engaging mimicry with participant-spectator before capturing somebody else, to Time4, dissolution of illusions, movements and projections.

Béland's installation integrates different qualities and intensities of light (daylight, light from the screens, the projector, filters, etc.), various form of movement (walking, dancing, playing and fighting with the veil, etc.) and of their double (projected, captured, lighted, reflected and transformed). First, she invites us implicitly to attune with the end of the day outside. Second, once having entered into the room, she slowly captures our attention, playing with duration through the sound projection and she mobilizes our expectation with the chronometers. Third, she coordinates the superposition of the recorded sources of images and sounds with the performance live *in situ*.

Immersed in a monumental space with big fenestrations on the west and east side, the set up built a continuous and changing effect of doubling things and humans, with increasing illusion up to engaging our body in mimicry.

From disruptive conditions to illusion

Béland's technoartistic 'mise en phase', different than 'mise en scène' more stage oriented, crosses disruptive conditions from the architecture (whistles from heaters, pipes noise, heat from radiators), from the use of accessories (lines of red paper pasted on the windows, white veil on the windowsill), from a mixture of devices and softwares (wall giant screen, computer screen on a pedestal, kinect, projector, four speakers) and from the participation of two professional performers infiltrating the inner and the outer space, and eventually transforming us in mimetic performers.

The scenography induces:

- a rupture from accelerated urban life to a slowness of waiting;
- a delay while watching the twilight;
- a gradual pulse taking of the place in tune with the descending darkness and the increasing artificial light;
- a transitive passage from individual presence to collective state;
- a plurality of projections/reflections/refractions transforming the doubles;
- five phases building a dynamic field for mimetic human and non-human performances;
- resulting in an empathetic experiencing disrupted by tensions.

Parasite Issues before Integration of Meaning

The slowness is disruptive to urban life of Montréal's downtown. First of all, the waiting awakens our perception and stimulates compensatory repositories while various questions parasitize or divert our attention.

Why starting at a specific time related to the decline of daylight and its shadows?

What do the five chronometers refer to?

Why is there a veil on the windowsill? What narrative function does it assume? Is it a micro-event metaphor of the global event?

Are the bizarre noises from the pipes and the hot air coming from the radiators conditions included in the scenography?

Are the red lines taped on the window there to capture a specific area, if so where is the camera? Is it for filming what has been done before or will be done?

Are the people traveling in the east and west sidewalks part of the event?

What is the significance of the capturing of a participant by a performer that mimics the movement she leads?

What happens to the body with these multi-layers effects affecting the individual and collective presence?

Progressively, as the magic begins to operate, the questioning proportionally vanishes as the body crosses and the bodies cross various states and feelings.

Body, Embody, Perform

"Our own bodies form lenses of experience, perception, cognition and disruption.'' [3] More and more immersed in *Chair de lumière*, the body feels, the bodies perform and embody variations of doubles. To perform here is a complex ongoing process, becoming to per-form in the words of Nathaniel Stern:

> The conception of a continuous embodiment, however, allows us to rethink bodies as formed through how we

> move in, and relate to, our surroundings. Embodiment, I contend, is not a pre-formed thing, but incipient and per-formed. [4]

Per-formed is to be underlined here in many ways. To begin, the waiting body, then, the alert body. With the intensification of the presence. The broadcasted mimetic body, the flesh in the Merleau-Pontian sense of this term in the encounter with images and others. The sensitive/emotional/mobile body. The inanimate and animate bodies, the physical and projected bodies in the space. Throughout the postdisciplinary per-formance orchestrated by the 'metteure en phase', the bodies of humans or non-humans participate in the illusion. The 'effets de présence' build an event of appearance and disappearance. As Pitozzi proposes:

> The effect of presence manifests the passage of a "body" that fits and takes place into the reception of the viewer: the trace of a movement, an image or a sound that is not there and at the same has been there, but that is no longer there now. [...] The effect, as a product of presence, corresponds to a combination of sensations that the presence induces and inscribes on the sensitive plate of the viewer's brain to produce a resonance in his muscles, in a shared dimension of empathy. [5]

It is about apparition and its modalities in the interval just before and after the illusion. It is an epiphany that induces empathy.

Affective forces that vary from one participant to another (the weight of expectation and the sensory exacerbation, the search for meaning and the plus or less easy integration of resonances, the cuts from one direction to another, etc.) and various emotional tones (the esthetic delight of some images, the joy or interest of movement mimicry, the magical effect of illusions, etc.) modulate attention and enlarge the depth of immersion.

By orchestrating the technoartistic phases with the performance of actors and their contamination of the spectators, Béland questions the political context of the accelerated speed, the virtual temporal components of urban life. By interweaving the virtual and the actual, in the Deleuzian sense of these terms, she invests spatiotemporal dimensions. Illusions open the ability of the body to feel the action seen and heard 'as if', things and beings carried out internally but externally inhibited and disinhibited. This feeling of doubling or being doubled introduces an empathetic bodily experience. Mimicry induces connection with the other. Our double? But also it provokes ambiguous feelings by seeing the performances or by feeling them as if we were doing them ourselves.

Empathy is central to understand how performance, human or non-human, is a conscious and unconscious source of mimicry. This emotional and motivational matrix influences constantly, and is also influenced by, our aesthetic experience and its multiple variations, not to say disruptions, and the ambiguous tensions that they provoke. In order to clarify what is happening, neurophysiology of empathy and mirror neurons can add some inspiring clarifications.

Empathy and Mime in the Light of Mirror Neurons

During the evening-event, the many unexpected lighting and reflecting micro-events intensify our resonance, we become empathetic with the performers, the others and their doubles.

According to neurophysiologist Alain Berthoz, empathy requires a change of point of view or of perspective. It consists of looking in our own way but within the extension of another's perspective. To do this, it relies on the memory of the past, while being oriented towards the future. Our memory has built a vocabulary of actions, intentions and related consequences that are used for anticipating situations that we encounter. [6] When we empathize, we feel what we see with an ambiguous tension. May be this tension is related with seeing only and with seeing as if doing.

These empathetic tensions gain light here with the phenomena of the mirror neurons described by Rizollatti and Sinigaglia. [7] After the discovery of mirror neurons in the macaques' brain, other studies have examined their role in action recognition and imitation in human brain.

Movements that we see have resonance in a certain zone of our own brain, as if we were doing them ourselves. Then movements from other entities penetrate our corporeity as if we had performed them ourselves, but only if we have similar movements in our vocabulary. Mimicry between the two performers that we look at and between one performer and ourself and so on, invades our individual and collective consciousness field. It has a visuomotor component that corresponds 'as if we would do it' if we have the vocabulary and, if not, only a visual component. Rizzolatti and Sinigaglia explain that, without any visuomotor resonance, it can be called following James, 'cold' or 'neutral' perception, which is devoid of any emotional colouring. [8] Nevertheless it still penetrates our body. I propose that these distinctions explain subtle feelings related to the empathetic experiencing. Neurophysiology adds neural information to diffuse experienced feelings.

So the contrast between the waiting and the incremental intensification brings at the forefront some of the conditions that otherwise we incorporate without acknowledging them. The perceived movement around us appears 'as if' they were lived in our own mirror. In fact, they are seen *in situ*, they are reflected in window and projected on screens. Mimicry reverses the inhibition of the body by unfolding its potential with our visual and/or motor connection with others. For example, in the fifth phase before ending, after the mimicry between the two performers, each performer mimics a selected participant.

When I am captured by the performer, I move in a certain way, to see to what extent she can imitate. What a surprise, her movement is very similar, except for small interruptions. As Massumi has discussed about the politici-

zation of the power of mime conducted by former United States president Ronald Reagan, "That power is in interruption. A mime decomposes movement, cuts its continuity into a potentially infinite series of submovements punctuated by jerks.'' [9] The effect of mime is immediate and affective. It carries an excess of intensity. It makes you the center of the interconnection, even more when you see your doubling on the screen and in the window. As Massumi highlights:

> The affective "atoms'' that overfill the jerk of the power-mime are monads, inductive/transductive virtual perspectives fading out in all directions to infinity, separated from one another by dynamic thresholds. [10]

In *Chair de lumière*, with the suspension of disbelief, a kind of magic settles. Through ninety minutes of passing-dynamic thresholds, a close relationship with doublings inaugurates a mimetic circuit between action, reflection and sensation. Progressively the hunt for causes fades until more complete immersive feeling prevails. In this suspended time modalities of illusions and sensorimotor modalities of tensions are subsumed by the contentment of an empathetic event and its waves of empathetic feelings.

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Alea (iacta est) – Dance of Presence

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Abstract

In this paper, I present an overview of the notion of presence in dance works. I give an analysis of the dance piece *Alea (iacta est) – the die has been cast* created by the Italian choreographer Simona Bertozzi, then follow with a comparison of dance productions that utilize motion capture.

In my analysis I define, or perhaps redefine, the concept of presence in performance within technology and human interaction, specifically Mo-Cap. The definition of presence that I propose is related to the notions of intention, attention and memory of the performers, as well as their relationship with space. The phenomenon of presence can be defined as an expansion of the body, rather than an overlapping of it; hence, my argument is that presence requires a physical body as a starting point. To be present means to maintain a certain degree of tension between the dancer's body, his or her intention and the performance space.

The research is driven by several theoretical and methodological approaches, such as: phenomenology of Maurice Merleau-Ponty, historical explorations, and my own experience as a dancer.

Keywords

presence, dance, phenomenology, choreography, awareness, Simona Bertozzi, performance methods, motion capture, interactive media arts, Alea (iacta est), Homo Ludens

Introduction

'Presence' is a controversial and multifaceted term that cannot easily be defined since it has been used in a wide variety of disciplines, such as theatre, cinema and dance. I claim that the phenomenon of presence, in dance and performance, occurs when dancers/performers have a clear intention and a strong attention that allows them to become aware of the space through their bodies. This awareness creates a relationship between time, space, body and audience.

The rising trend of the use of technology in dance and performance has changed the way we conceptualize liveness and, consequently, presence. Since I argue that to be present means to maintain a certain degree of tension between the projection of movements and their actualization in the space, I pose the question: Is the physical presence of a body necessary in order for presence to be manifested? If so, how can the notion of presence be redefined in an interactive media-art performance?

In the first section of this article, I investigate the dance piece *Alea (iacta est)*, third episode of the project *Homo Ludens* created by the Italians Simona Bertozzi and Marcello Briguglio. *Alea (iacta est)* exemplifies what I intend as the phenomenon of presence, defined from a phenomenological perspective, in a non-technological dance piece.

I then investigate the same phenomenon in interactive media-art performances, specifically in pieces that use the motion capture (Mo-Cap) system. I argue that *presence* can be defined as the expansion or the projection of the body into space. This definition allows the use of the concept of presence in a technological environment because it considers presence as exceeding of the body rather than an overlapping of it.

Alea (iacta est) and dance productions utilizing motion capture produce different results in the manifestation of the dancers' presence, but they share the same principles: strong intentions and attention of movements. To conclude, I argue that in order to create the phenomenon of presence, defined from a phenomenological perspective, a physical body is always necessary as a starting point.

Alea (iacta est) – Dance of Presence

In colloquial language, 'presence' defines someone or something that is in a specific time and place. Usually, the word 'presence' is linked with the idea of 'liveness' and of the presence of a physical body. However, in the field of art, especially in disciplines like theatre and dance, this term usually describes the characteristic of a performer being present on stage and being open to an audience. This implies that performers must have an awareness of the intention of the movements and be conscious of the relationship between their bodies and the space. According to the phenomenology of the French philosopher Maurice Merleau-Ponty (1908 – 1961), the body has a tendency to exit and open up to the world. This inclination is comparable to the projection I indicate as the source of presence.

The phenomenological approach of Merleau-Ponty can be seen as an attempt to explain how the intention of an artist (the invisible) becomes visible in a work of art. Merleau-Ponty describes the invisible not as "the contradictory of the visible"; instead he states: "the visible itself has an invisible inner framework (*membrure*), and the in-visible is the secret counterpart of the visible, [appearing] only within it."[1] From this perspective, the

notion of presence represents neither the physical body nor the feelings of the performer; rather it is an expansion of body into space. Presence does not overlap the physical body; instead it transcends it. As Merleau-Ponty describes it, presence is the invisible.

The definition of presence that I propose is related to notions of intention, attention and memory of performers because "presence implies temporality, too – a fulcrum of presence is tense and the relationship between past and present."[2]

Based on these premises, we can make an analysis of the notion of presence in the dance piece *Alea (iacta est)* (2010-11). *Alea (iacta est)* is the third episode of the project *Homo Ludens* (2009-2012) choreographed by the Italian dancer and choreographer Simona Bertozzi. This project consists of four dance pieces, each dedicated to a different character, which refer to the categories of play as defined by Roger Caillois in his work *Les jeux et les homes* (1958), based upon the book of the same name written by Johan Huizinga in 1938.

The first piece, titled *Ilynx* (2009), represents ecstasy, vertigo and the idea of the vacuum; the second is *Agon* (2010), where Bertozzi examines competition and challenge in sports; in *Alea (iacta est),* the third episode, Bertozzi investigates gambling and games in which everything is left to fortune; and in the last piece, *Mimicry* (2012), she focuses on mimesis and fantasy.

Alea (iacta est) is a duet, originally created in collaboration with the English dancer and choreographer Robert Clark, then interpreted by the Italian dancer Manfredi Perego. The piece clarifies the important role of intention, attention and memory; it also exemplifies what I defineas "invisible dance".

Bertozzi considers the body as an instrument that is always collocated in a specific time and space. The body is open to an environment and inhabits movements; therefore it becomes a witness of the space. In other words, there is an intertwining between the inside and the outside of the body; there is an exchange between the space and the performer. Dancers' actions find space both inside and around their bodies; presence cannot be seen outside the dialectic between the projection of movement and the reiteration of the bodies' action. It is in the subtle space between the visible and the invisible, between the movement and its projection, that the phenomenon of presence becomes visible.

In *Alea*, the audience sees wandering bodies moving into space, leaving their movements' marks on the stage. As Bertozzi writes:

> Starting to move only some parts of the body slowly so as to avoid leaving a deep mark into the space; it is necessary to feel its organic nature. To cut through it by connections, by casting lines between the various points of its material consistency, so as not to seal it inside a choice of physical depiction that is aesthetically pre-established.[3]

Let us consider the moment where the two dancers, Bertozzi and Perego, blindfold their eyes with their own hands. They explore the space as if it were the first time they had entered it. They constantly change levels, from standing vertical to lying on the ground; these transformations leave traces of movement that create geometries of space. Dancers construct the space through the signs of their movements; this allows the storage of gestures into the memory of spectators. Bertozzi states:

> Gestures are actions of the body that fuse a before and an after […] I experience movement as a multiplicity of figurations and possible events with the intention of generating a dialogue between the visible material and its corresponding element in absence. Presence and ghosts. Gesture and movement, thus enacted, measure themselves against a perception of time based on quality. [4]

An analysis of *Alea* allows us to reflect upon human behavior because the two dancers become participants in a play in which they are deeply involved. The play evolves as a dialogue between their bodies until it dictates the rules of the choreography.

The awareness of body and space is such an important feature of Bertozzi's aesthetic that it also inspires her teaching methodology. Her dance workshops focus on the intention and attention of the dancers using different strategies, such as somatic practices, clear thinking, and the dancers' ability to put thoughts into words. Using the information that she gives, dancers can expand their imagined, dilated bodies. Bertozzi usually asks her dancers and students to imagine their bodies and to visualize their anatomies projected into space before the movement takes action in the tangible world.

This process generates what I define as the phenomenon of presence. Presence in dance is an ability to project movements and bodies into space in order to create a tension - between projected bodies, actual bodies, and movements - which makes the phenomenon of presence visible.

Interactive media technology

I would now like to introduce and discuss the definition of presence as it relates to performances that include interactions with technology, specifically motion capture. The integration of multi-media technologies into dance and performing art requires a redefinition of the concept of presence because the use of motion captures, as well as of digital projections, has transformed our understanding of the notion of presence.

As discussed previously, the phenomenon of presence in dance means a tension between an actual movement and its projection, as well as between a physical body and its dilation in space. The definition of presence that I presented oversteps the physical body; therefore it allows the term to be applied to a technological environment. I argue, however, that the phenomenon of presence always requires a physical body as a starting point.

The use of Mo-Cap makes it possible to receive information regarding performers' movements that would otherwise be impossible to reveal; for example, a virtual movement can be read as a trace, a phantom, or as presence - as defined it in the previous paragraphs. The use of digital supports makes it possible to explore new paths, to open the field of the possible without restricting or binding the body to a predetermined order.

First of all, it is important to emphasize, as the performer and philosopher Susan Kozel notes, that there is a distortion of the term virtual. It can occur as something "embedded within the virtual-real duality and used to qualify an action, object, space or emotion that is distinguished from the real." [5] In this case, the term virtual is used to highlight the dichotomy with reality. On the contrary, when I argued that the notion of presence does not overlap the physical bodies of dancers, but concerns their virtual bodies, I was referring to a dilated body, which is an expansion or an image of the physical one. The virtual body, both reproduced by movement sensors and intended as dilated, does not identify with the physicality of the dancer; rather, what is created is a dilation of it that opens up new horizons and possibilities of movement.

In an interactive media environment, the 'physical presence' of the performer can be replaced with its virtual reproduction. Giulia Tonucci explains that, in this situation, two different processes are ongoing: the "doubling of presence" and the "amplification of presence". The former is referred to as a scission between the physical presence and its digital double; the latter is defined as "the movements captured, elaborated and then digitalized and amplified, in real time or in post-production." [6]

Tonucci's clarification is useful for analyzing creative practices, as the introduction of technologies has changed the manner in which choreographers and artists compose. The scenic composition, as Tonucci claims, becomes a new environment: new technologies offer new tools to analyze and compose it. Nevertheless, I disagree with her definition of presence because I believe that what she defines as "amplification of presence" has nothing to do with presence; rather, what she describes is the power of new technologies, considered as an instrument for learning about movements and for breaking down dancers and choreographers' habits.

On the same topic, in her book *Closer* (2007), Kozel states:

> When I encounter my digital self I discover that it is not simply me. […] The figure with which I perform is always at the same time both my own body and another body; […] If we follow Merleau-Ponty, perception is more than just the neurophysiological mechanism by which I apprehend the world. Perception is constitutive of who and what I am.[7]

In other words, the digital body is not the double of the body; it is not a different and separate entity. The digital body is the materialization of presence, interpreted as an expansion and a projection of the body and its movement. It is evident that in order to talk about the phenomenon of presence, the physical body is necessary.

However, if we consider Bill T. Jones' piece *Ghost-catching* (1999), I suggest that, in this case, the digital body can be considered as a double of the physical one because the performer was not on stage. In this digital art installation, created in collaboration with Paul Kaiser and Shelley Eshkar, the dancer's physical body is separated from its movement; movement is withdrawn from Jones' body.

The use of motion capture changes the relationship between the performer and his or her body. The description of Kozel's experience as a dancer in the event *Real Gestures, Virtual Environments* (1998) reveals similarities and differences with Bertozzi's aesthetic. Although Kozel interacted with visualized data, whereas Bertozzi established a dialogue with mental images, she performed "with visual movement data projected in real time on a surface adjacent to the performance space […] so that the visualized data becomes a partner in the space." [8] In a similar way, Bertozzi danced with space, creating imaginary shapes into it and transformed the projection of her own body into a partner.

Conclusion

This article has presented the notion of presence through the lens of dance studies and an analysis of the dance piece *Alea (iacta est)* choreographed by the Italian artist Simona Bertozzi.

I have presented a definition of presence that does not overlap the physical body, but rather oversteps it. From this perspective, presence is the invisible as Merleau-Ponty defines it; it is the ability to project dancers' movements and bodies into space. In other words, the phenomenon of presence is made visible on stage by the tension that dancers create between their actual movements and their intentions or, in the case of productions that utilize motion capture, by the digital/virtual body.

My argument is that Bertozzi can be considered new and innovative, even though she does not use any kind of technology in her works; instead she uses dance as an image-making technology. She creates and composes with mental

images in dialogue with the body and the space. Although there is no use of technology in her dance pieces, the intentions of her movements are extremely clear so that we can see the expanded/dilated body moving in space. In both Bertozzi's works and those of interactive technologies, presence transcends the actual dancing body and becomes 'visible' on stage.

Through the strong focus and attention that Bertozzi places on movements, spectators can recognize traces and signatures of her dancing body without the aid of technologies, as if her pieces were interactive media-art works where virtual figures can be perceived, touched or felt as if they were projections of dancers. The phenomenon of presence exceeds, or at least corresponds with, the performers' bodies.

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Augmented Simulacra: conditioning the post-digital body

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Abstract

This body of work explores the transformation of the human body, both physically and mentally as increased reliance upon electronic technology forces conditions of artificial that replace the "natural". This Fundamental shift in stimuli becomes a tipping point in evolution.

Keywords

Evolution, Artificial Selection, Interactive Installation, Telepresence.

Post-Body

From the beginning of human existence there has been an innate desire to control and shape both our world and ourselves. The construction of primitive tools from bone has accelerated into a dramatic shift in the evolutionary process of the human species. As the tool making species increases its reliance upon its own constructs, many residual effects work to alter its progress. Throughout time there is, and arguably always will be a universal struggle for existence, but in today's technological society the factors that dictate survival have shifted to a rupture point where the velocity of human modification of the environment is out pacing our evolutionary adaptation. The basis for natural selection put forth by Charles Darwin, states that 'through competition, generations of a species will transform or adapt itself with those qualities' [1]. By the simplest of genetic distortion, the 'fittest' will survive longer, enabling them to reproduce more often and hence contribute more of their genetic character to the species as a whole. Today, however, due to the increased reliance upon electronic technology and biomechanical engineering, the gene pool itself is shifting in a contradictory direction. The traits once considered assets for survival are now obstacles. As technology further augments the 'natural' with the artificial, the more the 'weaker' traits of the species will prevail, further perpetuating the reliance upon the artificial for increased productivity. The tools the human species makes in turn make them. Contemporary adaptation is increasingly transformed into an artificial process driven by a social collective, which seeks survival through technology.

The tools created to control the environment are now controlling us, both in how we individually function and collectively as a species. Genetic alterations are shaping our species by this very technology. Those who cannot exist or reproduce naturally are now, through the advent of technological means, living longer and reproducing more. The natural genes, which enabled their dependency upon technology is being passed through generations in an increasing abundance fostering a deeper reliance upon the artificial. Systematic cultural design is transforming the interface we use to know the world, while internally the mind is processing and absorbing a world not based upon natural stimuli passing through the body, but understanding itself from the artificial.

Biomechanical technology seeks to alter the physical body through artificial selection. From the advent of external limbs through the recent development of genetic engineering, a progressive restructuring of the physical body is occurring. Almost all cultures, both past and present, practice some from of body modification. The oldest human remains found to date, the five thousand year old mummified body of a man frozen in the ice of what is now the Italian Alps, had tattoos. However palatable the current trends of body modifications are, the future offers more exaggerated displacements of the current body image, encouraging a deeper rift between the natural and the artificial.

As an artist, I am concerned with the impact technology has over our collective development and how it further embeds itself inside of us. The notion of socially directed body modification dates back thousands of years, the Greek "super-anatomical" sculptures helped to invent the ideal form, the 19th century development of moving pictures illustrated the behavior and movement of that form, but it wasn't until the technological development of "X-Rays" that the real notion of the body changed. Today, through physical examination and reliance upon machines, we can communicate directly with the body. What the patient know is untrustworthy; what the machine knows is reliable, and those machines are shifting.

Technology is not just a tool. It is information, in that it shapes how we think and in the absence of an alternative reality (i.e. nature) what we think about and know.

Black Lung, (figure 1) an interactive sculpture, responds directly to the technological restructuring of the body. This piece consists of a compressor and a motor driven valve system, which allows the artifice to simulate a working lung in the human body. Additionally, a motion detector is added to the compressor to emphasize the need for social approval in order for the machinery to successfully augment the body. This motion detector is hooked solely to the

Figure 1: Black Lung, Interactive Installation, Bill Hill

compressor so that without the reinforcement of an audience (the masses) the machinery continues to control the physical body but grinds away unproductively. The single lung expands and contracts inside a human rib cage, pointing to the simplification of the current biological system. The entire work is mounted to the exterior of a steel box, a sign of the industrial revolution. The body becomes the skin of the machine controlled unknowingly by a passive community.

The metal box acts as an artistic reference to the pedestal of "High" art, which seeks to elevate the work from the grounding of functionality. Here the use of steel is a direct reference to the manmade alloy that serves as armor to protect the body, but ironically is functioning inversely. Similarly the organs of the body are presented outside and exposed along side the gears of the machine that is controlling the body; nothing is hidden. Aside from the literal interpretation of the need for machine to control the body and the need for other to control the machine, this work seeks to examine the very need of a body at all in a post digital world. Conceptually, Black Lung refers to pneumoconiosis developed from inhalation of coal dust that destroys the body's ability to regulation oxygen; the natural is harvested to the increased reliance on the processed. The individual is disrupted to provide for the collective, the destruction of the one body for the machine.

Conversely, *Belay* (figure 2) consists of 21 handholds attached to a wall that is 24 feet in height. Positioned at the top corner of the wall is an organically suspended sculpture with a video viewer. There is a direct reference to the human anatomy through the abstraction of the esophagus form and the video loop with resembles the view of an endoscope inserted down the throat.

Using mechanical spring contacts that compress with weight the piece tracks the users progress and rate of ascent, which then sets the frame rate of the video once all holds, have been used. Conceptually this work examines the parallel structure of control placed on exploration. Whether it is the biological investigation of the human body or the human exploration of the natural world, both are limited by the constructs of the system.

In examining the physical and social aspect of interaction, this piece seeks to engage the audience through a direct and overt methodology. Simultaneously it seeks to look inside the body both physically and emotionally with a direct reference to physicality and biology.

As our collective culture and our physical bodies coalesce with technology there is an essential and traumatic remapping of our physical and psychological networks. These electronic works are concerned with the transformation of the human species, specifically its biological components and it behavioral characteristics. This transformation or evolution is an environmental reaction to the manifestations of science and technology. These works examine the need to address the physical body and how the action of users needs to be interconnected with the interface and content of an interactive piece. From the development of opaque sculptural input devices to the use of transparent technologies these interactive works seeks to examine the process of conditioning users; their predetermined interaction and the physicality of computing.

Figure 2: Belay, Interactive Installation, Bill Hill

Electronic technology not only invades and alters the body but it fundamentally reforms the cognitive process of the mind. As the computer becomes more integrated with the developing mind, especially as an interface with knowledge, it shapes not only our understanding, but also ourselves. We are becoming a hybrid of the machines we use. By its very nature, Machines replace the activity done by humans, to displace the labor and the interaction with the natural. Additionally, in an effort for immortality, we develop machines to foster an illusion that our body and mind are separate. But when the receptors of knowing

Figure 3: Nomadic Dominion, Interactive Installation, Bill Hill

change so do our understanding and we can never return to Plato's cave. This not only impacts the function of the body, but the environment in which the human interacts and knows.

Michael Foucault, in his text *The Order of Things*, refers to these spaces that disrupt conventions of order as "heterotopia". Heterotopic sites seem familiar, as they are subsumed within a society's conventional ordering system that links them to other sites, yet they are unfamiliar in that they simultaneously contradict the premises by which these relationships are sustained.[2] Therefore the complexity of these machines destabilize the seemingly straightforward transcription of real space and create not only an inverted but parallel space. We know ourselves and our word thru mediated experiences with a disrupted reality, or to use Foucault's word an *aemulatio*; the idea that patterns of resemblance can occur between things despite the spatial distance separating them: "There is something in emulation of the reflection of the mirror: it is the means whereby things scattered through the universe can answer one another." Of course, the problem is which is the reflection and which the reality? Foucault responds by stating that "emulation is a sort of natural kinship existing in things; it arises from a fold in being, two sides of which stand immediately opposite to one another." [3] As a result, multiple 'realities' are juxtaposed. It is even more intriguing to consider the mediate experience as unique sites in which the fictive space of utopias and the real space of heterotopias converge. The "mirror" is a utopia in the sense that it projects a virtual space behind its surface, a space in which the observer is misperceived as being present.[4] Conversely, the mediate space is also heterotopic due to the oblique manner in which it affirms the observer's position in real space: "it makes this place that I occupy at the moment when I look at myself in the glass at once absolutely real, connected with all the space that surrounds it, and absolutely unreal, since in order to be perceived it has to pass through this virtual point which is over there." [5]

In our contemporary post-industrial information society the machine is not only eliminating the human factor in the work environment but is affecting communicative behavior and interpersonal relationships. Virtual interaction is generating a nomadic citizen increasingly identified with abstract and distant symbols offered by electronic culture. *Nomadic Dominion* is a projected immersive interactive environment, with a mixture of photo-based panoramas and computer generated environments and objects. Users wearing red/blue stereo glyph glasses navigate through a hyper-real simulated world using didgeridoos to guide them.

Nomadic Dominion (figure 3) is using telepresence to allow a person to feel as if they were present, to give the appearance of being present. It is focusing on the environment as a metaphor for the artificial dependency, which is inherent in our species. We tend to force external changes rather than internal. The land is modified. As soon as we put down roots and begin agriculture we start the process of modification. This environment is the predecessor of virtual reality. We don't follow food; we manufacture it. We edge our lawns, plant crops in rows, reroute rivers, and use pesticides, all to reshape the natural into the artificial.

As Eduardo Kac states in his article on *Telepresence Art*, "at its best, interactive art implies less stress on form (composition) and more emphasis on behavior (choice, action), negotiation of meanings, and the foregrounding of the public who, now transformed into "participants," acquire a prominent and active role in shaping their own field of experiences. The role of the artist in interactive art is not to encode messages unidirectionally but to define the parameters of the open-ended context in which experiences will unfold." [6]

While Foucault challenges the mediated space as an alternate structure that stand in binary opposition to the "real", Jacques Lacan finds the reflective other as both external and affirming. In his theory of the mirror stage, a child encountering a mirror realizes that he or she has an external appearance. From a psychoanalytical perspective prior to this recognition the "I" of identity is a primordial form, but afterward it is objectified in the dialectic of identification with the other. From here language works to restore them into one universal subject. At this moment in a child's development, they recognize themselves as a uni-

fied image, as a whole self. Once this occurs the child will no longer see the reflection as projected other, but rather it projects consciousness into the image and transforms it into "self". Arguably this is one of the first independent actions of a child, while still nursing, unable to walk, and prior to language; they place consciousness into an external image that they control and see it as perfection. Later this ideal will add tension to the self as something that can never be matched, a fiction to be lived up to, while creating a desire to be whole with the other. Although we sometimes feel alienated from our "self" we see in the reflection a unified whole.

Contemporary reflections of self and the other are mass-produced and distributed through various projected means along an electronic umbilical cord feeding our conscious and subconscious selves. The blending of this artifice within the make up of the self is wholly infused with identity and is widespread. This is evident in the pervasive use of social media and digital recordings to document ones tangible existence through virtual means, #selfie. But it also transfers into mass consciousness as the ideal is mass-produced and disseminated into a world where the physical is becoming increasingly blurred into a virtual understanding of self. We are increasingly faced with an integrated dialectic that conflicts with traditional views of identity and relies upon simulated projections detached from and isolated in time and space.

As Émile Littré once stated "Whoever fakes an illness can simply stay in bed and make everyone believe he is ill. Whoever simulates an illness produces in himself some of the symptoms." [7] Art of the new media can be seen in binary approaches with the human body; ***robotic*** in the sense of augmenting or replacing the action of the physical or ***telepresent*** in the sense of bypassing the physical receptors. In both they strive to construct symptoms though a simulation of something that can no longer be considered real.

Similarly *The UnCultured Pearl* (figure 4) is an interactive video that has a direct one to one relationship with the viewer. Using a video-tracking camera mounted on the ceiling. The work tracks the users proximity to the video screen. As the user approaches the screen the figure treading water on the screen submerges. The closer the viewer comes to the screen the deeper the virtual figure descends.

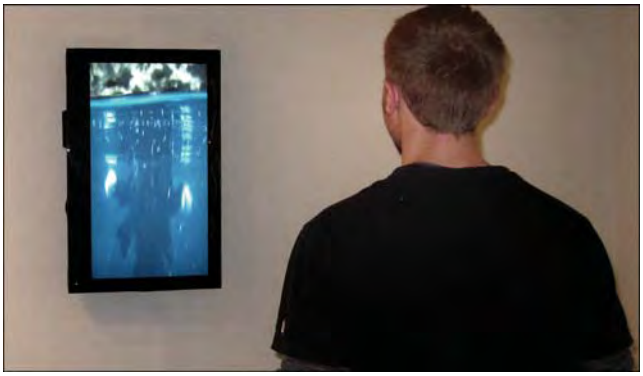

Figure 4: The UnCultured Pearl, Interactive Installation, Bill Hill

Conversely, as the viewer moves away from the screen the virtual swimmer ascends to take another breath. Conceptually this work examines the parallel structure of control placed on exploration. Whether it is the biological investigation of the human body or the human exploration of the natural world, both are limited by the constructs of the system. Using the metaphor of a *Bow and Arrow*, the more one pulls inward, the further out they can thrust themselves. Here the audience is forcing the figure to submerge while at the same time they come closer to examine the details. Time slows to a stand still as the two are at the closest points. This submerged figure acts as a digital mirror of the collective self.

Here the work is less about the developing the illusion of an open-ended experience, but to restore a Brechtian perspective in the audience and reconnect to the limitations of both simulation and the body. Building upon this physical interaction, the work explores the transcendental spectacle that is secondary improvisational theatre. The audience is both participant and performer creating a secondary performance for others. Similar to the early *flaneur*, who would stroll down avenues people watching or gazing at merchandise of a consumer dream world but today's digital world shifts the purpose and function of the body.

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Author Biography

Bill Hill is a tenured Associate Professor of Intermedia. He served as Dean of the College of Fine Arts at Jacksonville University for 9 years and has 20 years of teaching experience. He holds a Master of Fine Arts degree in Electronic Intermedia from the University of Florida. His artwork has been exhibited internationally at festivals, galleries and museums, including *Siggraph's Annual International Conference*. His work has been published in numerous periodicals and newspapers including *Computer Arts*, *Exposure* and *Leonardo*, in addition to the book entitled "Art, Technology, Consciousness: Mind @ Large". Presentations on his work have been given at national and international conferences including *Siggraph*, *College Art Association*, *International Conference on Computer, Communication and Control Technologies*, and *Consciousness Reframed.*

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Multiple Bodies in Interactivity. Representations and pathways of the corporeal.

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Abstract

The present work looks into the place the body occupies within interactive experiences. Firstly, we explore the nature of the machine in its corporeal dimension, and the human body in the digital representation process. Then, a classification is proposed for the modes of articulation of the participant's body in interactivity, following various analytic frameworks. Finally, we analyze the difference between the physical bodies within an experience and the construction of the bodies present in the artwork, outlining the dialogue between technical engineering and the symbolic dimension.

Keywords

Body – Interactivity – Interfaces – Representations - New Media.

Introduction

"An interactive work challenges one to undergo a transformation from an onlooker to an "interactor", an active agent. A peculiar kind of dialogue develops. In addition to mental interaction that is a precondition to the reception of art in general, physical, bodily action –one that involves more than just movement of the eyes-takes place".

Erkki Huhtamo

Interactive Art shakes the spectatorial tradition, and invites bodies to get up from their exclusively receptive position and assume an active role within the artwork territory.

If we look closely at an interactive work, we will see bodies in motion, exploring, communicating, and relating sensorially to the work. Through direct observation, they will appear as whole bodies. However, there is a difference that often goes unnoticed between the interactor body in the installation space and the body that is integrated into the interactive experience, and through which the public interacts. The physical bodies in the installation space differ from the bodies perceived by the interactive system and the interacting bodies, but still all of them fold and converge into the subject who converses with the artwork.

As Caroline Jones (2005) states, mediations in human sensoriality have greatly intensified.

The physical body of the public who is immersed into the artistic experience shares the space with the mechanical body of the artwork. When they meet, they define a semantic universe which reconfigures the relationship among objects, subjects, and environments.

The Mechanical Body and its Senses

"Today, we are transferring what we know about machines into living organisms, and vice versa. For this reason, we sometimes refer to bodies as machines, and to machines—or technical processes in general—as a kind of life (artificial life)."

Arlindo Machado

Just as the interactor is a kind of mind-body unit, the computing device may be understood as an artificial mind-body configuration. The *hardware-software* pair which makes up chips in action suggests the idea of a physical dimension (*hardware*) and an intangible dimension, similar to mental processes (*software*). Considering the pair as a whole, *hardware* could be thought of as the interactive system body.

In this context, *sensors* in a machine would be equivalent to *senses* in human bodies: bridges between the inside and outside, a means of information exchange, points where receptivity from the outside and exteriorization of internal processes are articulated. The lexical connection between the word *sensor* and the word *sense* points to the underlying analogies regarding the constitution of machine devices. In this sense, *sensors*, like windows to the world, allow the system to *perceive* and establish a relationship with the environment.

The human body may also be thought of as an organic interface. David Rokeby outlines a comparison showing the difference between our body and the interfaces:
'Our "organic" interface is extraordinarily complex and massively parallel. Our sensing system involves an enormous number of simultaneously active sensors, and we act on the world through an even larger number of individual points of physical contact. In contrast, our artificial interfaces are remarkably narrow and serial…' (Rokeby: 1990)
Given the diversity in sensors, there are several senses that may be built into the *hardware.* The machine body is, by definition, a polymorphic body. Its senses and thresholds are defined by algorithms, and are subject to processing speeds. The characteristics it assumes in each artwork will, in turn, define what dimensions of reality it will be able to

perceive and which bodies in the audience it will be capable of conversing with.

The Organic Body and its Representations

"Far away from the mechanical logic and inserted into the new digital regime, modern bodies act as processing systems for data, codes, encrypted profiles, information banks. Thrown into the pace of technoscience, the human body seems to have lost its classical definition and its analogical integrity; within the digital plane, it becomes permeable, projectable, programmable".

Paula Sibilia

The physical body of the public in contact with the interactive work turns into another body's framework: the represented, virtualized body; the body that is perceived by the artwork. These two bodies may coincide or differ considerably. The following sections present -using a taxonomic approach- different modes in which the body becomes integrated into interactive works.

The Body as a Unit

In some artworks, interaction is based on actions from a unified body. Generally, these are works that use movement in space as the variable for interactivity. A work like «*Rain Room*» (2012), by Random International, invites the user to experience a curious situation: walking in the rain without getting wet. In order to achieve this, the heavy rain falling within the room will open special hiatuses at the exact point where the body is located. Bodies circulate and go around the space enabling, as they move, rainless patches that make them waterproof, shielding the skin from humidity. Thus, the body acts as a unit during the experience.

The body is conceived as a unit that stimulates the artwork, and triggers the transformation of the shape.

The Partial Body

In various interactive works, the body stops being a compact unit, and is reinterpreted and partially incorporated into the artwork. In the same way as, in movie productions, an actor's entire body at the stage is analyzed and visually cut when captured in a close-up, in many interactive works, the body is fragmented, keeping the physical component as a material framework for the interaction, and trimming certain senses, limbs or organs that form part of the interacting body in the artwork. We will establish three main analytical spheres for partial bodies.

1- Senses

"If the mission of 20th century art was to make the invisible visible, 21st century artists will be concerned with finding ways to allow us to sense the invisible in the visible. The ratio of the senses may shift, and new perceptual modes may be uncovered."

Roy Ascott

Various artworks build their interactive mechanism based on a particular *sense*.

A) Sight - Eyes

One of the emblematic works using this approach is «*Zerseher*» (1991) by Joachim Sauter. In an art gallery setting, the one-time spectator stands before a painting when something unusual occurs: his or her glace starts to deconstruct the image. This work fully addresses the classical issue of spectating as a passive phenomenon, and the interactivity derived from interactive aesthetics.

In this artwork, the main point of contact in the interactive activity is the eye and, more precisely, eye movement.

B) Hearing - Ear

Due to its receptive nature, hearing is not a sense that usually generates stimuli for artwork input; nonetheless, it may be observed that, in some works, it plays a main role in terms of the connection between the body and the work. This variety includes the project «*Hot and Cold Whisperer*» (2009) by Ebru Kurbak and Jona Hoier, which emulates children's "hot or cold' game. The interface consists of a headset the user needs to wear. In cities, Wi-Fi signals are an invisible and intangible presence. The headset works as a signal detector. A voice whispers 'hot', 'warm' or 'cold' into the user's ear announcing the proximity of a Wi-Fi signal while the user wanders round the installation space.

C) Taste - Tongue / Smell - Nose

Taste—together with smell—is probably one of the least explored senses in interactive works. However, a few examples do exist. We might mention the work entitled «Mate Parlante» ('Talking Mate') (2013) developed in the UNA Multimedia Art course of studies (in Argentina) by Mariano Ferle, Azucena Lozana and Sebastián Caiafa. This work invites the user to sit down and drink mate. A thermos with water allows the user to pour this liquid into the mate containing yerba mate, and acts as the interface. Once the user pours the liquid, he or she can drink it through the straw. With this gesture, while the user drinks, the mate will tell a story related with the tradition of this infusion, exploring a founding ritual for River Plate idiosyncrasy. The artwork content is accessed through the physical action of drinking.

D) Touch - Skin

The introduction of the sense of touch is probably the main innovation brought by Interactive Art in terms of the artwork sensorial dimension. As Erkki Huhtamo (2007) states, Interactive Art is bound to the touching action, and this generates important conceptual changes in the field of artistic experience.

The work «*Delicate Boundaries*» (2007) by Chris Sugrue is based on the sense of touch, in several ways. Virtual organisms contained within a screen move into the physical space, travelling on the user's hand, and can go

around his or her upper limbs surface; skin is where the body and the image meet.
In the work *«Touch Me»* (2004) by the Dutch group Blendid, integrated by David Kousemaker and Tim Olden, users must press their body on a frosted glass surface to leave an impression of themselves. Almost emulating a large-scale scanner, participants put themselves against the glass in various manners while a light scans the surface and prints the body; the visual result resembles drawings made in caves 10,000 years ago. A great number of modern interactive works include touch in same way.

2. Limbs

Another possible criterion is thinking about the body in terms of its parts or limbs. This classification overlaps with the senses, but, essentially, the purpose of the approach is based on the perspective that some configurations do not seem to be mainly related to the senses, even though they may include them.

A) Hands
«*Mobile Feelings*» (2002), a work by Christa Sommerer and Laurent Mignonneau, focuses on the hand as point of interaction. Through a tangible interface, a pumpkin-shaped object, two users can feel the vital parameters (heart rate and breathing) of the other person. As a result, this work generates a non-verbal, bodily and intuitive communication between remote people.
We may even go into more detail and observe some cases where only part of a hand can become the acting body in the artwork. In the work «*Pulse Index*» (2010) by Rafael Lozano Hemmer, a finger is the point of contact between the public and the artwork. The user is invited to introduce a finger into a wall cavity. The interface captures an optical image of the fingerprints, which are projected, amplified, on screens around the exhibition space. At the same time, the interface senses heart rate and prints images at a speed that is analogous to the user's pulse.

B) Head
The Australian artist George Khut created «*Wee Leaf*» (2009) within the framework of the residency entitled «*Thinking through the body: Sensorium Gymnasium*», where various artists explored the potentiality of movement, touch and proprioception. In this work, a tree leaf hangs from the ceiling, at a person's head level. This work invites users to stand on a platform capable of sensing body balance, and induces them to touch the leaf with their face and cause movements. The swinging of the leaf in space, and the balancing are translated into sounds, in a situation that proposes an experience for the body that is unusual in interactive works: interaction is mainly achieved through the face; interactive action occurs in the head as a whole.

C) Vocal Tract
«*Universal Whistling Machine*» (2004) by Marc Böhlen and JT Rinker addresses the topic of language universality, and resorts to whistling, which is common to all cultures (and several species), as a communication code. Thus, participants face a system that can engage in a dialogue with them. They are invited to whistle, and then that whistle is reproduced by the machine in a sound mimicry act. In this case, as we can see, the *interacting* body is the vocal tract (and the lungs providing air for the whistling sound to be created). In reference to the perceptive thresholds described in previous sections, this work is only sensible to whistling, not to words. That is, if the user pronounces verbal language, the work remains immutable; this action falls outside the perceptive ranges of the work.

3. Organs

> *The body and the outside universe have exchanged places; the new adventure is not to discover new lands or planets but to see and map the inside of the body.*
>
> Lev Manovich

The third segmentation is based on the body and its integration through the organs. This category implies traveling beyond the dermis into the body's inner core. Bodies become reversible, folded, to reverse the relationship and put the inside on the edge, in contact with the outside world.

A) Heart
We can find a group of artworks using heart rate as interactive action, with a peculiar characteristic: action is usually involuntary. Rafael Lozano Hemmer explores the scope of this approach in a series of works entitled «*Pulse Room*» (2006), «*Pulse Park*» (2008), «*Pulse Spiral*» (2008), and «*Pulse Tank*» (2008). All versions share a common operation: the user pulse rate is translated into light impulses or water movements, in closed or even open spaces.

B) Lungs
Works that use breathing or blowing as interactive action connect to lung activity as a contact point with the installation. Scott Snibbe developed his work «*Blow Up*» (2005), where whistling supports the whole experience. An interface composed of a matrix of small coolers waits for the user to activate it. Through blowing, the user makes the micro cooler blades turn. The air pattern is memorized and then replicated in an analogous, larger structure with big coolers. That small gesture is reproduced by strong drafts in the installation space. Other people present in the room can stand before the larger cooler matrix and feel the wind designed by the user, in the analogous interface, on their skin. In this case, the work combines partial modes of interaction/reception.

C) Brain
In some works, the measurable phenomenon that drives the evolution of the artwork tangible form is brain activity. In «*Eunoia*» (2013), by Lisa Park, brain waves are read in order to manipulate water movement in containers surrounding the body of the performer, who interacts while

remaining utterly still. Surfaces vibrate, and water forms varying patterns driven by an intangible inner process.

The work «*Neuroknitting*» (2013) by Varvara Guljajeva, Mar Canet, and Sebastián Mealla, provides the user an interface to measure brain activity. The visual representation of waves makes up the knitting pattern of a machine that reproduces the design. When the experience concludes, the user gets a physical weave that reflects inner, mental activity.

In such cases, we find a paradox: bodies interact while seemingly at rest. When looked at from the outside, they do not differ greatly from spectatorial bodies. In fact, considering their eyes remain closed, they seem to be closer to sleep than to wakeful activity. However, there is an ongoing interactive process connecting the inside with the outside.

Conclusion

Body engineering has come to Art, not always in the form of physical reconfiguration, as expressed boldly in prostheses and foreign body implants. There is a subtler way, though equally impactful on the artistic experience: body design in the artwork, the conception of a body which will be *perceived* by another body (the machine's) and which will be allowed to act under certain circumstances and in particular contexts. *Represented* bodies overlap or run in parallel, and are elevated from the physical level to the symbolic level.

Behind the optical illusion of *whole* bodies in interaction, we may discern the presence of a *symbolic* body, different from the *physical* body within the space of the work, holding metaphors as well as sensations. The body is contained in a double sense: contained by the design limits, and contained as an inherent part of the expressive proposition put forward by the artistic event in which it is inscribed. It is usually assumed that content is beyond the interface, that the interface represents the border between the subject and the content. The changes we are witnessing may be signaling that the time has come to rethink these notions, and realize that the body, in Interactive Art, is incorporated as an expressive resource in the artist's palette, through new media.

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Among her artistic works in collaboration with other artists are included: 'Sentímetro' (2005), 'Heroes' (2010), `MASA' (2014); projects selected in open calls, with the support of institutions such as Espacio Fundación Telefónica de Buenos Aires, Fundación Telefónica de Lima, Museo de Arte de Lima (MALI), Escuelab, Alta Tecnología Andina and Medialab Prado Madrid.

Her works on new media theory have been selected in festivals such as 404 International Festival of Electronic Art (Argentina), FILE10 (Brazil), ISEA2010 (Germany), FILE 2013 (Brazil), RE-NEW Festival (Denmark), ISEA 2014 (Dubai), Computer Art Congress (Brasil), SIGRADI (Uruguay).

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Post-Humanism in Post-Modern Dance

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Abstract

Post-modern art has adapted to post-humanism, and has begun to use technological advances as an extension of the human body. This paper will address the technological transformation occurring in the post-modern post-human dance era. The primary focus will be on pixelated representations of the moving body, mechanically generated art, and extensions of the physical body through technological sensing systems. The use of technology as an extension of the physical body in post-modern dance is a model of human computer interaction in the post-human era. This model can be utilized to maintain a connection between the physical body and an environment that is shifting faster than the evolution of the biological body.

Keywords

Post-Humanism
Post-Modern Dance
Mechanically Generated Art
Sensed Body

Introduction

Post-humanism is usually associated with futuristic science fiction, where the human becomes the machine. However, in Cybernetics and Post-Humanist Theory, the human has already become post-human. 1 In her book *How We Became Post Human,* author atherine Hayles warns of two possible routes that can be taken in a post-human era. One path is lead by Descartes ideology where the mind can exist without the body. If this path dominates the post-human evolution, human beings will be perceived as individual parts that can be recreated and replaced. 2 The second, more favorable path will be that the post-human consists of extensions that integrate with the biological body. 3

Post-modern art and dance have adapted to post-humanism, and have begun to use technological advances as an extension of the organic body. This paper will address the technological transformation occurring in the post-modern post-human dance era. The primary focus will be on pixelated representations of the moving body, mechanically generated art, and extensions of the physical body through technological sensing systems.

The Edited Body

Representing the movement of the body in a pixelated form separates the original occurrence from time and space. In order to document movement, the original event is cataloged in encoded text, and when replicated undergoes a process of decoding. Through post-production editing and broadcasting, the original movement becomes a pixelated, post-human extension of the original event.

Philosophers such as Hayles warn against the segmentation of the human body. 4 The pixelated body dissects the body into non-organic parts, but it also enhances the body's abilities. The pixelated body breaches the limitations of time and perspective, and can defy the laws of physics. Re-coding a live event changes the way we view the human body and frees the body from its physical constraints. 5

Movement Abstraction

Online databases of choreographic scores have re-contextualized movement. MotionBank is a video database that has created text to describe the events of the body, and digital representations of movement. 6 William Forsythe's *Synchronous Objects* was a primary leader in this type of visual adaptation. Figure 1 is an example of a still from a visual manipulation of the original film. The image shows movement patterns co-existing in a shared space. However, these events did not originally occur simultaneously. The post-production of Forsythe's work becomes an extension of the original work by manipulating time and space. 7

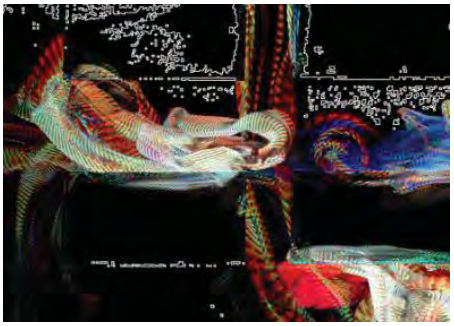

Fig. 1 Synchronous Objects: One Flat Thing

Post-Production Video Editing

Post-production editing gave choreography the ability to detach movement from time and space. In 1946, Maya Deren created *A Study for Choreography and the Camera*. 8 The film explored post-production editing tactics in dance such as tempo, space and repetition. Deren's film served as a guide to editing movement. In post-production video editing, movement can be repeated, reversed, slowed down or speed up. Editing also allows the movement to modify space by flipping the image across horizontal and vertical planes, changing the point of view of the camera, or taking the body to a new location all together.

The Camera as a Bodily Extension

In the late 1960s, the camera decreased in size and cost, and the time required for post-production editing was reduced. The camera turned into an extension of the post-human body as it became more accessible and portable. 9 Other artists began to further explore choreographic editing concepts manipulating time and space. Members of the Judson Church Project frequently used video and projection as an extension of their body's limits during live interdisciplinary events such as "9 Evenings." 10, 11 Film allowed their faces to become larger, the viewer's attention to be localized, and their bodies to simultaneously exist in more that one place at a time.

The Viewer as a Bodily Extension

With the increase in broadcasting networks and household television sets, the viewer gained the ability to become the editor. From our iPhones, we can manipulate another's body by turning a video on and off, rewinding and repeating, and observing the movement from any location at any time.

Broadcasting generated yet another way to increase the body's capabilities. A performer's body can now be viewed anywhere on film, and their physical body does not need to be present. 12

Through broadcasting, the viewer gains the ability to experience events they cannot physically attend. The viewer also gains the ability to replay and re-experience an event. 13 Some theorists such as feminist film theorist Annek Smelik and cybernetic theorists Roy Ascott would argue that being places without your body would eliminate self-identity and control over oneself, leaving the performer at the mercy of the editor, broadcaster and viewer. 14, 15

Post-human extensions of choreography on film raise multiple ethical questions. Once the dancer and choreography are captured and logged, who becomes the artist? Is it the dancer and choreographer, editor or viewer who ultimately chooses the location, length and frequency of an event? To what extent does a viewer have the right to manipulate an artist's work? To what extent does an editor or viewer have the right to manipulate another person's body?

The Mechanically Generated Body

In the case of post-humanism in post-modern dance, the artist is the one who generates the idea, and their post-human extension is the crafters or tools who help them manifest a final product. Artists began to use computers as a tool to manifest their ideas or to provide them with ideas. This is visible in work by visual artist, Vera Molnar, who developed a computer program that evolved shapes into a visual work (fig 2). Once she approved of the machines adaptation of the original image, she would paint the end result by hand. 16 If the computer generated algorithms design the patterns, who is the artist, the programmer, computer algorithm or painter?

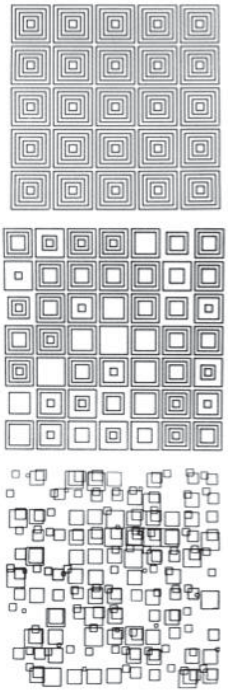

Fig. 2 Computer Drawings

Dance performances such as *Choreobot 2.0* by Julie Cruse raise similar questions of authorship between the program designer, artist and tool of expression. *Choreobot 2.0* programs chance procedure algorithms into a computer that determines the choreography of the dancer in real-time. Choreography determined by computers turns the computer into a technological post-human extension of their creator. Both in Molnar and Cruse's work, the computer assisted in the process of generating a product, and the body was used as a tool to create the program's decisions.

The Sensed Body

The next stage of post-humanism in post-modern dance involves utilizing data from the moving body and sending it to a computer to produce a final product. The final product achieves a result that the body could not create with only their body's movements, but instead require a post-human integration.

Artists began to expand the limitations of the human body through motion-tracking systems and sensors. Prior to cybernetics, computational technologies and interactions with technology had been based on the idea that the brain can exist without a body, and that the human does not need a body to use the technology. In this scenario, the human would become more like a machine.

Cybernetics shifted the way human computer interactions are designed by attempting to make the machines more human. There is continuous investigation on redesigning technological interaction based on the somatic use of the embodied mind. This occurrence is visible in the

adaptability of technology as it molds in size, shape and weight to become an extension of the physical body. Hayles points out that humans are not evolving as quickly as their environment. To compensate, humans are generating tools that can allow their bodies to execute tasks in the evolving world, be it an axe to chop wood, or a portable camera in the palm of a hand. 17

In dance performance, the human body gains a post-human extension by sensing and tracking devices. The devices react to the movement's tempo, axis, size and frequency, and produce visuals and sounds that accentuate the physical movement. In the dance work, *Mortal Engine*, a team including computer programmer Frieder Weiss, generated a system that tracked the movements of the dancer from above, and produced visual images and audio. 18 In this instance, the human-computer integration served as an audiovisual extension that affected the space around the movement.

In addition to video tracking, data from the body's movement has also been captured through sensing devices such as muscle sensors, accelerometers, gyroscopes, and pressure sensors. In *Re-Mapping the Body* from the dance company Linga, muscle sensors on the dancers send data to computer systems, and is then utilized to produce audio. The audio is responsive to the muscular activity of the performer. The company describes the sound system as a place where "dancers explore a new relationship with their bodies, **augmented** by the possibility of making sound." 19

In these two examples, the technology systems respond and expand the physical actions of the body, and generate a post-human bodily experience for the performers. Sensing technologies bridge the gap between the human and the computer, and allow the dancer and technology system to communicate simultaneously.

Conclusion

Post-modern dance has been evolving parallel to the path of post-humanism. The mechanically generated body and the edited body have the potential to drive post-modern dance towards a post-human body that is a combination of individual parts. When edited, the body can be separated and replicated through broadcasting, film or other pixelated representations.

The mechanically generated body drives post-modern dance towards a post-human state where the body becomes a machine, free from thought. As the machine controls the actions of the body, the mind of the dancer and/or artist is no longer necessary.

Body sensing systems require the mind-body-system to co-exist in order for the system to work. As post-modern dance continues to expand into their post-human bodies, body sensing models should be used to maintain a connection between the changing physical environment and the physical body.

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Julie Akerly is the co-director of artist residency space, *[nueBOX]*, founder of *Phoenix Dance Review*, and artistic director of *J.A.M. (Julie Akerly Movement)*. She received an MFA in Dance and Interdisciplinary Multimedia and Performance from Arizona State University. Julie has had dance film screened at GLOW, Breaking Ground, Bustin a Madcap, and (e)Motion Film Festivals. She has presented interactive dance performance pieces at EMERGE 2014, Slingshot, and Breaking Ground Festivals. She has also performed with D Spair, an interdisciplinary improvisation group in the Phoenix area.

[Session 16]

Embodied Interaction and Dance

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Parallax: Dancing the Digital Space

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Abstract

Parallax is a contemporary dance work that integrates live performance and stereoscopic illusions. This performance work was designed to demonstrate the transformative potential of stereoscopic technology for contemporary dance.
Parallax explores how the technology can change the traditional theatrical idea of space. We propose that the theatrical space is overlaid by a stereoscopic space that is best defined as a square pyramid. The stereoscopic image within the theatre environment creates a new area for the, choreographer, dancer and audience to experience dance and opens new creative possibilities. First, the choreographer needs to negotiate a different form of perceived space, and to work with both live and animated bodies. Second, the dancer may become less central and more part of a technical system, and s/he is required to negotiate digital environments and objects that are invisible to them.
Finally, the audience experience of the stereoscopic dance performance is significantly different from, and potentially more immersive than, other forms of dance that use technology. This paper proposes that the inclusion of three-dimensional (3D) scenography requires a reorganizing of the conception of space in the creation and performance of contemporary dance and theatre.

Keywords

3D, stereoscopic, dance technology, choreography, multi-media dance, trans-media dance.

Introduction

This paper focuses on the use of stereoscopic imagery in live contemporary dance performance. In particular, we examine how the stereoscopic illusion changes the perception of space in the theatrical stage setting. We will argue that through the use of the stereoscopic illusion the perception of space is altered and the experience of space is transformed for the participants of dance, the choreographer, dancer and the audience. We will do this by focusing on a contemporary dance stereoscopic contemporary dance work, *Parallax*, created by the first author. [1] Through *Parallax* we will highlight how 3D changes the traditional role of participants of dance performance, the choreographer, the dancer and the audience. The choreographer needs to negotiate how the stereoscopic imagery exists within the live performance and stereoscopic space and how the 3D imagery can be placed with the live performer in space.

Through the use of stereoscopic imagery the performer is required to dance with images that are mostly invisible to them but which provide powerful contextualizations through virtual stage settings and performance partners. The dancer also needs to perform 'with' these images, which have a different form of gravity and space. Audience perception of a 3D enhanced performance space is very different from that of a traditional theatrical space since the audience becomes part of the technical process, in the sense that the audience must 'complete' the technical process of 3D projection by fusing the images in their minds. The 3D imagery opens up the theatrical stage space with panoramic views and environments that can rapidly change and which are inhabited by stereoscopic objects that appear to move into the audience space. We aim to show how conceiving of the theatrical theatre space as having a pyramid shaped overlay that embeds the stereoscopic content is a helpful concept in understanding how this is altered environment functions artistically and aesthetically.

Approach

Parallax was developed using a multi-modal practice-based research approach, intertwining artistic and theoretical perspectives. The practice-based method is described by Australian and English writer and academic, Linda Candy as; 'original investigation undertaken in order to gain knowledge partly by means of practice and the outcomes of that practice' Candy's explanation of a practice-based methodology encapsulates the processes undertaken within this work. [2] The performance *Parallax* was created to explore the issues involved in using 3D in live performance as part of a dual process where the creative domain of art creation and the investigative domain of 3D informed each other. Australian choreographer and academic Cheryl Stock describes the dual process:

'These artist/researchers play dual roles reflecting on, contextualizing and theorizing their own practice whilst drawing on dance and cultural studies and a range of methodologies to inform their practice.' [3]

In this process, the first author/choreographer particularly drew on technical work by Robert Neuman a stereoscop-

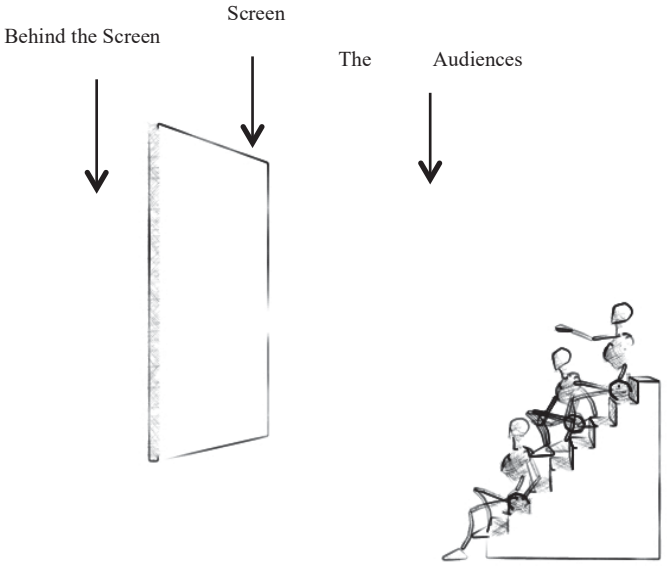

Figure 1. Film Depth Budget. ©Megan Beckwith

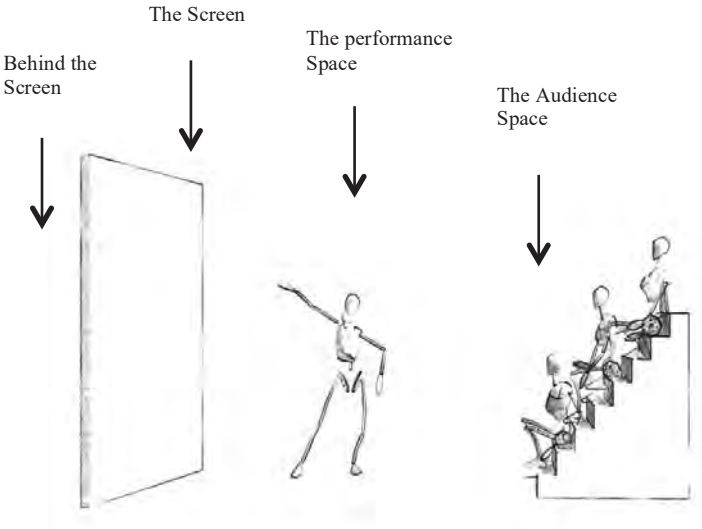

Figure 2. Live Dance Performance Depth Budget. ©Megan Beckwith

ic supervisor at Walt Disney Animation Studios. His work provided a rich source of technical artistic provocation in relation to space, during the development of the performance *Parallax.* She also drew on her triple roles as choreographer, performer and animator in the development of *Parallax*, using a hybrid process to create the different elements of the performance. These multiple roles gave the choreographer/animator a unique insight to the development and creation of performance work that utilizes stereoscopic illusions for performance and the construction of the performance and stereoscopic space as one entity. The stereoscopic dance practice was developed in an intertwined and reciprocal process where the animation and choreography informed each other.

Parallax was created as a 40-minute contemporary dance and stereoscopic work. The dramaturgy serves to help drive the journey of the live character, explain and contextualize the constantly changing environments and give the audience a hook in which to situate the performance. The work explores the human body in an induced illusionary and virtual environment. Through the use of 3D stereoscopic animations *Parallax* explores how a person might physically and emotionally interact with illusionary or hallucinated worlds. This work explores two key questions; how does the body react within a distorted reality and how does hallucination affect emotions? This performance takes the dancer and the audience through a seemingly infinite set of virtual spaces, which are animated abstract environments, hyper-real landscapes and rooms. These spaces are inhabited by stereoscopic props that function as agents of change that seemingly 'interact' with both the dancer and audience.

The work explores the boundaries between the real, virtual and illusionary states. The performance opens as a woman drinks a green drink and appears to enter an induced illusionary world in which she is transported through a series of iconic spaces and times. The hallway she is standing in becomes a portal to new digital worlds. Each world she enters is different, sometimes dangerous, though sometimes not. The environments she enters contain fragments of the past that are 3D objects such as, Leonardo da Vinci's spheres from his *Treatise on Painting* and Charles Wheatstone's stereoscopic cubes from his paper *Contributions to the Physiology of Vision. Part the First. On Some Remarkable, and Hitherto Unobserved, Phenomena of Binocular Vision*. Each object she encounters creates different physical and emotional problems the woman needs to negotiate. In each world she sees herself from different perspectives, creating an effect of parallax.

Background to Stereoscopic Imagery in Performance

The stereoscopic image changes the perception of space. The stereoscopic image is a visual illusion that manipulates binocular vision, transforming the appearance of space and the animated objects within it. Imagine the letters on this page floating towards you and the page falling through your hands and away from you into infinity. It is this type of illusion of visual depth and relief that the stereoscopic image can achieve. Objects appear to hang impossibly in space directly in front of the audience's eyes and scenographic views fall away from the audience infinitely. Two-dimensional (2D) projected surfaces appear three-dimensional and panoramic scenes and animated objects seemingly become part of the viewer's world. It is these apparently magical possibilities that have an impact on the live theatrical performance space and require new conceptual ideas around space and relationship with the choreographer, dancer and audience.

The use of the stereoscopic image in live theatre and in particularly with dance is not a new phenomenon. The stereoscopic image has been in the domain of film since its

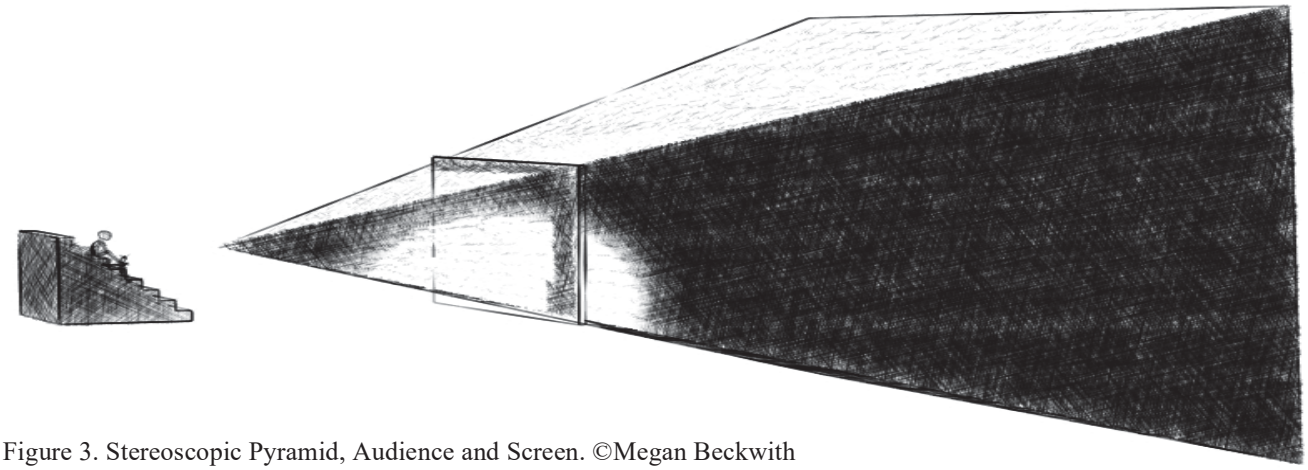

Figure 3. Stereoscopic Pyramid, Audience and Screen. ©Megan Beckwith

inception in the peepshow boxes of the 1900s. There was one early attempt by Laurens Hammond, the inventor of the Hammond organ, to popularize the stereoscopic illusion for live performance. [4] Hammond's patented *Shadow Graph* an anaglyph lighting technique was used within the 1927 Florenz Ziegfeld's review called *Padlocks*. [5] From Ziegfeld's seminal 3D dance performance it was not until the 1990s that the stereoscopic image was more successfully used in dance performances in dance works by artists such as; Billy Cowie; Klaus Obermaier; Robert Lepage; Heather Raikes; John McCormack; Wayne McGregor and Garry Stewart. The dance and animated shows that these artists create represent an emerging style of performance that includes stereoscopic 3D within the theatrical staging conventions and is a small but growing phenomenon.

Stereoscopic Space and the Live Theatrical Space

The use of the stereoscopic element in performance creates a digital aesthetic that is different, both from other dance forms and from dance that has historically used technology. One of the changes that the stereoscopic illusion affords dance is how the space is perceived and potential use of this space within live theatrical performance setting. This research is born from a desire to explore the potential of the 3D environment for contemporary dance performance and live theatre to create a greater understanding of the stereoscopic illusion in my own practice. The key point is to examine specifically the impact of stereoscopic image on live dance, which introduces a different kind of perceptual experience to performance. Part of this experience is how the live theatrical performance space is changed with the use of stereoscopic imagery and how can it be potentially be utilized.

The stereoscopic image offers an alternative layer of artistic possibilities for the creator of dance or live theatrical performance. The stereoscopic animated image appears other than just background or an interesting lighting device. This image is constructed by a technical system that presents two different but very similar images to the right and left eye. The images themselves are slightly off center, one for each perspective of the right and left eye. The two images are fused together in the brain where the illusion of relief and depth is created. The brain processes the stereoscopic illusion as a three-dimensional landscape or object. The visual (and neurological) impact can be seen when the audience reacts to the 3D imagery by jumping, flinching or reaching out to grab the projected image. [6] Even though the audience knows it is an illusion, it is almost impossible to fight the urge to react. Some audience members enjoy and indulge this instinctive effect.

In tandem with the physical reaction the audience may also experience an emotional reaction to stereoscopic illusion. Robert Neuman describes this emotional response:

'the emotional distance we feel from what we see transpiring on the screen is proportional to our separation from it in 3D space. Of particular significance the emotional distances is the relationship of the subject to the point of zero parallax, the screen'. [7]

Neuman is describing how when the 3D images move past the screen and closer to the audience there is potential to elicit a more emotional response from the animated content. This artistic technique is potentially a powerful tool for the choreographer or theatre creator as audience reactions can be increased or decreased by the placement of the animation in space in relation to the audience.

In film, the detailed placement of 3D imagery is described as a depth budget. The depth budget is 'analogous to a musical score in how it is orchestrated to reflect the emotional content over time'. [8] This technique is also relevant to live theatrical performance that uses 3D imagery. However, the depth budget for live performance is different from a depth budget for film. In film, the stereoscopic image moves through the screen and, as Neuman

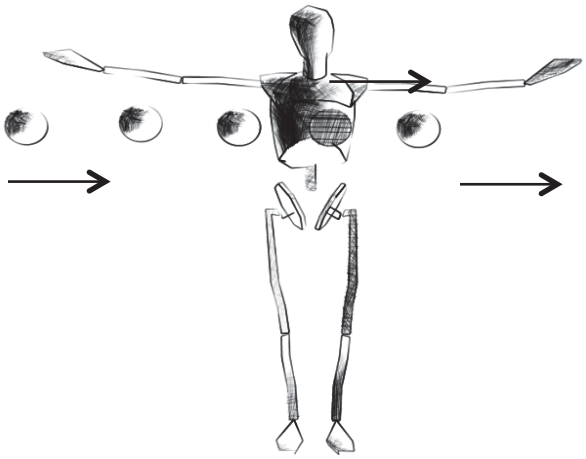

Figure 4. Front Projected Choreographic Violation, as the 3D image moves across the un-polarized body the 3D affect is lost ©Megan Beckwith

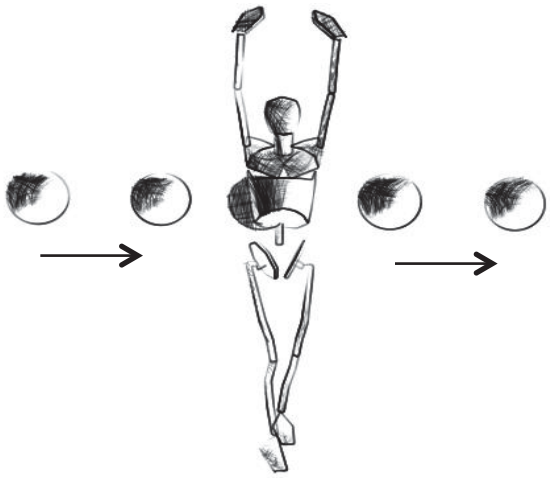

Figure 5. Back Projected Choreographic Violation, as the 3D projected image moves behind the body the 3D image it is hidden from view or occluded by the performer's body and the illusion is lost ©Megan Beckwith.

describes, into the 'audiences space' (See Fig.1). [9] Yet, stereoscopic live performance has another layer, the performance space (See Fig.2).

We propose that using stereoscopic projection in live performance creates a space that we refer to as the performance stereoscopic space. This space is created by the elongation of the animation due to the larger animation throw created by the need for the dance performance space. This space stretches from the screen to the audience space. We also think of this space as a pyramid as this is more accurate and precise term as it indicates the height, depth and width of the shape rather than indicating the floor space or a general area. The pyramid of animation space is situated lying on its side, with the tapered end facing the audience (See Fig. 3).

If the animation moves out side of this pyramid space a window violation will occur and a visual conflict will be created for the audience, also known as a 'paradoxical stereo window effec. [10] Neuman describes the window violation as 'the conflict of depth cues that occurs when an element that in terms of stereopsis lies in front of the screen, nevertheless is being occluded by the vertical surrounds of the frame line, which lies behind it as screen depth.'[11] In short, when a stereoscopic image appears that in front of the screen moves off the screen without appearing to move behind the screen, a visual conflict happens.

There are two common ways to project the stereoscopic imagery in the theatrical stage setting. The first method involves the projectors placed in front of the performance space, usually hung from the lighting rig, with the stereoscopic image being projected onto a polarized screen. Alternatively, the projectors are situated behind the performance space and the projection is shone through a shear polarized scrim. Even though the stereoscopic image is being projected from different directions, the pyramid scape is the same as the illusion is created through the separation of the imagery and not the direction of the projection.

The dancer appears in the stereoscopic space as they are bathed in the projection light and placed within the same visual scape as the animation. Due to the live performer appearing in the stereoscopic pyramid 'choreographic violation' can occur. Not unlike window violations, 'choreographic violations' become apparent with front projection when the stereoscopic image appears over or occludes the performer. The stereoscopic image appears to squash flat on the performers body (See Fig. 4). This flattening of the animation happens due to the stereoscopic image needing a polarized surface to be projected from. Unlike the stereoscopic screen surface the performer is not a polarized surface and therefore the illusion is unable to be maintained, since two identically shaped but horizontally separated images are no longer presented to each eye.

With the back projection, the image does not appear on the body as the image is occluded by the live body. The audience perceives this as the 3D imagery disappearing behind the performer. The visual conflict can occur if the illusion is perceived further forward than the live performer in space. As the image disappears behind the live body it appears to impossibly disappear only to re appear on the other side of the performer. (See Fig. 5) This visual conflict created is very similar to a window violation. This visual conflict appears to be more forgiving than front projection and is a way of reducing the appearance of occlusion of the imagery of the body. However, in the theatrical stage setting the use of back projection can be problematic as the space required at the backstage of the scrim is often only available in very large theatres even with the use of short throw projection lenses.

The construction of the stereoscopic space in the theatre environment is very different from the traditional use of theatre space where the wings, cyclorama, backdrop, floor

and proscenium arch mark out the viewing and performance space. While the space itself is not structurally changed by the use of the stereoscopic image the audiences' perception of space is altered. For the audience the back wall is opened up with panoramic views that have texture, depth and ambiance and the screen appears, as Neuman describes in the case of 3D movies, as 'proscenium arch to this stereoscopic content'. [12] The space above and around the stage can be potentially filled with 3D objects. The theatrical imagined fourth wall can be breached by animated imagery and the space directly in front of the audience can be apparently filled with 3D objects.

In *Parallax* the construction of this performance design can be understood from the layering of the different components within the performance scene. There are three elements that make each of the individual components work in conjunction with each other and builds the work in three ways, through: 1) an animated background that can include 2D and 3D animations and video content; 2) a dance work that is situated within the traditional performance space and; 3) stereoscopic imagery that exists behind the screen, in the performance and audience space (See Fig. 6). The use of this volume and indeed the perception of space changes for each participant of dance; the choreographer, dancer and audience members.

The Choreographer's Space

The negotiation of space is different for the choreographer in a performance work that uses 3D imagery due to the different layers of real and illusionary content. The stereoscopic image creates alternative choreographic opportunities within a carefully constructed virtual world that appears spatially infinite containing endless possibilities, but also has specific limitations. The opportunities are found in the animation process where the director or choreographer could create any image and is only limited by imagination, time and financial budget. Limitations can be found in the pyramidal nature of the stereoscopic animation space and the need to confine imagery to within the cone defined by this space and particularly, to the available space in front of the screen. The pyramid space narrows as objects move closer to the audience and in the use of the live body within that space is limited by the need to avoid choreographic violations by avoiding obscuring key stereoscopic imagery.

In *Parallax* the ability to place animated objects within the choreographic and stereoscopic space was an interesting element. The animated objects could be choreographed, not unlike live performers, and could appear as a soloist, duo partner or virtual corps de ballet.

In *Parallax* this dance between the 3D objects and performer was a careful negotiation between choreographic and animation processes. The choreographer/animator started with the animation process creating the stereoscopic landscapes, environment and props for the performer to work with and contextualize themself. The linking to the animation and the movement was conducted throughout the choreographic development. She often re-worked ani-

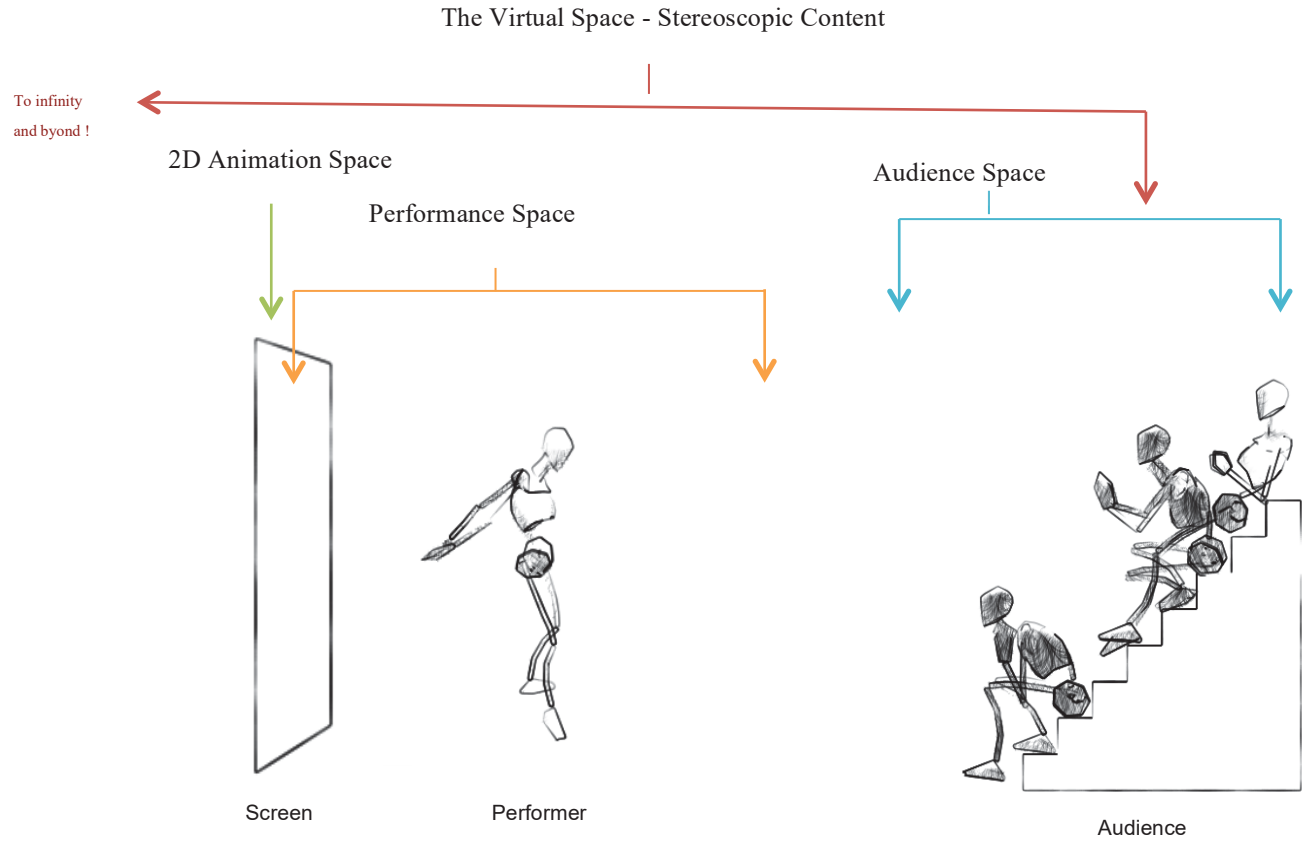

Figure 6. The Layered Design of the Space. ©Megan Beckwith

mation during the choreographic process drawing the two different elements into one performance. In this way the different elements work in conjunction with each other and appear as one performance.

One reoccurring problem within the space of *Parallax* was the creation of choreographic and window violations. One technique that proved useful was the use of animated small particles as this seems to confuse the eye and appeared to be a more forgiving affect. Yet, simply dropping the performer to the floor or moving the dancer out of the way of the animation was also very useful. Furthermore, using the choreographic violation proved a powerful effect when employed to deliberately disturb the audience. When animation moved forward in the space towards the audience, due to the visual perspective the animation appears larger, however the stereoscopic pyramid space tapers in, creating possibilities for window and choreographic violations. This visual conflict is usually avoided by keeping the images within the stereoscopic pyramid. However, in *Parallax* where relativity of size was not paramount, reducing the size of the animated objects as they moved forward in space was a successful way of avoiding violations. In the future, the use of back projection would possibly also help minimize the affect of choreographic violations in my work.

reflection, not dissimilar to visualization and ideokinesis

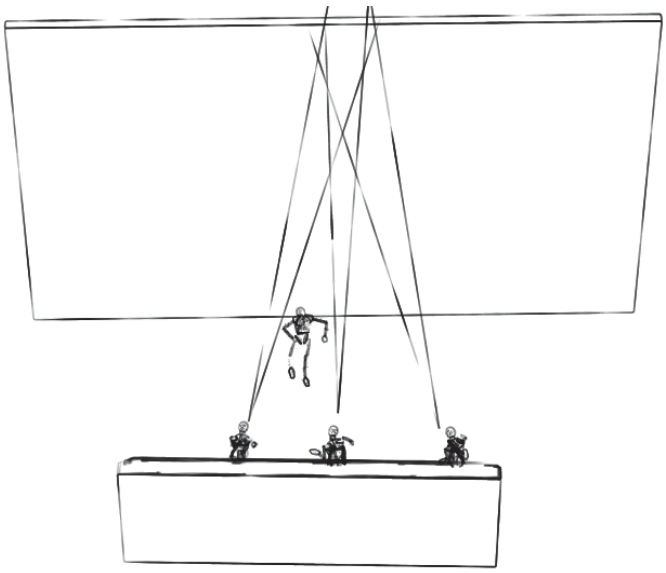

Figure 7. Example of the different view points of the stereoscopic image fro the audiences point of view. In relation to the performer the image changes perspective. ©Megan Beckwith.

The Dancers Space

In stereoscopic performance the dancer must negotiate both physical and virtual 3D space. The stereoscopic image appears to co-exist with the dancer and becomes part of the dance performance, appearing as both content and performance partner. The stereoscopic animation transforms the environment and situates the dancer differently within the performance space.

The dancer experiences the stereoscopic space much differently from the choreographer and audience members. The dancer does not wear glasses and is facing away from the screen and therefore cannot see the 3D illusion. The performer can only see the video content on the screen as a blurred 2D image. In *Parallax* this issue was addressed in several ways. The choreography and movement was carefully blocked with an eye on where the animation would appear, and marking of the floor with tape was also helpful for dancer orientation. The performance was rehearsed with the animation footage from the early development phase and the animation in turn was animated directly over the rehearsal video footage. The use of a video fold back during performance was also extremely helpful in enabling the dancer situate herself within the space and in relation to the animation.

While the animation is palpable for the audience but invisible to the dancer, in *Parallax* the performer needed to appear to interact with the animation. This interaction was difficult, and for the performer, the stereoscopic space had to become like an imagined space. In a way that seems, on techniques used in contemporary dance development, the dancer needed to create a 'virtual map' of the space rather than simply respond to the visible, physical, limits of the performance volume.

In *Parallax* the performer is sometimes not the most important thing in the space. Often, the audience was presented with imagery that are not visible or apparent to the performer. This can be unusual for a dance performer as the focus of most contemporary dance performance tends to centre on the performer, and specifically the performer's embodied presence. Furthermore, the audience wearing glasses can be a distancing effect for the performer, who cannot see the audience's eyes or gaze, and this presents a different environment in which the dancer relates or responds to the audience. Finally, in *Parallax* the video element does not change as the video projection is pre-rendered. Performing with an animated partner that does not alter or react to the dancer is unforgiving and the dancer needs to employ a spatial accuracy throughout the choreography and movement that is defined by the image, not the performer or the physical space.

The Audience Space

The audience perceives the theatre space differently when stereoscopic imagery is used. In a stereoscopic performance the audience completes the performance and the stereoscopic animation. This could be said of all live performance, yet within stereoscopic theatrical performance the animation is fused within the audience's perception. If

the audience is not present, no one can see the animated objects as three dimensional. In this way the audience is, in a sense, part of the technical set up as they must perceptually fuse the animation. By wearing 3D glasses, the audience completes the animation and the stereoscopic element and stereoscopic performance space emerges.

It is the fusing of the imagery that tricks the brain's perception of the stereoscopic imagery as if it was a real object, prop, scene or room. In *Parallax,* by using animated imagery as a choreographic element the choreographer was able to create emotional audience reaction. This was achieved by bringing the 3D imagery forward (downstage) and backward (upstage) in the space. This positioning of the 3D imagery in relation to the audience became an interesting choreographic tool.

In *Parallax* it also became apparent that established and traditional theatrical placement cues and choreographic blocking of the space had changed through the use of the stereoscopic image. The dancer is bound by the normal conventions of time, space and motion in the stage space. However, powerful and compelling 3D imagery and theatrical information can be included in space not available to the live performer, such as behind the screen, above the performer and directly in front of the audience within the stereoscopic pyramid. It also appears that the ability to fill the space directly in front of the audience can draw the audience into the performance making them feel like they are almost part the show.

Each audience member has a different viewpoint of the performance, which happens in live theatre and film, however the issue is amplified by 3D projection. The perspective or angle of the stereoscopic animation in space can change dramatically in relation to the placement of the live performer, and objects appear to move horizontally depending on how far from centre the viewer is located. This can create visual conflicts depending on where the audience member is sitting (See Fig. 7). This shifting of perspective for audience members has the potential to create a new premium-seating plan for stereoscopic performance audiences, where the middle centre of the performance seating becomes the prime space rather than the traditional stall seating plan.

The potential placement and perception of stereoscopic imagery in live performance is outlined in Beckwith and Vincs (2013) [14].

Conclusion

Parallax, the performance, demonstrates some of the ways in which stereoscopic imagery in live contemporary dance performance changes the perception space in the theatrical stage setting. The perception of the theatrical space in contemporary dance is altered and the experience of space is transformed for the participants of dance, the choreographer, dancer and audience. In particular, *Parallax* reveals how the traditional roles of the choreographer, dancer and audience can be changed. The choreographer's role has shifted as s/he is required to negotiate stereoscopic imagery and live performance within a performance space that is embedded within a pyramid shaped stereoscopic space. The performer is required to dance with images are mostly invisible to them but are a powerful contextualization, stage setting and performance partner. The audience perception of the performance space is also altered as they become a part of the technical process by fusing the imagery and space in their own minds and experiencing animation that appears from infinity to directly within their space. New possibilities became apparent that include alternative choreographic strategies, such as the use of animated imagery and depth control to heighten the audience's perceptual experience through the use of the stereoscopic space in tandem with the live space.

The use of stereoscopic imagery in live dance performance may not be for everyone. Just as not all movie audiences seek out 3D experiences, stereoscopic work in dance has sometimes been described as 'more of a distraction than enhancement', and may be interpreted as confusing, disconcerting and an annoyance for some theatrical theatre audiences' [13]. Our contention is that the spatial ambivalence between physical and 3D projected space can be constructed as either troubling and confusing, or as choreographically generative and productive, by virtue of the potential for disruption of traditional stage space and choreographic process described here.

Future explorations would see a development of the *Parallax* performance or other new performances with specialized theatrical lighting for the optimizing of the 3D effect. Powerful stage lighting can enhance or reduce the stereoscopic illusion and animation texture. The use of active projection techniques for live performance would also be an interesting possibility.

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Authors’ Biographies

Megan Beckwith is a Melbourne based choreographer who works across the fields of dance and animation. Megan is currently studying for her PhD at the Motion.lab at Deakin University and is researching the application of the 3D stereoscopic illusion within the live theatre environment. Megan creates live animated dance works by combining contemporary dance and animation in a choreographic process that layers one over the other. Megan is a research assistant within the Building Innovative Capacity in Australian Dance through New Visualization Technology Building Creative development project for Kim Vincs, she also teaches at Deakin University and is a founding member of the hybrid live arts organisation Punctum Inc.

Professor Kim Vincs is the Director of the Deakin Motion.Lab, Deakin University’s motion capture studeio and performance technology research centre, which she established in 2006. She has been a choreographer for over twenty years, and has focused on interactive dance technology for the last ten. Kim has five Australian Research Council projects in dance, technology and science, and has established numerous industry collaborations in motion capture, movement analysis and digital art.

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Perceiving Physical Media Agents: Exploring Intention in a Robot Dance Partner

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Abstract

The use of media in interactive performance is continually developing. Performers are exploring increasingly complex relationships with media agents including robots. One common approach to developing performer-media relationships is to base the interaction on pre-set patterns and direct control of the media. However, performance theory shows that performer-performer interactions incorporate elements of improvisation. Two key elements are trust and the perception of intention, which provide the basis for reciprocal communication. Recent research has developed models for performer-media interaction that incorporate reciprocal communication in the context of performer improvisation with ephemeral (audio/ light based) media agents. This project explores whether these same principles of embodiment apply to physical (robotic) media in performance. One might expect that a performer senses (sees or hears) the movement of media object and responds to it regardless of the form of the media (ephemeral or physical). However, research in performers' cognitive process suggests that their intersubjective and cross-sensory perception produces subtle differences in the perception of ephemeral and physical media. We suggest these differences could have a great impact on their experience. We present our findings from two pilot studies exploring robots as interactive dance partners that use principles of embodiment as cues for interaction.

Keywords

Performance, Media Objects, Robot, Perception, Intention, HCI, Spatial Interaction, Interactive Performance

Introduction

Practice and research in interactive performance has largely focused on the use of auditory and light based media (ephemeral) [8] while the use of responsive physical objects (robotics) has remained under researched. Though the use of robotics in performance is not new, explorations with robotic agents on stage has recently gain momentum [1][17][20] [22]. This trend is supported, in part, by developments in electronic prototyping platforms such as Arduino and tools such as quad-helicopters. These developments have made the design and implementation of robotic systems by performance practitioners more financially and technically accessible. These systems also allow for new models of interaction to be designed and implemented.

The traditional approach to designing interactive systems, for both ephemeral and physical media, has focused on the *system's* ability to sense the actions of the performers. Earlier research by the authors in performer/system interaction with sound and light based media has shown that it's possible to heighten trust and understanding of the system's gestures by leveraging the *performer's* perception of the system's intention to act [6][7]. Researchers in the field of human-computer interaction have also shown that designing for anticipation can affect the effectiveness, efficiency and quality of robot-human interaction [11]. However, a performer's perception of an improvising robot in the context of performance remains under researched.

One might expect that a performer senses (sees or hears) the movement of media object and responds to it regardless of the form of the media (ephemeral or physical). However, research in the cognitive process of performers interacting with media suggests that cross-sensory perception provides subtle differences in *how* the ephemeral and physical media are perceived [5]. The impact of these subtle differences on the performer's experience holds many opportunities for new research. A better understanding of the principles for embodied interaction in the context of responsive physical *objects* requires a unique understanding of the performer's perception. Building this understanding could help in the development of new models of performer-system interaction.

We are interested in finding parallels and differences between the performer's experiences of working with ephemeral media (auditory and light based) and their experiences with responsive physical objects (robots). We use the term ephemeral based on the changeable quality of the media. This paper presents our work-in-progress research focused on developing approaches to Performer-Robot interaction that leverage the body knowledge of the performer. At this stage in the project we are investigating if the principles of embodied interaction that have been explored in the context of ephemeral media remain the same in the context of physical media. We have conducted two studies with participants improvising with robots. The interaction design for these sessions has been informed by earlier work on performer-system interaction and research in human perception of interaction. We have implemented a model of performer-system interaction for physical media that moves towards supporting more embodied modes of interaction, based on research from performance theory

and pedagogy, cognitive science on human perception of intention and performer-system interaction. Our studio sessions serve to test this model.

Background

Ephemeral and Physical Media in Performance

Digital media and computation have had a long and varied position in performance practice [8]. Developments in interactive media have influenced both the way performers work with media and the role the media takes in the performance. The increasing accessibility of interactive tools such as the Kinect, programming environments such as Max and Processing, and devices such as Roomba, Lego Mindstorms and Quad-copters have provided a new push to the continually growing use (history) of media in performance. These different types of interactive tools and media are being used to extend and heighten the artistic expression of the performers. It is reasonable to expect that as interactive technology develops, performance practitioners will be developing increasingly complex approaches to performer-system interaction with an increasing variety of media. The current range of performer-system relationships continues to expand and now includes: responsive tools such as MIDI instruments, triggered lighting systems [3][4][19], semi-autonomous media agents such as projected lighting and interactive scores [19], and autonomous agents such as AI systems and robots for dance and theater performance [7][15][19][22]. As performers offer more autonomy to media agents, including robots, the process of exploring a *collaborative* relationship in place of a *control* relationship requires new models for interaction to be developed.

Performance Improvisation and Intention

One standard approach to incorporating ephemeral or physical media into a performance is to base the interaction on an *Instrument* paradigm [19]. This approach includes programming the system's behaviour with a set of patterns (similar to choreography or blocking) that are directly controlled or triggered in response to the performer's actions (similar to "knowing one's lines). This paradigm can be viewed as deriving from an extreme or highly rehearsed style of performance. What is missed in this approach to designing the system-performer interaction is an understanding that in every interaction between human performers there is an element of improvisation [9][18]. Cognitive science and performance theory suggests that the interaction between human/ performers is always a reciprocal communication happening often in anticipation of the subject's actions.

Bogart and Landau, in their teaching of 'Viewpoints', coach students of improvisation to "*trust* in letting something occur onstage, rather then making it occur" [2]. To trust in the 'something that will happen' is to coordinate the actions and enable the development of events as a group. Yet this development of events cannot be done in response, such as trying to re-contextualize or direct a partner's actions. The improviser must move beyond the cognitive actions and trust in the intuitive actions to foster a balanced or reciprocal communication for negotiation [15].

For a performer to be open to negotiation with others on the stage, they must trust the environment. A sense of support is established when their actions both affect and support other agents. This support comes from trust in the inter-subjective understanding of the moment. This understanding keeps the ensemble synchronized, but requires that all the performer-agents are able to track the intention of the others. Therefore, it becomes imperative that all agents be able to project their own intentions.

Human Intuition of Intention

The understanding that performers negotiate their interaction using a sense of intuition runs parallel to developments in the understanding of performer-performer interaction and general human social interaction [2][10][11][15].

Research in the field of neuroscience has recently suggested links between *intuition* and *intention*. Neurons found in pre-motor areas of the brain have been shown to fire not only when producing a sound or action, but when the subject hears the sound or observes others doing the action as well [10][13][12]. The firing of these neurons allows the subject to predict the outcome of their own actions as well as the actions of others. "This implicit, automatic, and unconscious process of motor simulation enables the observer to use his/her own resources to penetrate the world of the other without the need of theorizing about it" [9]. What is crucial to this phenomenon is that the action observed must be goal oriented, that is it must have intention [10][13][12].

However, there is some question as to the usefulness of mirror neurons in human-computer interaction. The findings to date concerning a person's ability to perceive intention in others suggest that this ability is linked to the physical similarity with the other. This means that a human subject is able to perceive the intention of other humans well, but less so apes, only slightly with other animals and not at all with machines [9][10]. The prevalent reason given for this distinction is a perceived similarity of motion [10]. For this reason it is then unclear whether a system's response actions, if accurately modeled on human movement, would affect a performer's per-cognitive process of perceiving intention.

Still, the presence of this pre-cognitive function implies that the human cognitive system as a whole works in connection with this mechanism, and that even at a cognitive level, interaction is governed by the prediction of events as much or more then reaction to events, an interpretation supported by the presented theories on improvisational performance. These findings suggest that as social being we have developed the ability to intuitively predict the actions and sounds of those around us.

The idea that human action and intention happens before the act has been shown in other experiments as well. Wegner in his book "The Illusion of Conscious Will" presents the work of Kornhuber and Deecke (1965) as well as Libet (1983). These researchers measured a rise in brain activity up to 800ms before an action took place. In the case of Libet's experiments, brain activity was recorded over 300ms before the subject was even aware they wanted to act [21].

These findings further indicate that humans do not live in a static present moment but rather in a moment becoming the next. Our social engagements are informed by an embodied empathy that allows minor predictions of those around us. We react not in the moment but in the next moment over half a second late.

Research in Interactive Performance

Referencing this research in human perception of intention, research in the interaction between ephemeral media agents and performers has shown that the performer's ability to sense the media's preparation to act, its *intention*, is important in how the performer perceives and interacts with the media system [7][11][17][18][22]. In the context of audio agents, it has been show that the sound of a breath leading into the audio gesture improves the performer's ability to understand and interact with the audio gesture [6]. In the context of visual media, it was found that a light agent that indicates its intention to move was experienced by dancers as more engaging to work with [7]. Underlying both these findings is a contingency that the preparation cue is felt by the performer as connected to the system's mechanism for acting. In the case of the audio agent, performers commented that the *breath sound* seemed to be the system breathing in order to play the instrument. In the context of the light agent the graphic simulating the agent, a circle of light, shifting its center of gravity in order to move. It has been suggested that it is this connection to the perceived mechanism for acting that leveraged the performer's embodied knowledge [5][6][7][10][13]. We are interested in how these findings apply with a physical object that has a physical mechanism for acting.

Research has show that the construction of an embodied understanding in the context of media in performance relies on cross-sensory perception and the iterative process involving their *contextual awareness*, *physical awareness*, and *interpersonal awareness* [5]. This constructed understanding also involves assigning a trust of agency: exploring if the performer trusts the agent to provide usable information, guidance, and support for the continued structuring of the performance [7].

Yet the research also shows that the cognitive process is iterative and complex [5][7]. The interaction between the system and the performer's perception of the environment has three aspects: Environment – Object – Agent [7]. The decisions made by the performer and the trust they have with the system in the moment of performing are all affected by subtle aspects of their perception of the media agent [5]. Research into some of the prominent parameters of perception for visual and auditory media in performance has suggested connections to general interaction design theory and theories in cognitive science [1][20]. However, in the context of robotic media, the parameters for projecting a media agent's intention remains under researched.

System Design

The Sphero Robot

We have used two robot platforms to help us explore the parameters of physical media that may engage or facilitate the performer's embodied understanding of the robot's upcoming gesture or intention. In the first part of the study we used a Sphero 2.0 [www.gosphero.com/]. The Sphero 2.0 is a robotic ball, 2.9 inches in diameter and 5.9 ounces, controllable by an app on a smart device. We control the Sphero's movement and colors using an iPad app called "Drive". The Sphero 2.0 provided a commercially accessible robot with the maneuverability that we required for this study. The ball shape robot is somewhat familiar as an object to engage with and its movement is very natural and smooth making it a suitable test robot for first part of this study.

Figure 1. Sphero Robot

Custom Robot

The second part of our study required that the robot be able to indicate its intended change in direction. Indicating the intended direction before moving was not possible with Sphero. We designed a custom two-wheeled robot approximately the same size of the Sphero. The two-wheel design enabled this robot to turn in place as well as make smooth turns. The robot was programmed to randomly change its direction and speed. LEDs placed in a semi-circle around the font of the robot could be light up to indicate a intended change in the robot's direction.

The robot was programmed with two basic modes, 1) using the LEDs to indicate a change of direction and 2) not using the LEDs (so the intended change of direction would not be indicated). When using the lights, a delay was programmed between when the LED turned on and when the

robot moved in that direction. This delay was varied throughout the study from 100 – 800 ms.

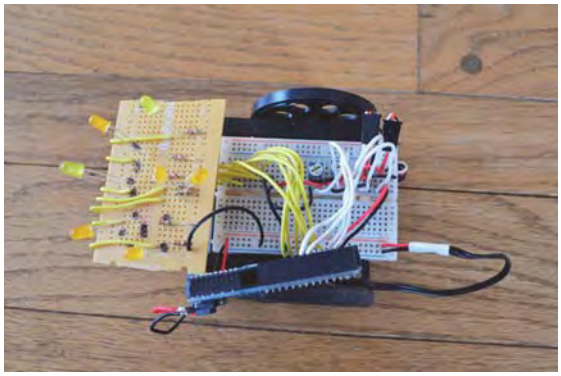

Figure 2. Top View of Custom Two-Wheeled Robot

Studio Research Method

We use a combination of Case Study and First Person methodologies to explore the experience of the performer to the two robots. The study was separated into two parts. In Part 1 we explored the experience of student performers working with the Sphero. Part 2 focused on the first person experience of the researchers working with the custom robot. The sessions in both parts of the study were done using structured improvisation between a single performer and a single robot. Each system was tested separately to keep the focus on the experience of the system itself, rather than on a process of comparison.

Structure of Case Studies with the Sphero

Each participant worked with the Sphero for one session consisting of three stages. During the session, the researchers noted observations and collected comments from the participants. The structure for the session was based around simple 'Tag" game progressing in intensity. Over the course of the session, the participant played several rounds of tag with the Sphero. This basic structure provided consistency between the participants while still leaving room for them to experience improvising with the robot. The stages that made up each session were:

- Familiarization session: the participant was introduced by a researcher to a Sphero on the studio floor and was asked to physically move around with it. Any initial impression of his/her experience was captured.
- 'Tag' game session in a slow speed: the participant played the tag game twice with the Sphero at its a slowest speed setting. The participant started as 'Not It' and becomes "it" when tagged by the Sphero.
- 'Tag' game session in a fast speed: the participant played tag twice with the Sphero at its fastest speed setting. The game proceeded in the same way as the previous session.

The Sphero was controlled by a human. Rules were added to constrain the participant's movements. These constraints provided more challenge for the participant, heightening their awareness of their interaction with the robot. For example, the participants had to walk normally on white lines intersecting the play space (see Figure 3) and tag the robot with their hand.

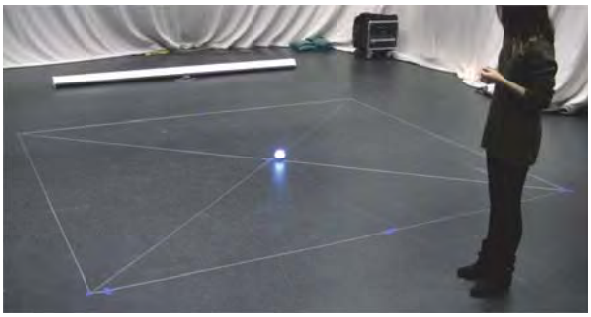

Figure 3. Stage Setup for the Sphero Study

Structure of Sessions with the Custom Robot

The sessions with the two-wheeled robot were based on a single task derived from Viewpoints "kinetic response" and Contact Improvisation. Viewpoints and Contact Improv are established forms of movement improvisation. Combining Viewpoint's concept of Kinesthetic Response with the general practice of Contact Improv outlined a basic task for the performer to stay as close as possible and respond to movement gestures such as spins while not touching/ interfering with the robot.

Each First-Person session consisted of multiple improvisations with the robot. The researchers journaled throughout each session and between sessions about their experience improvising with the robot. The behavior of the robot was varied for each improvisation to test different conditions. These conditions were: no LEDs to indicate the robot's intended direction, and LEDs lighting up 100 ms/ 300 ms/ 600ms/ 800 ms before the robot's movement. For all these conditions, the same task was applied. The robot's style of movement was adjusted during the tests to explore if the approach to an embodied interaction was affected by the style of movement.

Working with the Sphero

It was not surprising that for some performers, working with robots had a novel appeal. In general, participants reported being engaged with the robots and had a tendency to anthropomorphize the robots when describing their interactions. Participants often commented on the Sphero seeming like an animal or small child and evoking feelings of caring and protection. These perceptions or feelings seemed to lay a foundation for the performer-robot interaction.

Relationship Shifts with Sphero

During the study, participants discovered and built different relationships with the robot. These relationships did not necessarily appeared in a linear order.

a. Initial relationship making

At the beginning of the studies, most of the participants did not move much and just paid attention to Sphero's movement. They were observed taking time to investigate its characteristics and figure out how they would respond. Since the robot is very small and rolls on the floor, the gaze was grounded all the time.

"I just look at its movement and what I do is to break it down. So I look at the characteristics, how's it moving and what it does."

b. Caring Relationship

Even though most of participants knew there was a robot controller, they often reported feeling that they were playing with the robot not with the human controller. Because of the size and the simple behaviors of Sphero, participants felt that they should take care of it and reported their personal memories related to this. This phenomenon was also observed, mostly during familiarization sessions but participants kept the caring attitude to the robot through out all sessions. For example, when Sphero was closer to participants, participants became more careful not to stepping on it and let it move around them.

'I feel like I am a cat when I am following the robot…when I am being chased by the robot, I feel like I am a cat."

"…Makes me feel like I am playing with my 2 year old niece. I do exactly the same thing, like I lift my legs. She runs after me. Very playful.'

"This reminds me looking at a hamster's play"

"I don't want to step on it."

"When I was young, my sister had a pet hamster. This reminds me that."

c. Collaborative Partnership

Over the study sessions, participants often reported feeling they were collaborating with the robot. The information obtained from the initial familiarization session helped them to define the relationship with the robot. They tried to move around the robot and to do something with it. In the slow sessions, the participants were moving much slower to balance the quality of movement with the robot. They were waiting for the robot when it was off track. Participants were often observed trying to talk to the ball by expressing their emotion or cheering the ball on.

"The robot is much simpler but I feel like I improvise with my dance partner… First time, you get to know the person observing how the person moves… You kind of need to see the partner and analyze the partner's movement (like they typically do?) I am starting to guess what would be good with this…This is kind of the same principle but the human is more complex."

Competitive relationship

During the 'tag' game sessions, participants often reported feeling competitive with the robot. When Sphero was moving fast, participants felt more anxious about the game and tried to move fast to win the game.

"Oh my gosh, it's coming to me what do I do next."

Movement Cues from Sessions with Sphero

The quality of the participant's movements was affected by the quality of the ball's movement. There were multiple elements that affected the participants in terms of how they moved and made choices.

Speed cue

In the 'tag' game sessions, the Sphero was rolling at two speeds: slow and fast, which were set by the app. Speed elements definitely affected the participant's movements. In the slow speed, they reportedly enjoyed the aesthetics of the ball movement and spent more time on how and where they move at the end of lines. When the robot moved faster the participant moved faster and changed their directions in the middle of the lines more often. It seemed people enjoyed the faster speed with Sphero. They reported that it was more fun, engaging and focused.

"When it is slower I have more time to think but when it was faster it was intimidating."

Trajectory cue

The ball moved very much like a real ball, which was smooth and natural. When it rolled, it moved in curves. However the participants' movements were constrained by the rule to walk on the lines in the game setting. So the participant needed to balance their attention between observing the robot's trajectory and his own movement. Participants mostly found it was difficult. From the initial familiarization session, participants learned that the ball moved widely and couldn't make quick turns. So they could predict the ball's movement and move in response to it.

"The robot is coming after me, I had to wait for a second to see the robot's path and turn to the opposite direction."

"I needed to predict which way it travels. I needed to think one step ahead."

"I was just watching. It was going like an arc or circle. I noticed the pattern. It's gonna cross over right here. So I tried to guess it."

"I tried to dodge. It looks like the ball has to turn wider. So if I made a sharp corner, it would be tricky."

Color cues

Observations suggest that the colors of Sphero were appealing, and participants consider colors as aesthetic ele-

ments rather than informational elements. Sphero had two color modes: solid blue mode and gradual changing mode. When the ball was chasing the person, the color of the ball was blue and when the ball was being chased, the color was gradually changing in hues. The blue color mode helped participants to focus on the path of the robot on the stage. The gradual changing mode helped participants to see the ball all the time without staring at it even when it is in the periphery vision.

Distance cue
When participants were playing with the robot, the distance to the robot seemed to affect what they felt and how they moved. When the ball was rolling close to the participants, they ignored their peripheral vision and just focused directly on the ball. This encouraged participants to connect to the robot and immerse into the immediate situation. However, they weren't able to move freely and this forced them to decide on their movement right away. In contrast, when the ball was far away, participants were able to take time to observe the robot's movement. In these situations it was easier for the participants to predict where the ball was going and to move freely in the environment.

> *"When its close, it's hard to move with it because I had to make sure that I'm not stepping on it or it's not on my way. So it makes me slow. I had to think more, but when it's far away, I don't think too much."*

> *"When the ball is too close to me, it was hard to predict. When it's far away, I was able to see how and where it is going"*

Sound cue
The sound that the ball made when it was rolling on the hard floor helped participants to be engaged in the situation by supporting the perception of its quality of motion (speed, acceleration, direction etc.). The data is unclear whether it helped participants assess the Sphero's intention.

Working with the Custom Robot

Relationship Shifts

Over the course of the sessions, the relationship with the custom robot approached the level of collaboration and then diminished. The journal entries suggest that as the movement pattern of the robot became more aesthetically interesting it was easier to engage with the robot on an embodied level. Such comments suggest that is was the quality of the movement that encouraged the engagement with the robot. However, when the LEDs that indicated the robot's intention were turned off, the relationship was lost. The speed and style of movement were adjusted to try and compensate but the relationship could not be reestablished until the LEDs were engaged again.

Movement Cues moving with the Custom Robot

Quality of speed.
The speed of the robot at first made the robot unattractive as a partner. But the speed was also the main inspiration for working in close proximity, and for using techniques of contact improvisation in the sessions.

Sound cues
The sound of the custom robot's motors was reported to be very consistent and quickly ignored, as not providing any information to the movement intention of the custom robot.

Trajectory cues
It was found that noting the current path of the robot help interact with where it was going. This was especially noted when working with the robot without the LEDs. However, it was also noted that in sessions where the robot's movement gestures where short, the gesture was over by the time the trajectory was perceived which caused problems with the interaction at close proximity.

LED cues
The most common comment concerning the LEDs was that they seemed to indicate the intention of the robot but were not connected to it. When describing the experience with the robot with the LEDs engaged, phrases such as *"I consider…."*, *"I see …"*, *"I think…"* suggest a rational rather then embodied understanding of the LEDs. However, some comments refer to the LEDs as lying, which could indicate a social or embodied relationship to the information being presented.

LED timing
Throughout the sessions, the timing of the delay time between the direction LED lighting up and the robot's change of direction was adjusted. It is significant to point out that the strongest comments of being engaged with the robot occurred when the delay time was 800 ms.

LED mis-triggers
During the sessions, the robot's LEDs would light up but the robot would not move in that direction. These mis-triggers in the LEDs were commented on as confusing and as reducing the performer's trust in the LEDs in general as useful information. It was also commented that some LEDs were more likely to mis-fire then others. Along with these journal entries were comments that sequences of LEDs were responded to. This is of interest because there was no significance to the sequence of LEDs programmed in to the system.

Discussion

In this paper we have outlined theories concerning a performer's perception of objects and agents in a performative environment. Theories from cognitive science and performance theory suggest that performers interact in anticipa-

tion to each other. Research on performer-system interaction in the context of ephemeral media (light and sound) has show that systems can be built that leverage the performer's ability to anticipate an agent, by modeling embodied cues connected to the action of the media agent. For example a system generating sound is interacted with in a more natural manner when a model of breathing is incorporated into the behaviour of the media agent [7]. It has also been shown that performers build their understanding of a performance environment through a cross-sensory experience iteratively with knowledge based on their training and expectations [5]. This project has explored whether this same principle of embodiment applies to physical media in performance such as robots.

Comments collected from participants suggest that performers make dynamic relationships to the physical media they are interacting with. This means that the performer is constantly observing, learning and reassessing the robot's movements and adjusting their own behavior to best suit what they feel the performance required. This finding is not surprising and is very much inline with the iterative process observed in other research projects on interactive performance media.

It is also not surprising that the quality of the robot's motion was found to have a large effect on the relationship and resulting interaction that the performer felt they *could* have. Again this finding is in line with earlier research in interactive performance.

A discrepancy in the experiential data seems to be uncovered when we look at the comments on anticipating the intention of the robots. First, the participants working with the Sphero mentioned anticipating the actions of the robot based on its motion. These comments mention tracking the robots trajectory, showing how skilled humans are at using the information they are provided with to try and anticipate their environment. It also suggests that the physical nature of the robot is enough to engage this human skill. Yet, the researcher found that they were not able to effectively anticipate the movement of the custom robot when the LEDs were turned off (providing no indication of the intention of the robot). If the physical nature of the robot was enough, then the physical presence would make it possible to anticipate both robots equally.

Other comments made by participants working with the Sphero suggested that the speed and proximity of the robot to the performer effects where the how the performer relies on anticipation. The researcher working with the custom robot tended to be in close proximity so depended on the robot's projection of its intention 800ms in advance of the action based on the research discussed earlier done by Libet. This finding suggests that we can design mechanisms for projecting the robot's intention through their physical structures, making them more natural to collaborate with.

However, the 800 ms used in this study is at the long side of the window suggested by Libet. In earlier research with a light based media agent it was found that 200 ms was sufficient for the performer to intuitively feel the intention of the media agent. If we are to say that the LEDs on the robot are engaging the embodied intuition of the performer, we should explain this discrepancy. Research with ephemeral media has found that the performer will often not even notice that they are responding to the media agent's projected intention to move, but they comment on intuitively feeling the intention. The researcher working with the custom robot described their experience as considering and seeing, suggesting rational perceptions of the robot's intention rather than intuitive perceptions. We contend that the extra cognitive process of rationally perceiving the LEDs accounts for the additional 600ms of time. This explanation suggests that the LEDs are not as much an embodied projection of the robot's intention, but more a pre-signal to the performer that they learn as part of the specific performance environment.

The last piece of this puzzle may lie in the perception of cause and effect. Participants experienced the rolling of the Sphero as a natural and smooth motion. The arching turns obeyed the participant's expectations of how a ball can – and therefore would- move, allowing them to anticipate the movement. The custom robot was designed around a two-wheel design allowing it to turn on the spot. This allowed it to engage in performer's movement patterns that were unusual for a wheeled object, therefore making it harder to anticipate. This analysis suggests that the robot's mechanism for moving may affect how it needs to indicate its intention to move. The LEDs on the custom two-wheeled robot were not perceived as part of its movement mechanism and therefore perceived as signals rather then embodied cues. In the earlier research with the light-based agent, the graphic modeling of a shift in center of gravity was perceived by the performer as a *cause* to the resulting motion.

Conclusion and Future Work

Through this study we have found that the principles for embodied interaction that were previously developed for ephemeral media do generally translate to physical media. However, we found that the *quality of motion* and the performer's perception of how the physical object to move (enacting its intention) needs to be considered when modeling an embodied interaction. While physical objects have inertia and are subject to the same laws of physics as the human performer, the mechanical mechanism does not always show its preparation to move in the same way that a human does, making an embodied perception of the system's intention weak. While adding this preparation to move is relatively easy with ephemeral media, physical media is still constrained by the actual physics of its motion, so designing a preparation can de a large design challenge. We will explore this challenge further in future work.

We also found that size of the robot had an impact on the type of relationship the performer felt they could engage in. The smallness of both robots made them seem fragile and not able to withstand true contact. In future

studies we plan to explore the performers experience with larger robots.

This study has also illustrated that proximity between the performer and the media agent is a key factor in determining what information the performer requires in order to feel engaged with the robot. We found that performers looked for an embodied based interaction with the robot most strongly when working in close proximity. We will be conducting future studies focused on close proximity interactions between robots and performers.

Robots and other physical media will continue to be used in performances. As the tools, programs, and devices become more accessible, performers will be extending the relationships they have with interactive physical objects on stage. By understanding how these design challenges relate to research already done with ephemeral media, the path to robots as engaging partners on stage will be made easier.

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Puzzling Gestures: Prototyping a Teleoperated Interactive Artwork Using Techniques from Glass and Electronic Art

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Abstract

This paper presents the initial stages of prototyping a digital-sculptural project that mines conventionally undesirable artifacts of mass production and material residue for their expressive worth. These artifacts are used as both inspiration and raw material to transform touch and movement into reflexive structures. This is done in the form of a remote controlled 'teleoperated' interactive artwork. This artwork, called *Gesture Puzzles*, is inspired by antique glass and wood-framed dexterity puzzles that use a player's hand movements to maneuver a marble through a maze. The piece describes practical collaborative methods that use creative electronic process to exploit both desired and undesired material residues from molten pressed glass, waterjet cutting and touch screen interfaces.

Keywords

Glass, waterjet, electronics, gesture, puzzle, digital sculpture, prototype, Rapid tooling, interactivity. Teleoperation, touch screen

Introduction

Fingerprints, smudges and smears remain on touch screens as biological residue of daily use. While often unnoticeable, these marks compose a tangible reminder of physical actions that have initiated digital results.

This paper will describe the creative process behind making a sculpture in which disused processes and materials, including screen swipes, serve as a medium to prototype a teleoperated artwork. This work combines material residue in the form of wasted wood, glass and evidence of user interaction. These create the physical structure of this work, and in the rationale for their use, as a basis for conceptual frameworks in future iterations.

These objectives are supported by the following three aims. The first is to creatively utilize the tactile experience of remote control/teleoperated machines in an artwork. This artwork is influenced by antique dexterity puzzles in which a player maneuvers a marble through a maze. The second aim is to creatively integrate latent materials and performed actions. This concerns the advantages of recycling, or making creative use of discarded or overlooked resources, including how to capture hand gestures and transform them into digitally fabricated objects through rapid manufacture. The third aim is to promote interdisciplinary collaboration between the fields of glass and electronic art. This is approached by reinterpreting, not only glass, but other analog craft processes in digital ways. This reciprocity is relevant to the field of electronic art because, with access to proper training and equipment, glass' nature as an inert, non-conductive material can be implemented expressively and structurally in digital artworks. After addressing these aims, this paper concludes by reviewing progress and suggesting future directions.

Project Description:
What is a Gesture Puzzle?

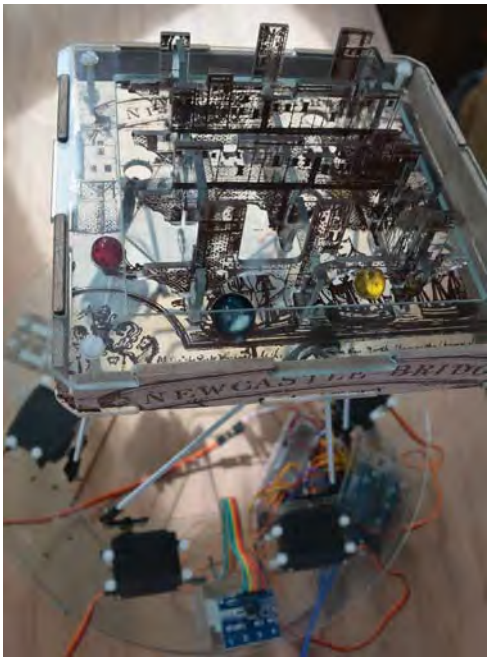

Figure 1. *Gesture Puzzle 1: Newcastle Bridge.* Glass, enamels, wood, capacitive touchpad, Arduino microcontroller, servomotors. Hursty, Bradbury. 2015.

The *Gesture Puzzles* will use a tablet or mobile phone to remotely tilt a glass and wood-framed box to maneuver a marble through a maze. The boxes are designed and cut

through CAD/CAM. When being manipulated, their pitch is controlled by servomotors, which adjust the rotation of the X and Y axes. These servos are controlled by an Arduino microcontroller and will be manipulated through a tablet touch screen interface.

To interact with this sculpture, the teleoperator will swipe a tablet to control the movement of the box. This movement is similar to the analog mechanism of Labyrynth, a popular sphere-in-maze, pitfall dexterity game developed by Brio, a Swedish company in 1946.

Figure 2. Brio Labyrinth game. [1]

In *Gesture Puzzles,* a program will record the direction and pressure of a participant's swipes. These recordings will be processed to display the gesture visually as 2D forms. Our current prototype (Figure 1) uses a capacitive touch pad, but we are pursuing a resistive touch screen interface as the most promising approach to registering the pressure of the screen swipes as 3D data.

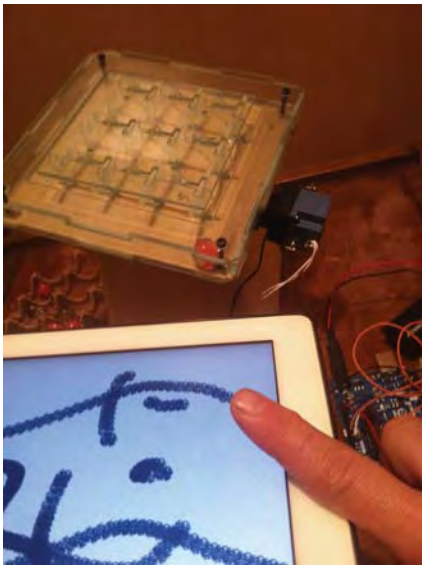

Figure 3. concept image of maneuvering a maze by swiping a tablet. Hursty, 2014

This data will be used to print 3D profiles as sculptural records of each time the puzzle is used. Depending upon the various pressures applied in each swipe, they will appear like the troughs and peaks of a sound wave. These will be incorporated into the subsequent sculpture as part of a grid structure that constitutes the navigable maze.

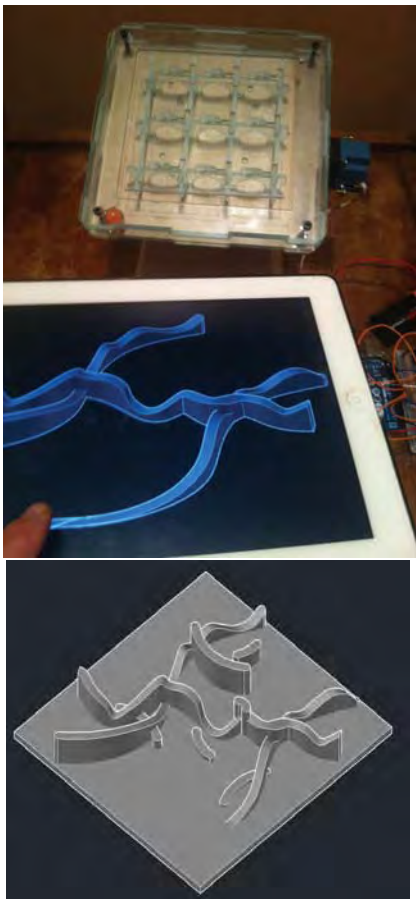

Figure 4. Concept image of capturing swipes as 3D profiles for 3D-printed maze insert. Hursty, 2014

Background: Path to Puzzle Making

Gesture Puzzles resulted from a series of projects that used press-molded glass creatively. These projects used waterjet cutting and rapid manufacture to make bespoke molds for pressing molten glass. *Muqarnas*, 2014, were the first artworks in this series. *Puzzle Boxes*, 2014, followed. The residual materials generated by these presented an opportunity to make *Gesture Puzzles*.

The choice to make glass boxes arose from applying the rising prevalence of Rapid Tooling in Rapid Manufacture to the cutting of sheet glass molds into which molten glass could be pressed. [6] The *Puzzle Boxes*, 2014, were developed to demonstrate how molten pressed glass forming, an obscure method within glass art, could be used artistically. [5] The specific premise was that by creatively reinterpreting pressed glass, which is based on elaborate

mold-making, a method could evolve in which the mold permanently encompasses the finished artwork.

Developing this method resulted in a series of works entitled *Puzzle Boxes*. These are box-shaped mold artworks inspired by Chinese puzzle boxes. The Qing dynasty (1644 – 1911) boxes were carved from ivory, wood or jade. They opened in elaborate or hidden ways and were prized curiosities exported along maritime trade routes to the West. The term 'puzzle box' also refers to boxes containing sets of intricate carved ivory puzzles during this same period. [2]

Figure 5. Chinese export puzzle set, 19th century. Copyright 2014, Discovery Museum, Newcastle

Hursty's *Puzzle Boxes, 2014,* were made out of bespoke sheet glass produced for the field of artistic fusing. These could be heated to a high temperature and then poured into with ladles of hot glass. The project was conceived for two reasons. First, as transparent shells for witnessing the normally opaque process of pressing molten glass into a metal mold's crevices. Also to fuse designs of varied glass colors, including the mold itself, together, like glass marquetry.

Fusing glass molds like this is a new technique for mold-pressed and cast glass that can expand the creative possibilities for glass casting. This development also inspired performative work that focused on the spectacle of the flowing molten glass (Figure 6). Importantly, this technique substituted glass for making molds instead of metal, the most favored material used for press forming. Pouring into transparent molds in this way makes the opaque process of pressed glass visible.

Figure 6. Montage of pressing molten glass into a sheet glass *Puzzle Box*. Hursty, 2014.

The glass boxes that resulted, as well as the discarded wood that was sacrificed in the process of making them, evolved into the *Gesture Puzzles* described in this paper. This happened by recycling the disposable byproducts of the design and making process, the scrap glass and wood components, to make experimental boxes that could never be fused together. Instead, they are being developed as interactive dexterity puzzles inspired by the movement and flow of hot glass.

The ebb and flow of process that influenced the final *Gesture Puzzles* also involved electronic methods. First, it influenced the CAD/CAM that was required to make the components. Second, it became an inspiration to develop an interface to manipulate the boxes through touch-screen teleoperation.

Using Residue as a Creative Resource

The raw materials, the glass and wood used to make *Gesture Puzzles* emerge from the residue of rapid manufacture and digital process. The residual glass came from experiments with disposable window glass rather than expensive fusing glass. This provided an inexpensive way to test that the tolerances of the joining nodes could be fit by hand and that they could be cut reliably using the waterjet machine.

Waterjet cutting is a computerized numerical control (CNC) process that uses extremely high pressures to allow a .75 millimeter stream of water infused with garnet abrasive powder to cut glass (and most other materials). When cutting sheet glass with high water pressure, a backing board is required to avoid breaking delicate pieces. This underlayment is usually made of wood, though other materials are possible. This incidental support is cut as a twin, in the exact pattern as the overlain glass material. It is usually disposed of as it is considered scrap. In *Gesture Puzzles*, both the wood and inexpensive non-fusing glass are kept and assembled to make up the platform and boxes. Using these materials in this way allows for different assemblages and aesthetic permutations to result across the series.

Figure 7, *left.* Waterjet cutting glass with disposable wooden backing board underneath. Hursty, 2014
Figure 6, *right.* Discarded waterjet cut wood underlayment. Hursty, 2014

Another source of residue for the boxes comes from mark-making. The concept of *Gesture Puzzles* is for them to function like a drawing tool by making creative use of tactility. The movements of playing are simultaneously transformed into mark-making that is both immediate and mediated. The marks imply meaning as both a record of the teleoperator's intent to get a ball through a maze and as an artistic record. This represents the path taken through the maze and the biological residue in the form of fingerprints and smears that are left behind. These gestures reflect not only the daily performativity that occurs between tablet users and screens, but as an interface between manual touch and digital results.

Design Researcher Tavs Jorgensen explores the possibilities of digital products whose physical forms bear the traces of manual shaping. One such product was a set of tea towels on which motion capture imagery of a hand using a tea towel was printed. [6] In that application Jorgensen utilized a 3D motion capture glove for its 2D expressivity. The goal of the *Gesture Puzzles* is not only to register screen swipes as X and Y axes for 2D profiles but also to capture the pressure of the swipes as a Z axis in order to transform the movements of a user' movements of 3D profiles for digital manufacture.

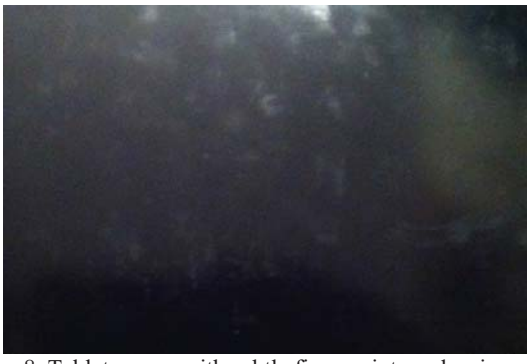

Figure 8. Tablet screen with subtle fingerprints and swipe marks visible.

Screen swipes have been used by artist Evan Roth in his *Multitouch Paintings*, which were "created by performing routine tasks on multi-touch hand held computing devices." [7] In this series, the fingerprinted gestures of playing a game, using an app, or engaging with social media are displayed in a grid (Figure 9). This flattens, concretizes, and equalizes the time and effort that has gone into these otherwise fleeting acts. Whereas Roth employs the 2D nature of multi-touch through painting, *Gesture Puzzles* seeks to capture the depth of such mark making to make them into tangible objects.

Figure 9. *Angry Birds All Levels*. Ink on tracing paper. Evan Roth, 2012. [7]

Judith Donath expresses the signifigance of mediated touch in communication channels that depend upon screen-based devices.

> *"As human beings, we interact with one another through many modalities: gaze, touch, gesture, and speech. In our daily experience with laptops and desktops—e-mail checking, Web surfing, and game playing—touch and text are our main communication channels."* [4]

As we use mobile devices to access information online, play games, and to interact socially, our physical gestures disappear with only the slight residue of fingerprints remaining. *Gesture Puzzles* would freeze these gestures in time, reinterpreting and reconstituting them as components for new boxes. They would then serve as physical reminders, ghosts of movements that would otherwise disappear.

Technique: Making the boxes

When the boxes were first assembled, they drew comparisons to mass produced antique puzzles. Belying this simplicity was an iterative and complex process, which is described here.

The sides of the boxes are cut in uniform patterns from 3mm thick sheets of wood and glass. These create flat interlocking sections that are possible because the patterns contain complementary dovetail joints, allowing the various segments to fit together. The profiles are drawn using CAD in multiple versions. After being cut, in order to be fit together, they are heated to 575 degrees centigrade, and then poured into by molten glass at 1260 degrees centigrade. Once experimentation with fusing glass began, further versions had to be made to improve annealing of the boxes (slowly cooling them to relieve destructive tensions within the glass) and to accommodate new designs. This experimentation generated the substantial amount of disposable wood and glass components mentioned earlier.

The original *Puzzle Boxes* had annealing problems. These arose because the height of the protruding glass tabs was too extreme; the overlapping tabs would not anneal properly or would crack. To minimize this problem, dovetail joints, common in woodworking, were applied to glass cutting. By doing this, overlapping joints became practically flush with each other. This improved their annealing prospects.

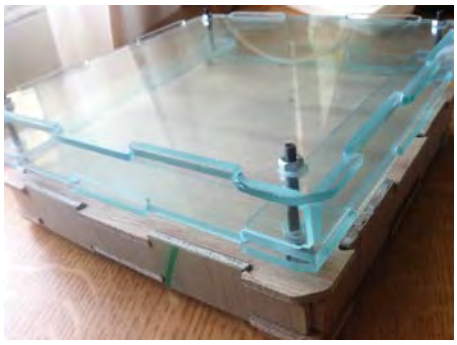

Figure 10. Waterjet cut dovetail joints in glass and wood. Hursty, 2014.

From a tooling perspective, cutting dovetails at the perimeter of the glass was a quicker and less fragile technique than poking holes, which had been done in previous versions. The reason these design decisions led to the *Gesture Puzzles* was that with so much material being cut to develop an ideal shape, their underlying sheets of backing plywood and scrap glass result in an equal amount of matching components. Because the sheets of wood and glass are the same size, they are interchangable and can be swapped to make hybrid glass and wood boxes. These boxes resembled sphere and maze games such as *Labrynth* and *The Busy Bee*.

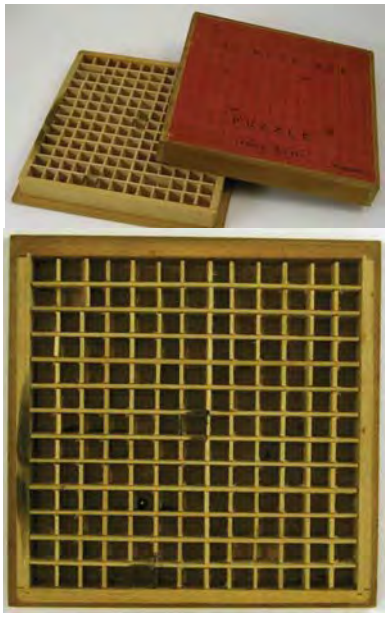

Figure 11. *The Busy Bee*, sphere in maze route finding puzzle, late 19th century. The Puzzle Museum. [2]

Wooden games traditionally would have been cut by hand, band saw, or router. Due to the fact that glass can only be cut in certain ways without shattering, the glass and wood shapes used in *Gesture Puzzles* are cut with high-pressure waterjet. This type of cutting, in terms of detail, provides results similar to laser cutting. This level of detail, from an ancient technological perspective was achieved by Chinese jade carvers who used abrasive powder on thin bronze wire bow saws to carve intricate patterns.

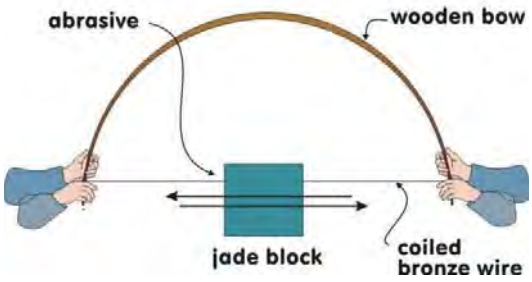

Figure 12. Chinese bow saw used for ornamental jade cutting.

Though the glass boxes were originally intended as one-time use molds for pressing molten glass, they have been used in different ways throughout the series.

A Duel in the Air: teleoperation

Maneuvering the puzzle boxes as a gestural fluid motion game also took inspiration from glass's molten properties. Hot glass practitioners must constantly maneuver glass to balance it "on-center" like a gyroscope. This maneuvering can be compared to dexterity puzzles like *Sky Pirates*,

where a biplane pilot, or his marble proxy, must avoid falling into holes fired by a piratic dirigible.

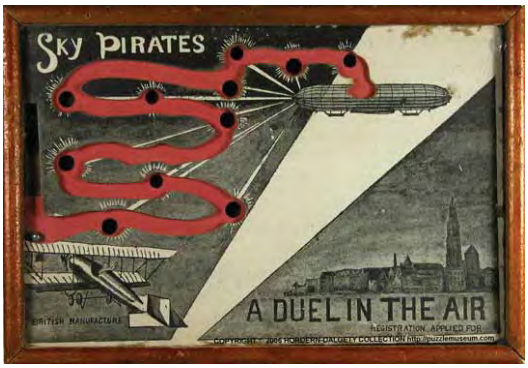

Figure 13. *Sky Pirates*, sphere in pitfall maze dexterity puzzle, 1910-1918. The Puzzle Museum. [2]

Hot glass has a time limit and can only be worked for short periods. In the course of playing *Sky Pirates*, a mistake can be reset. With one-time use glass molds, however, once a mistake is made and the glass fuses together, the process is irreversible. To reflect the reality that hot glass cannot be directly manipulated by hand, but rather through intermediate tools, it was decided that the boxes should be toggled remotely through electronics. The *Sky Pirates* slogan, *A DUEL IN THE AIR*, resonates with teleoperation, which uses invisible communication to maneuver something from across a room or removed to a different location entirely.

The feedback loop between human and machine sought by *Gesture Puzzles* points to a cyclical conversation of touch and materiality. This is reflected in an analog sense in dexterity puzzles such as *The Busy Bee* game (Figure 13), in which a player was tasked to move a ball around a maze, the route and pathways of which they could not clearly see. This draws a comparison to the underlying, hidden nature of programming code that directs and manages our interactions with electronic devices. Sitting beneath the surface of our gestures and communications sits a labyrinth, an obfuscated language that controls us in ways of which we are only superficially aware.

Conclusion

This paper describes the creative development of the first *Gesture Puzzles* prototype. Process and content have been linked from the original objective of making an artwork from press-molded glass to incorporating that project's residue into the *Gesture Puzzles*. This ethos of reuse inspired the current work's content without losing the series' original pressed glass focus.

Though the assembled boxes were no longer used for pressing glass, a metaphor for molten glass evolved that used the trope of antique maze games. This was intended to elicit a comparison to the formal theme of the work; abstracting touch and movement into reflexive structures.

This research brings little-known glassworking processes in line with electronic art. Waterjet cutting and rapid manufacturing techniques resonate with electronic arts practice, which is versed in rapid prototyping and laser cutting, but less so with cutting and melting glass. One benefit of an exchange between glass and electronic art is that the same CAD files can be used in both laser cutting and in the comparatively obscure practice of waterjet cut glass.

While it is understood that analog materials have physical limitations, digital formats are expected to have unlimited potential to do what we ask of them. Analog limitations of glass include specific ways of how, and at what temperatures it can be fit together. Limits of digital interfaces include the requirements of programming code to perform pre-determined actions in precise ways. Comparing analog and digital materiality through this interdisciplinary artwork problematizes the expectation of ultimate efficiency in digital formats with questions of interface and intuition.

This crossover was seen in *Gesture Puzzles* in the following examples. Teleoperation parallels the enforced distance and intermediate tools that must be used when working with glass. It also removes the hand of a player from obscuring the glass box, allowing light to be projected through the object. *Gesture Puzzles* offers an open-ended maze, with numerous exit doors, that are not intended to restrain, but to open a framework for digitally transforming physical gestures into tangible glass objects. While glassworking is an ancient technique, its use here demonstrates to the field of electronic art that new, potentially relevant glass techniques are still being discovered for creative use. This relevance also applies to how glass, with its properties of clarity, light and many other qualities, can be employed as a source of content by electronic artists.

For future *Gesture Puzzles* iterations, further comparison will be forged between teleoperating a machine and mediated social relationships. Transforming actions between digital and physical, sometimes over long distances, could be compared to interacting with other people, both on and offline. These different social modes can be evaluated as they are communicated through touch and iterative object.

The shape of the box forms could also evolve to a point in which the functionality of the maze breaks down completely as visual and physical complexity grows. Instead of composing a maze, the components can be used to build other sculptural forms. Whatever new forms result with this platform, the focus on remote control and the absence of tactile and vestibular (balance) feedback remain relevant for continued development. As teleoperation allows more tasks to be performed remotely, an emphasis on preserving a sense of tactility and sculptural resonance will remain.

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[Session 17]

Expanding Performance

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LAIT – The Laboratory for Audience Interactive Technologies: Don't "Turn it Off" — "Turn it On!"

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Abstract

The **Laboratory for Audience Interactive Technologies (LAIT)**, has been established at the University of Illinois Urbana-Champaign to investigate possibilities for mobile devices to enhance the dramatic and informational experience of audiences at theatrical events, including dance, theater, music concerts, sports events, and installation. LAIT has a two-fold mission to 1) create a new type of theatrical experience for the 21st century, 2) provide an experimental platform for industries to develop applications for entertainment and informational use. This paper describes a mobile development platform that will enable theatrical producers to rapidly prototype and produce deployable applications that run on services provided either by LAIT or by the end user, without the need to write a custom application for each production. This will provide a cost-effective application solution for individual theater, dance, music, and installation producers. LAIT also intends to provide guidance for aesthetic use of applications within the context of live performance, so that it can enhance or augment that experience, rather than distract or detract from it.

Keywords

Mobile applications, theater, dance, music, installation, augmented reality, LAIT, smartphone, tablet computer, DSL, Unity

Introduction

Growing out of a successful experiment with designing and deploying a custom mobile application for an audience to use during a dance production at the University of Illinois Urbana-Champaign (UIUC), the Laboratory for Audience Interactive Technologies (LAIT) was established at UIUC to investigate possibilities for using mobile devices to enhance the dramatic and informational experience of audiences at theatrical events, including dance, theater, music concerts, sports events, and installation art. LAIT's mission is two-fold: 1) create a new type of theatrical experience for the 21st century, 2) provide an experimental platform for industries to develop cutting edge content for entertainment and informational use. Rather than providing application development services, LAIT is developing a *platform* that will enable theatrical producers to rapidly develop and deploy solutions that run on services provided either by LAIT or the end user. This obviates the need to create a custom application for each production, and provides a cost-effective, rapid development solution for theater, dance, music, and installation producers. LAIT also intends to provide guidance for aesthetic use of mobile technology within the context of live performance, helping users to produce content that can enhance or augment that experience, rather than distract or detract from it.

Background

Kama Begata Nihilum, [1] a dance that premiered at UIUC's Krannert Center for the Performing Arts in February 2014, featured a cast of seven dancers moving onstage with networked iPads that displayed synchronized graphics and texts, controlled by custom software written specifically for this performance. A mobile application made available to the audience provided for the display of additional graphical content including augmented reality, that provided meaningful content to users who pointed their smartphones and tablets at a projection on the stage, that was not available otherwise.

The proximity of the iPads to the bodies of the performers, along with the connection the audience felt to the performance through their personal digital devices, resonated in a tangible way throughout the theater. At a Q&A session after the performance, one audience member said that, because of the smartphone application, he had never felt connected to a performance as he had that evening – he claimed that the experience was highly "interactive." Even after being challenged on his use of that word (in this case, the mobile application afforded no user input capability), he insisted that his experience was "really and truly interactive." Others attending the performance not only echoed these sentiments, but also provided several suggestions for expanded uses of this technology.

The enthusiasm felt by this audience might be explained by Camille Baker's findings that mobile devices can help bring "liveness" and "presence" to performance in the 21st century [2], particularly in the connection among participants in a shared event. Owen, Dobbins, and Rebenitsch also describe similar audience involvement and engagement to what we experienced with *Kama Begata Nihilum*. Their "Theater Engine" performances explore the use of mobile devices for live dance, and the technical and design

considerations necessary for these types of productions. [3] Like *Kama Begata Nihilum,* their highly complex work faced challenges coordinating multiple specialists working many hours on each production as well as challenges with respect to infrastructure and deployment.

To address some of these difficulties and to continue to build on audience enthusiasm for mobile devices as part of performance events, an effort was begun to leverage the research and design resources available through the National Center for Supercomputing Applications at the University of Illinois (NCSA) to develop the expressive, informational, and integrative possibilities afforded by personal digital devices in the context of live performance. The result of this effort is the Laboratory for Audience Interactive Technologies, or LAIT. Taking advantage of the phones, tablets, watches, or other devices an audience member may use to connect to the world around them, LAIT intends to extend that connectivity to the domain of live performance to assist artists in engaging their audience and in conceiving new works with mobile devices at their core.

Artists generally don't have access to the resources necessary to develop and deploy a mobile application. Since the idea of using this technology to enhance or augment live performance is new, they also may not have the ability to readily imagine what might be possible.

LAIT's strategy to counter these deficits is two-fold:

- Develop a platform, or toolkit, to assist artists in creating content for mobile devices and provide a ready delivery method immediately useful in live performance and flexible enough to accommodate last minute changes;
- Consult with individual artists and host group brainstorming sessions to assist creators in conceptualizing how content for mobile devices might be used in live performance.

Defining the problem space

One of the challenges facing a builder of a generalized platform aimed at using audience member's mobile devices in the context of live performance lies in the paucity of previous discussion on the topic. While it bears a resemblance to the design disciplines commonly found in the performing arts, like lighting design or scenic design, its role in the context of performance is not as clearly or easily defined as those disciplines.

Much of our work has been driven by discussing the potential of the platform with prospective users and collaborators. On May 1, 2015, we held a "LAIT Day" general discussion about the capabilities and possibilities that our platform can bring to live events. Participants were asked what role the content provided by the LAIT platform should, or can, play in a performance. Their answers generally make reference to three broad, yet distinct, modes in which a LAIT designer ought to be able to create.

The first of these is the *display*, or exhibition, of content in support of the overall aesthetic of a performance. In *Kama Begata Nihilum*, this was the only functionality afforded. However, we discovered that even simple actions such as the ability to remotely change the color of a phone's screen, display an image, or vibrate the device, can have a profound expressive effect.

Another mode that interviewees felt would be important is leveraging the use of *input* afforded by mobile devices. From allowing a user to click on a button to signal recognition of a specific dance gesture [4] to using the aggregate accelerometer data of an entire audience to drive a particle system projected on a screen behind the performers, the potential of using this kind of data in performance is exciting, even though the technical challenges are complex – particularly on a scale of massively attended events.

The final mode appearing in preliminary discussions about this platform's role is *annotative*. A broad array of performances could benefit from the addition of content to help audience members understand complex art forms. Operas often require supertitles, which now could be provided in many different languages. Novice orchestra concertgoers could learn from the identification of an instrument currently playing a solo. Or, an actor's true motivation could be hinted at via audience's devices.

These three broad modes of content creation, then, function as guidelines for developing the LAIT platform.

LAIT Platform Architecture

LAIT is an extension of the application we built for *Kama Begata Nihilum.* It is being built for speed and reliability, because in live performance, precise cueing times and reliability are absolutely necessary. A performance will suffer, or even fail, if a cue comes too late or doesn't show up at all. Therefore, LAIT is being developed using the Unity 3D game engine, a proven commercial platform used by game developers worldwide. Unity 3D offers a robust scripting layer that allows for extensive customization, along with reliable networking functionality.

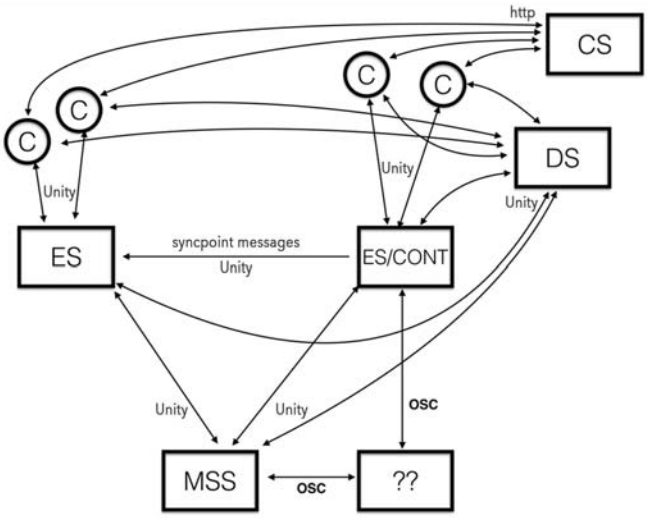

Figure 1. LAIT System Architecture

The LAIT architecture consists of several components whose interconnection is illustrated in Figure 1:

- Client (C) – the mobile device carried by the audience member
- Directory Server (DS) – helps to direct Cs to a server associated with a specific live performance event
- Event Server (ES) – relays cue messages (Qs) to the Cs during a live performance
- Event Controller (ES/CONT) – as above, with additional functionality allowing for the triggering of Qs
- Content Server (CS) – delivers any content needed for the performance
- Message Stream Server (MSS) – accepts and parses input from the audience members' devices
- Other Services (??) – output to other services, computers, and processes

Prior to a performance:

- An audience member downloads the Client (C). Upon launch, C connects to the DS.
- DS sends a list of events that are currently active.
- Audience member chooses the event he/she is attending from the list provided by the DS. This connects C to the event's ES.
- C is directed to download the Q-List and other necessary assets from the CS.
- C parses the Q-List and constructs the content specified within it.

During a performance:

- Q triggers are sent rom the ES/CONT to C's.
- C's response to the Q trigger is described in the specifications of the Q-List (e.g., display a graphic or text, flash a color, vibrate phone, etc.).
- Any input from C (accelerometer data, screen touches, etc.) is passed through ES directly to the MSS.
- MSS collects input from all the ES's. It may choose to process the data itself or pass this data on to an external process. The input data may ultimately be used in or out of the system.

Scalability is achieved by the ability to deploy multiple ESs for any given live performance. If an event were expecting one hundred audience members, one ES would suffice. For five hundred seats, two or three ESs might be necessary, and so forth. Theoretically, LAIT could be scaled to thousands of users. Extensibility is achieved through modular design and by communicating with components outside the LAIT architecture using the Open Sound Control protocol (OSC). [5] OSC is used for data communication among interactive applications, and implementations exist on a wide variety of platforms.

The Domain Specific Language

In order to promote speed, flexibility and ease of use in our networked platform, we have implemented a modular domain specific language (DSL). A "Q-list" Document (QLD) written in the DSL is loaded by the C upon connecting with the Event Server. The QLD tells the C what content or function will be needed during the performance, and associates that content with an integer index, or "Q". Then, during the performance, concise messages containing a Q's index are used to trigger relatively complex sequences on the C, such as displaying a graphic, changing the color of something, playing animations, etc. The capability to execute these Qs is handled by *modules*, components that function similarly to plug-ins, each of which provides a specific capability to the LAIT system. Thus, the architecture has been structured to easily add capabilities as desired, such as dynamic location detection, biometrics, etc.

For example, in order to display a background color on the C, a plane must be created and a color applied to the plane. Specifying the color of the plane requires at least 256 bits of data for four floating-point numbers describing its red, green, blue, and alpha values. This number grows when adding consideration for the position, size, and orientation of the plane on which the color is to be displayed, and greatly increases if animating it on the fly. It is easy to see that sending messages of this size to hundreds of phones at the same time is inefficient, leading to latency and lost information on even robust wireless networks. However, since the C has pre-loaded the QLD, a single integer is all that is required to perform actions on a C.

While loading the event-specific QLD in advance of the performance allows for efficient use of network bandwidth, it also necessitates an abstraction of the content to be delivered to the device. This abstraction is further being used in the development of a simple WYSIWYG tool for content creation that automatically generates the QLD for use in the LAIT infrastructure. This tool will allow non-specialists to create their own content for mobile-device enabled events, significantly lowering the overhead and development time when compared with building a custom application.

Initial Experiments

LAIT exists at the intersection of performance and HCI as posited by Spence, Frohlich, and Andrews, in their Performative Experience Design (PED) framework. [6] An interesting use of the LAIT system in this context occurred during the American College Dance Festival at Iowa State University in March 2015. Dancers holding mobile devices were guided through an improvisation with LAIT. Just prior to the event, several dancers who volunteered to be leaders had their photos taken and uploaded to the CS (Fig. 1). Then the dancers loaded the LAIT application. At a certain point during the dance, the leaders' photos were displayed randomly on random phones. Dancers then gathered around and followed the movements of the dance leader who appeared on their screen. At another point, the display of random colors was used to form and re-form groups within the mass of dancers. Later, random evocative words were displayed on random devices, inspiring a

collage of movement and sound qualities that redistributed the dancers around the space. In these ways, LAIT melded spectator, performer, and group dynamics into a set of new and complex interactions that would have been otherwise unavailable. This experiment served as a proving ground not only for basic infrastructure and functionality of the system, but also demonstrated the ability to change content dynamically.

An example of LAIT's capabilities as an annotative tool occurred at a concert by the band Cody and the Gateway Drugs at the Krannert Center for the Performing Arts in April 2015. The LAIT system successfully delivered lyrics to patron's devices in synchronization with the live performance. Photos of the band members and promotional materials were also displayed. By offering more information about the band and its repertoire, LAIT was able to extend and enhance the audience's enjoyment and appreciation of the performance.

Conclusion

With LAIT we are hoping to help usher in a new era in live performance, where mobile devices are integrated into events instead of being banned from the performance venue. The usual dictate to turn your phone off at a performance is based on the notion that checking social media or playing games makes it impossible to pay attention to what is happening at the performance, and is distracting to your neighbors. However, if within valid aesthetic parameters, the phone is used to enhance lighting effects, display augmented reality content not otherwise visible, communicate hints regarding a character's motives, or to encourage audience participation by eliciting synchronized movement, then the device can be elegantly integrated into an artist's work, and add value for the event's producers.

Anecdotal experience has shown that people are unwilling to shut down their devices when attending a dance, music concert, drama, or movie. So, why not make use of their tremendous capabilities to push the boundaries of art by augmenting live performance? As we announced to the audience who attended *Kama Begata Nihilum*: "Don't turn your cell phones off, turn them on!"

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Authors Biographies

John Toenjes has a BA from Stanford University, and an MA in Music Composition from the University of Missouri-Columbia. He is Associate Professor and Music Director of the UIUC Department of Dance. His numerous interactive dances and movement-based installations include *Inventions Suite* (Cleveland Ingenuity Festival 2008), and *e's of water* (UW-Milwaukee 2007). He wrote the music and designed the wireless sensor networks for Trisha Brown's *Astral Convertible Reimagined* (UIUC 2010), and for *FraMESHift* (Teatro Astra, Turin, Italy 2011-12). He was Technical Director for IJPAN, the Illinois-Japan Performing Arts Network (2010-13), which produced his *Timings: An Internet Dance*, with dancers co-located internationally and connected to live avatars via Kinect. John is now Director of the Laboratory for Audience Interactive Technologies. http://lait.ncsa.illinois.edu

M. Anthony "Tony" Reimer's passion is designing sound effects and writing music for theater, film, video games and interactive experiences; his compositions and sound designs have been heard in venues across the US and internationally. He has a BGS from Ball State University, an MM in Computer Music and New Media from Northern Illinois University and is pursuing a DMA in Music Composition at UIUC. Tony has been audio director/composer for Mutiny Games. He has designed and implemented interactive installations and data sonification projects at UIUC's Krannert Art Museum and Krannert Center for the Performing Arts. Tony teaches sound design in the UIUC Department of Theater, and is a researcher at NCSA, working on projects involving the use of technology in art.

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Mashup Realities: Exploring Experience In Networked Interactive Environments For Dance

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Abstract

This paper explores user experience specifically in the context of telematic dance and networked spaces. New electronic sensor technologies that capture the movement of bodies provide opportunities to redesign the body in space. While much research in this area is informed by technology directly, in this research a 'user-centered' point of view is used to explore new design criteria for movement-based interaction. I discuss a series of performance-based projects titled *Mashup Realities*, an online platform for interaction, collaboration and creativity. The starting point for these projects is the exploration of people's performance experiences of communication and interaction through bodily movement, to make this experience a source of inspiration for the resulting designs. In this paper I will describe the process and technology behind *Mashup Realities*. By working with a range of dancers, choreographers, musicians, designers and programmers through adopting a participatory approach, this paper will outline how performers can be supported in developing a more meaningful and richer interactive experience to extend non-verbal communication and collaboration through the internet.

Keywords

User Experience, User Experience Design, Networked Interactive Environments, Dance and Technology, Non-verbal Communication

Introduction

In 1977, Kit Galloway and Sherrie Rabinowitz created *Satellite Arts Project,* the world's first interactive composite image satellite dance, between performers on the Atlantic and Pacific Coasts of the United States [1]. Existing research on the subject generally takes the viewpoint of the technologists or the performer. This research focuses instead on user experience design, speaking to the needs of the choreographer and dancers as they develop their art within the technological environments. This approach will outline design criteria to contribute to the development of a framework for technologists and non-technologists alike to utilise these tools and create interactive networked performances of their own. To achieve this, I am looking into the best possible way for available technologies, both hardware and software, to be redesigned, rebuilt and reengineered for an optimal performance space and spontaneous, real-time reaction and interaction in dance performance.

Mashup Realities is a platform for interaction, collaboration and creativity between dancers separated by distance, and will drive the practice-led research. Through observation and experimentation, we aim to develop a cross-cultural and cross-disciplinary platform to facilitate a cross-pollination of dance and new media arts. This paper discusses three dance projects: *Experiment.spaces no.1*, *Metakimosphere no.1* (MetaSeminar Digital Technologies Lab project, Brunel University) and *Experiment.spaces no.2 [Spheres]* that make use of a interdisciplinary approach, enabling collaboration between dancers, choreographers, musicians, designers and programmers. Given its key role in the practice-led research, *Mashup Realities* has two ultimate objectives: (1) supporting creativity in performance by investigating the potential for user experience design and (2) increasing non-verbal online communication and collaboration in remote Australia.

The internet is a key tool for the performing arts, especially in geographically remote locations. Online, networked communication offers artists working in these areas opportunities to network, research and create international collaborative relationships, when they would otherwise experience professional and social isolation relative to their city counterparts [2]. It expands the realm of their collaborative opportunities and vastly increases their interaction with other artists.

In this study, interactive environments are defined as spaces with technology-based interfaces that react to user input creating responsive physical and virtual spaces. Users are able to form embodied experiences by seeing, hearing, and feeling realistic perceptual cues linked to those experiences. Embodied experiences are defined as the state of being 'surrounded by simulated sensorimotor information in mediated environments that create the sensation of personally undergoing the experience at that moment' [3].

The term user experience (UX) is used by web designers and developers to describe the human–computer interaction between the application and user. The user in this context is not the audience but the dancers using the environments. UX encompasses all aspects of the dancer's interaction with the environment covering whether the system is easy to learn, efficient to use, pleasant, satisfying and meaningful.

According to Jodi Forlizzi, a rich experience is an interaction 'with a product which is satisfying, an experience that has a positive and pleasing value for the user, allowing the user to perceive beauty in the product and its use' and which 'has a sense of immersive continuity and interaction, which may be made up of a series of satisfying experiences' [4]. This term 'rich' is useful as it helps to describe the forms of interactive models and UX design methodologies used to create complex digitally mediated interactive environments.

The term networks in the present context means the distribution of content (visuals, audio and movement) over telecommunication and information technology systems. Research into telematic performance, dance and technology has described the application of information technology in dance as 'digital or virtual extensions of the body' [5] and 'the intersections of technology, body and code' [6]. Space, time and body are components of movement for contemporary dance, and space in particular is a key factor contributing to the shape of movement. This research aims to investigate distributing space – extending the physical parameters in which artists can perform – through the creation of hybrid connected environments, both physical and virtual.

These interactive environments offer rich layers of perceptual information encompassing lighting, costumes, choreography, sound, visuals and movement. Furthermore, digital scenography, as defined by Birringer [7], is the live performance architecture incorporating analogue, digital and network dimensions, where performers are inside and outside the digital worlds simultaneously. Meaningful interaction between the performer and space is crucial for the performance, and designing UX for these hybrid spaces will be an exploration of the 'convergences between performance, telematics, textile/fashion design and movement, clothing and choreography, visual expression, film/photography, and interactive design' [8].

In this paper I describe the process and technology behind the ongoing dance projects, *Mashup Realities*. These projects investigate user experience in networked interactive environments for dance, and methods that can be used to design for 'rich' experience. I aim to identify design criteria which support the creative process for dancers in interactive environments. To this end, flow theory and quantifying tools will be used, as well as industry UX testing methods. A user-centered approach is being adopted in order to create meaningful embodied experiences in interactive environments. A key question the research addresses is: what makes a meaningful 'rich' experience for the people choreographing, rehearsing, performing or collaborating within a networked interactive system?

Exploring user experience

Within the scope of this research, 'the performer is always the user, player and participant in an operating system' [8]. The dancer, understood in the context of interaction design as a user, has a unique set of requirements and aspirations. Through researching existing UX models and methods I aim to not just clarify the immediate needs, but also to get behind the driving motivations and values of the user: the dancer.

The initial approach will be to examine Birringer's research into telematic performance by applying the ideas from Csikszentmihalyi's flow experience, and its possible role in measuring and supporting engagement. Johannes Birringer is the Chair of Drama & Performance Technologies Research for Theatre at Brunel University London's School of Arts. He is focused on the exploration of networked performance and 'the intersections of technology, body and code; the aesthetics and politics of programming, the poetics of online communication or online contact improvisation, and the relays between architectural structures, institutional structures and distributed networks' [6]. Mihaly Csikszentmihalyi, who first developed the 'flow' concept in 1975, is a leading researcher in positive psychology and currently teaches psychology and management at Claremont Graduate University. With the aim of understanding experience and mental states in order to improve the design of the interaction, an user-centred approach will be used, or in other words a 'direct and active participation of all stakeholders in the design development process' [9].

Body (wetware)

Human bodily movement, non-verbal communication and interaction may be subtle or expressive, and occur at different scales of gesture or expression. In the context of software and hardware, the thought processes of users which lie behind the operation of computer systems are referred to as "wetware". Of relevance in the exploration of embodied experience are the thought processes behind bodily movement within interactive environments. Flow theory can help us to better understand these processes.

Csikszentmihalyi's flow theory has been used extensively in the study of human computer interaction (HCI) as an important means of understanding the efficacy of interactive environments, and in dance research for gaining insight into the possible facilitating and inhibiting factors that would support flow for dancers.

Flow experience is defined as a state of concentration so focused that it amounts to absolute absorption in an activity [10]. With relation to dance, 'flow is believed to be a psychological state in which the mind and body 'just clicks', creating optimal performance' [11].

The dancer has a unique set of skills, needs, emotions and experiences. *Mashup Realities* will study and evaluate how to support dancers own flow experience and how they feel about performing in an interactive environment. The aspirations of dancers will be factored into the system's design in order to understand how good UX design 'allows for personal and useful interaction, and arouses an emotion which unifies a satisfying experience' [4].

According to Jaime del Val (2013): '93% of our expression are in the form of non-verbal communication, yet current media reduce non-verbal interaction to a highly

reduced set of standardised and traceable gestures of interaction through interfaces' [12]. This research addresses the importance that non-verbal communication and embodied expression has for dancers and their collaborative processes. Throughout development, the aim is to utilise UX design to support non-verbal communication in networked interactive environments.

Code (software)

Movement-based and gesture-controlled interfaces will be designed and built to detect, measure and interpret physical movement. This creates a HCI system for dancers in interlinked physical and virtual spaces, including real-time digital mixing of audio, light, video and computer-generated imagery controlled by the user. The architecture consists of responsive behaviours that can be modified by the user through visual and audio parameters triggered by certain expressive movement and gestures. Also, at a later stage, the interactive environment will be developed to record and playback performances as a tool for collaboration and sharing.

An intriguing further consideration will involve system behaviours which are proactive and anticipatory. Research into intelligent movement-based interfaces investigates 'environments that can observe their human inhabitants, can interpret what they know, want and do, and reactively and proactively support them in their activities' [13]. This form of artificial intelligence could provide real-time feedback as to what the user is experiencing or feeling, including pain, fatigue, frustration and irritation, by collecting and analysing data about the user's regular patterns of bodily activities.

Technology (hardware)

The interactive environment is a sensory space for sound, vision and movement. The technology employed will sense and capture movement within the space and output visual and audio back into the space.

Digital scenography, as defined by Birringer [7], is live performance architecture that incorporates analogue, digital and network dimensions, where performers are inside and outside the digital world simultaneously. Meaningful interaction between the performer and space, therefore, is crucial for the performance. The exploration of latest sensory technologies for movement will inform the design of these hybrid spaces.

The intersection of body (skill, emotion, need and experience), code (interface, interaction and environment), and technology (sensing, capture and output) is where I believe we will find the 'rich experience' that Forlizzi describes.

Related work

Artists, performers and designers have experimented with the use of networks, telecommunications and information technology as a means of broadening their creative experience for decades. *Metabody, Zero Point, Danceroom Spectroscopy* are three current projects with goals closely related to that of the present research.

Metabody is a project financed by the European Commission which commenced in July 2013 and will run until July 2018 [12]. *Metabody* investigates cultural diversity, non-verbal communication and embodied expression by examining networks that connect institutions, organisations and people. The research aims to achieve an interactive mobile architectural structure for outdoor spaces (performances, interactive installations and immersive durational experiences). The resulting structure will include both analogue and digitally mediated environments consisting of space modules, objects modules and wearable modules, working both locally and telematically, with the possibility of connecting protagonists in different cities and countries. *Metabody* seeks to generate a new methodology for interdisciplinary research and artistic creation between this area of the arts, information and communication technologies, human science and philosophy.

Darren Johnston is a UK director, choreographer and video and sound artist with a contemporary dance background. Johnston undertook a week-long residency at the Barbican Theatre in London in March 2014 to experimentally use his own software in an interactive performance titled *Zero Point*. Using motion-sensing technology, video projections and light, he designed a performance in which shapes of light moved over a backdrop of darkness – 'it bathed the bodies of dancers with graphic texture and light.' The sensors and programming mapped and selected the dancer's body in the three-dimensional space and created a shape based on that of the detected dancer, which was then projected back onto their bodies in real time.

UK based *Danceroom Spectroscopy* is a science/art collaboration exploring languages and crossovers between physics, interactive art, performance and technology. It interprets people as energy fields, allowing them to influence both graphics and sound within the interactive environment using their movement. The technologies *Danceroom Spectroscopy* utilises in many of their installations are Max/MSP, Ableton Live and Microsoft's Kinect sensors.

Studio work

Three project (to date) form the foundational basis of my practice-led research. I will discuss in detail *Experiment.spaces no.1* and then briefly outline *Metakimosphere no.1* and *Experiment.spaces no.2 [Spheres]*. The performance installation *Metakimosphere no.1* was created from a workshop at Brunel University, London. *Experiment.spaces no.2 [Spheres]'s* application is in its very early stages of prototyping and testing.

Experiment.spaces no.1 - Choreography

This initial project laid the foundation for collaboration between choreographer (Seeta Indrani) and designer (myself), and by extension how we will collaborate with

the performers. Indrani and I started by discussing how to better understand and explore the possibilities that technology holds for the performance.

As a creative device, we employed 'Chance Operation' as a methodology for the performance and design of the interactive environment. From the Dadaists (Jean Erp), Cornelius Cardew, John Cage to Merce Cunningham, this technique has been used to employ non-predetermined and unpredictable elements that cause an event to have a certain result. Merce Cunningham introduced Chance Operations into contemporary dance and it quickly evolved to become an important compositional device. Cunningham was a leading American dancer and choreographer and is considered one of the most important choreographers of our time. He describes Chance Operation as a device, 'when I choreograph a piece by tossing pennies - by chance, that is - I am finding my resources in that play, which is not the product of my will, but which is an energy and a law which I too obey' [14].

Seeta Indrani graduated as a dancer from the London Contemporary Dance School. She made her stage debut as Cassandra in the original London production of Andrew Lloyd-Webber's *CATS*. Indrani describes the choreography concept: 'Relinquishing control to the randomness of the software is almost an existential approach. Unlike many works I'd created in the past this was not to be an organic journey of the emotions, characters, stories or instinct. We felt chance or randomness was a good fit. We knew we wanted elements of the computer or the software taking control and vice versa – the dancers triggering the computer software in real time.'

The choreographer's starting point was very simple 4 x 32 count phrases to be performed in a random order, with the computer determining the structure. These phrases would form the basis of all of the choreographic content. To fulfil these requires it was evident a gesture-controlled user interface would be needed.

Experiment.spaces no.1 - Technology

A great deal of research has gone into investigating the available software and hardware that best suit the project's requirements. We needed hardware to sense and capture movement, software to translate motion into data and additional software with a programming language to utilise the data to control or manipulate the environment via gestures, both visual and audio. The criteria was to find hardware which was cost effective, accessible and easy to set up.

After two months of researching and testing various applications, and investigating similar projects in London, we decided on the Microsoft Kinect motion sensor and a combination of applications and programming framework; Synapse, Syphon, Particle Warfare, Max 6 and Quartz Composer [Figure 1].

The Microsoft Kinect is a reasonably accurate motion sensor with a range of about 5 metres. Synapse is a piece of open source software designed by Ryan Challinor for the Kinect to send joint positions and hit events via Open Sound Control (OSC), a protocol for communication among computers. The software captured the user's movement via the sensor, which is then represented as a red skeleton or wireframe. Each point of the wireframe (10 of them; Head, Torso, Elbow (L), Elbow (R), Hand (L), Hand (R), Knee (L), Knee (R), Feet (L), Foot (L)) is measured and mapped as constant streaming X, Y, Z positions. This data is then fed into other applications that can receive OSC events. Both Max 6 and Quartz Composer can receive OSC events.

Max 6 by Cycling 74 is a visual programming language used by a variety of new media artists, musicians and programmers for interaction, moving image and sound. In this project it will be used to receive data from Synapse/Kinect and create a series of small applications called Patches, which will create the audiovisual contents of the responsive environment. Max 6 primarily handles the X, Y, Z position data from the Kinect sensor. Using these coordinates, hotspots in the environment (3D space) were created via a Patch based on a hand gesture. This triggered the random Patch, which selects a video at random from the database to be displayed in the background of the projection via Syphon (application-to-application communication) to Quartz Composer. Quartz Composer by Apple is also a visual programming language, but its strengths are processing and rendering graphical data. Therefore, all the visual elements of the environment are controlled by Quartz composer.

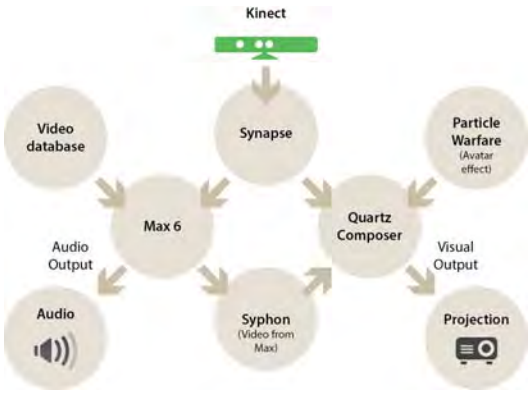

Figure 1. Applications and their relationship: Synapse, Syphon, Particle Warfare, Max 6 and Quartz Composer

Experiment.spaces no.1 - Practical work

In February 2014 we trialled this model in a London studio with a contemporary dancer and a martial artist. The aim was to test the responsiveness and range of the Kinect and software, and also to flag any potential issues the applications might have. The hardware setup included the Kinect sensor, a laptop computer and a projector. We created an environment where specific gestures triggered sounds and audio changes. The studio was 5mx7m and the sensor was placed at the front, with the user's wireframe or skeleton projected onto the main white wall. The visualisation was smooth and immediate, but the audio was

hit and miss. Three issues became evident. First, when the user moved too fast the wireframe was lost and the data, X, Y, Z positions, stopped feeding the OSC events. The second, range was less than 5 meters. At times we lost the wireframe and needed to recalibrate. The third, the sensor seemed to be confused when one performer crossed in front of another.

In August 2014 we started to conceptualise a performance, seeking to simulate two spaces networked together within the one performance area. The choreographed performance structure would be informed by the application randomly selecting the order of 4 x 32 count phrases in real time. The random patch would be triggered by the dancers via a particular gesture. The interactive environment was designed and developed over a two month period.

In October 2014, in my role as designer and developer, I entered the studio with two dance graduates from the Victorian College Of The Arts, Rachel Heller-Wagner and Louis Matthews, and the choreographer, Seeta Indrani. In this stage of the project I wanted to work closely with the users and the choreographer, utilising a participatory design approach to develop the interactive environment application and performance to a point ready for a public rehearsal. The choreography would play an important role in designing the interactive environment and the development of the programming.

For this initial studio work, I divided an image capture studio space located at MADA (Monash Art design and Architecture) into two sections [Figure 2]. The two halves would not be technically networked environments, but I wanted to use a technically simple division to allow communication between the dancers and the applications without too many IT issues. This helped me observe the non-verbal communication between the dancers and choreographer and better understand what will be required when we proceed to the next stage, linking two spaces separated by distance. Although the dancers were physically in the space together, the choreographer, Seeta Indrani, was collaborating via Skype. This provided an interesting insight as Indrani highlights, 'I was aware I was missing nuance, moments which might organically grow, take us off in other directions. Unspoken vibes.'

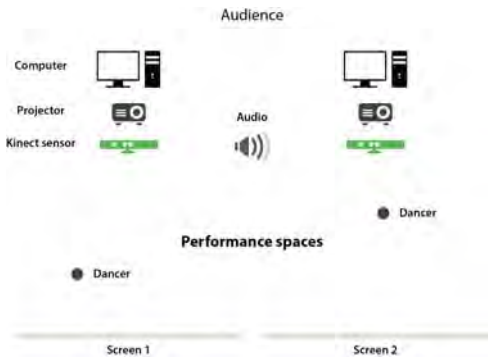

Figure 2. *Experiment.spaces no.1* performance spaces and the technology layout.

Working directly with the dancers and choreographer at this early stage in the development of the interactive environment's programming, I discovered new opportunities to refine the process that I would not have contemplated alone. From my professional experience as a web designer, understanding the user is key to building successful online systems. As Elizabeth B.-N. Sanders, PhD Experimental Psychology from Ohio State University's design department, notes, 'the roles of the designer and researcher blur and the user becomes a critical part of the process', and she continues, 'if we can access people's experiences (past, current and potential), then we can make user experience the source of inspiration and ideation for design' [9].

The public rehearsal was performed to a small audience and lasted eight minutes. The structure was divided into three parts; choreographed introduction with small solo performances, then followed by the Chance Operation approach where the order of the 32 count phrases were determined by the computer, and then final part had the dancers perform the phrases in unison in a predetermined order to finish the piece. A video sample of the public rehearsal can be view on Vimeo (vimeo.com/mashuprealities) [Figure 3].

Figure 3. Screen grabs from *Experiment.spaces no.1's* public rehearsal video documentation.

Experiment.spaces no.1 - Feedback

I asked for feedback from the choreographer, a dancer and an audience member regarding their experience of the project and the public rehearsal. This feedback was not

designed to measure experience, but simply to improve future studio work collaboration. Feedback questionnaires alone are not sufficient to evaluate experience. A combination of documentation (video), observation, experimentation, interviews, questionnaires and research, will provide valuable ways to measure these experiences.

Seeta Indrani, choreographer, was not physically present during the studio performance in Melbourne. She is a London based choreographer, actress and director. We linked up with her via Skype. The setup had the camera pointing towards the performance space and the audio running through the speaker system, so Indrani could view the dancers and communicate directly with them.

> "There is no substitute for being in the space together. I was aware I was missing nuance, moments which might organically grow, take us off in other directions. Unspoken vibes. All the reasons why we congregate in a rehearsal space in the first place. However, Chris and I have a strong working language and the dancers were very open with their suggestions and feedback which allowed the collaboration to move forward," Indrani.

Indrani's comments highlight the importance of how movement, both subtle and expressive, is communicated over the internet. In this case, 'unspoken vibes', or small movements which were significant to the collaboration and choreography, were lost during the Skype linkup.

Despite this, the collaboration in the studio between the dancers, choreographer and myself presented new ideas and opportunities to better design the interactive environment for the performance.

> "I enjoyed discovering what the technology could offer the movement. The dancers were very free in playing in the studios throwing out ideas, which usually then set Chris quite impossible tasks – but this was part of the experiment. How can it best serve the performance," Indrani.

Rachel Heller-Wagner and Louis Matthews, graduates from the Victorian College Of The Arts, are very skilled contemporary dancers and brought a lot of their own ideas to the collaboration.

> "Alongside new challenges and learning to work in alternative ways, I felt that the structure of the project facilitated creativity and thus allowed positive outcomes to occur... i.e. having a programmer able to explain and change things as you go, another dancer to bounce info and movement off etc," Matthews.

For the dancers this was the first time they collaborated on a project where the technology played a large part in the choreography. This highlighted how important instant feedback and communication was to the process. Specifically, how quickly the environment responded to movement, real-time feedback, during the rehearsals was crucial.

> "I found the motion sensors / projection component the most impressive and responsive part of this collaboration. Being able to see the visual programming of the project alongside a realised image behind was great to work with," Matthews.

Most importantly, as a designer, collaborating directly with users meant I could start to observe and interpret the project from other viewpoints. Their insight into performance and how the technology could facilitate and extend it meant I had a new scope of ideas to take on board in refining and optimising design.

> "I would really like to see some alternative objects/technology used i.e. rear projection screen, projection screens in non-conventional locations i.e. movement tunnel, suspended at angle from ceiling. I think that this could really aid to the interactivity of the project and start to separate it from the traditional 'action - viewer' experience. I expect all of these can be explored in future arenas where time and resources permit," Matthews.

Tony Gillan, is a fellow designer and developer, attended the performance as an audience member. The observation Gillan made was about the gesture which randomly changed the video backgrounds wasn't evident.

> "The wide sweeping movements of the dancers seemed to mesh well with the backgrounds and the feedback light effects produced by the application. Combined with the music, the effect was quite hypnotic. The two dancers and various sequences were harmonious, but I believe there could have been more interaction or cross-over between the 2 dancers and backgrounds, if the technology allowed. Also I didn't realise that the dancers themselves were changing the backgrounds until it was explained after the performance," Gillan.

Metakimosphere no.1, MetaSeminar Digital Technologies Lab project, Brunel University

The performance installation *Metakimosphere no.1*, by Azzie McCutcheon, Martina Reynolds, Helenna Ren, Seeta Indrani, Cameron McKirdy, Yoko Ishiguro, Johannes Birringer and myself was born of an eight week long *MetaSeminar Digital Technologies* workshop at Brunel University, London, facilitated by Johannes Birringer. The workshop was constituted of technologists, designers, dancers, musicians and artists, who all contributed to the installation.

Figure 4. *Metakimosphere no.1*'s dancers inside the gauze structure with particles projected onto their bodies.

The installation was created with hung and draped gauze in a circular formation with projections of particle effects from four sides, angled into and through the structure. The dancers were located in the centre with gauze draped over their bodies to form a single body within the structure. A Kinect sensor was placed inside the structure, so that each of the dancers' movements directly influenced the behaviour of the particles. As the dancers increased the frequency and speed of movement, so the movement of the particles would intensify and multiply. The audience was able to walk around and into the structure [Figure 4 and 5].

Figure 5. *Metakimosphere no.1,* a dancer moves in front of the Kinect sensor.

McCutcheon, Ren and Ishiguro have danced on a number of interactive digital performances, while for Heller-Wagner and Matthews from *Experiment.spaces no.1*, it was their first time. This performance installation gave some insight into how these experienced dancers interacted with the environment. They are much more aware of their surroundings and how their movement translates to the projections and images. The sense that the environment was an extension of their bodies was very evident in this project.

Experiment.spaces no.2 [Spheres]

This project is currently in the prototype stage, but was successfully tested during the *MetaSeminar Digital Technologies Lab* workshop. *Experiment.spaces no.2 [Spheres]* is an application which allows dancers to interact and guide virtual forms, in the shape of spheres, inside an online virtual space. Another dancer in a different location can also access this same virtual space over the internet and interact with the spheres [Figure 6].

Experiment.spaces no.2 [Spheres] is created from Max 6, which connects two computers directly using their IP addresses. Similar to *Experiment.spaces no.1,* the coordinates of the hands are tracked via the Kinect sensor and fed into Max 6. The coordinates are used to position and guide the spheres. In addition, the spheres and the virtual space have their own behaviours; the spheres respond in a similar fashion to a rubber ball and the environment simulates gravity. We are investigating how this application can be incorporated into a networked performance. From a UX design viewpoint, the aim here is to address slow internet speeds, delays, tolerance of error and loss of quality of movement over the internet and how these impact on user experience.

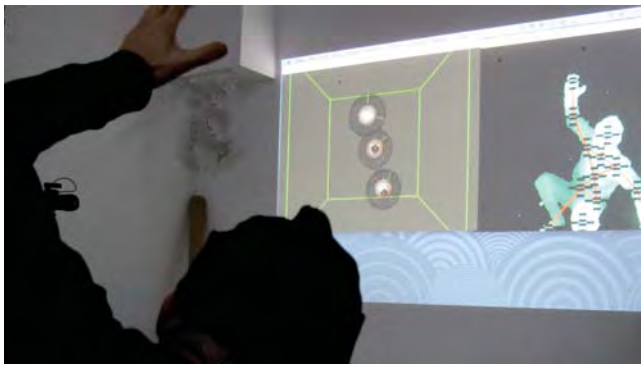

Figure 6. *Experiment.spaces no.2 [Spheres]* prototype testing.

Conclusion

My research is motivated towards providing artists in remote Australia with a set of tools to enhance their ability to collaborate online, assist the creation of interactive works and promote further development of performance in regional Australia. As expressed by Trinidad and Broadley: 'By connecting to the outside world it allows the outside world to view the value of the community. By bring the outside world into these communities allows the people to feel a sense of pride and importance in their cultural context' [15].

From the course of studio research investigated to date, we identified several aspects that were relevant to the user experience supporting non-verbal online communication. Based on these aspects we deduced the beginning of design criteria for the movement-based interaction. As the research continues to develop, criteria for effective system design will undoubtedly grow and these identified aspects will be refined:

- Three dimensional interactive space, both physical and virtual
- Cost effective, accessible and easy to setup technologies
- Low bandwidth streaming technologies
- Gesture interface controlling visual and audio outputs
- Communicate subtle and expressive movement
- Real-time immediate feedback

Formative studio work has revealed that a participatory design approach was beneficial for the development of the application, identifying processes that support and guide users, and towards a 'rich experience' for the user. While we are still at a very early stage in the development of the project, preliminary findings have indicated that subsequent design will benefit from building upon existing UX design principles and adopting flow theory to better understand users' embodied experiences.

The series of prototyping projects, outlined in this paper, informs the direction of *Mashup Realities*. It forms a critical and valuable stage in the research as we work towards the final project in which an Australian and a European dance school will participate in an online live dance networked performance. It is the ambition of the *Mashup Realities* project for geographically remote participants to dance, choreograph and rehearse together without leaving their home countries. The end result will be two simultaneous live performances, which will be combined online to create a single dance piece in a shared virtual space.

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Translating Expression in Taiko Performance

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Abstract

We describe our approach to collecting, analyzing and visualizing expressive movement data to support the creation of an interdisciplinary performance and installation work, *3 Movements in Translation*. We seek to understand how three perspectives (the performer, the audience, and the machine) can inform one another to create a cross-cultural performance that allows a broad audience to kinesthetically engage and empathize with expressive features of taiko performance. Taiko is a Japanese artistic practice that combines stylized movement with drumming technique. We share initial results in machine-learning analysis of taiko sound and movement. These results are used, in combination with a performer's perspective, to inform artistic visualizations of important expressive features within taiko. Through this process, we explore how multiple perspectives of taiko can inform the translation process between the performer, the audience and the machine.

Keywords

Taiko, Machine Learning, Dance, Choreography, Expressive Movement Recognition, Sound Recognition, Movement Classification, Musical Gesture, Interactive Installation, Kinesthetic Awareness, Visualization

Introduction

3 Movements in Translation is an interactive performance work that explores three perspectives of taiko performance: the performer, the audience and the machine. We seek to understand how these varying interpretations of taiko can inform one another in order to create a cross-cultural performance that allows a broad audience to kinesthetically empathize, appreciate, and understand taiko performance.

To support the creation of *3 Movements in Translation*, we formed an interdisciplinary team of researchers from Simon Fraser University, University of Illinois and an independent taiko artist. Each author focused on a different aspect of the project including machine learning, data capture, data visualization, movement analysis, choreography, and taiko drum technique. This work is still in progress, but is envisioned to be an interactive installation and performance. The installation will help expand the audience's kinesthetic awareness of taiko, while also influencing the outcome and perception of the performance.

In order to create this type of work we need to identify expressive components of taiko performance, find a method to extract these components from the data, and explore ways to create new representations of these expressive features so that they can be communicated in performance settings. According to Camurri et al (2004), "Expressive content concerns aspects related to feelings, moods, affect, intensity of emotional experience" and is not necessarily tied to a denotative meaning. This definition implies that expressive qualities can be found in any movement that contains information about the state of the mover—from everyday actions, such as walking, to actions executed in performance settings (Camurri et al. 2004).

While digital motion capture technology has helped generate an expanding corpus of visual movement features to analyze, insight into what these features mean in the context of expression has been challenging to isolate and recognize. In our research we examine how the artfortm of taiko is taught. Through examining taiko instruction, we can identify perceptually evident features within the technique that are important to its artistic expression and integrity.

The Japanese practice of taiko also provides an ideal form to analyze expressive components of performance because expressive movement and sound are explicitly integrated in taiko technique. This multi-modal coupling allows us to study expressive components through both sound and movement simultaneously, which can help inform the recognition process.

Overview of Taiko

Taiko, meaning "fat drum," most commonly refers to a Japanese form of ensemble drumming that became popularized as a performing art in the mid-20th century (Varian 2005). Taiko is a unique form because stylized, choreographed movement is highlighted and integrated with drumming technique. Stylistically correct sounds in taiko can only be produced with stylistically correct movement forms. Therefore, the accuracy of movement qualities can not only be *felt* and *seen*, but also *heard*.

Taiko is traditionally communicated through *kuchi-showa*, a phonetic vocal notation system that represents the timbre qualities of taiko sounds. There are six main sounds in taiko technique: *Don*, *Doro*, *Tsu*, *Tsuku*, *Ka* and *Kara*. Don is a loud sound, Tsu is a soft sound, and Ka is a rim sound. Doro, Tsuku and Kara refer to either 2 Don, Tsu, or Ka

(a) Front View (b) Side View (c) Back View

Figure 1: Kinect Sensor raw depth map data modulus 256

beats (respectively) played in succession. Jason Overy of Uzume Taiko in Vancouver British Columbia (Overy 2014) created a syllabus defining aspects of taiko that are traditionally demonstrated, but not verbally articulated in traditional taiko technique. In Overy's syllabus all taiko sounds can be performed within five gears that refer to the body part or action initiating the sound, such as fingers, wrist, elbow, full-arm, and jumping (labeled Gear 1-5 respectively). Traditionally Don is is played in high gears (e.g. Gear 4/full-arm and Gear 5/jumping) and Tsu is played in low gears (e.g. Gear 1/fingers and Gear 2/wrist). Within each gear Overy defines five levels that refer to the angle of the drumstick in relation to the drum. Level 1 is 0 degrees and level 5 is 90 degrees. This level system is inspired by techniques used in drum corps training.

Data Collection Process

Taiko Informed Data Collection

We used Overy's syllabus to inform our data collection process. Using the gears and levels as a guide, we gathered a wide range of Don and Tsu strokes performed in similar gears and levels. We discuss initial results for distinguishing between Don and Tsu strokes performed in Gear 2 Level 4, Gear 3 Level 4, and Gear 4 Level 5. We chose to start with these particular combinations because they felt "natural" to the performer when playing both Don and Tsu sounds.

Motion Capture

In order to digitally capture movement, we used the Microsoft Kinect sensor to allow the taiko artist to perform as expressively as possible by providing an environment that limited technical intrusions into the performance. The Kinect captures movement through the generation of depth maps, utilizing a camera and an infrared sensor. From the depth maps, a variety of informative data can be extrapolated, such as a skeleton frame representing positional data of the subject. This provides subjects with a minimally invasive situation where they are not required to wear any additional devices that may inhibit their ability to replicate the physical qualities of performance. This is especially important in the case of taiko, where expressive performance demands high levels of control over a diverse range of nuanced percussion techniques. This control can be dramatically affected by extra weight (e.g. an attached accelerometer) or atypical performance attire (e.g. a motion capture suit). The Kinect sensor is also more practical for the artwork and will allow us to present the work in a large variety of venues.

We arranged five Kinect version 2.0 sensors in a circle around the performer with one sensor directly in front of the performer, providing a panoramic view of the drummer (see Figure 1). All sensors were set at waist level except the front sensor, which was elevated to head level in order for the drumhead to be seen clearly.

Audio Capture

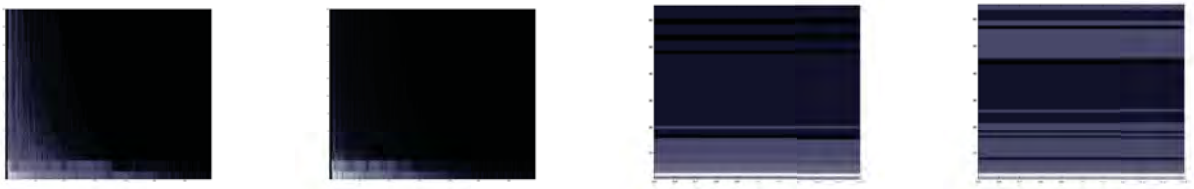
We captured audio from multiple perspectives in order to fully realize the expressive sounds produced by the taiko drum and performer. To accomplish this, we used an array of cardioid condenser microphones: one below the drum that captured the more resonant sounds of the drum; one above the drum that captured higher frequency attack sounds; and one off-drum to the right of the performer that captured vocalizations and the ambient room sound. The audio data captured by the array was sent thorough a multi-channel mixer where only minimal processing was done in the interest of maintaining sonic integrity.

Machine-Learning Analysis

To identify expressive qualities of Don and Tsu strokes in taiko, we performed analysis on the data using two different machine-learning techniques: a Naïve Bayes (NB) classifier (John and Langley 1995) and the Hidden Markov Model (HMM) (Rabiner 1989). HMM is a method for analysis of temporally sequential data and performed better than the NB classifier in distinguishing the visual data of taiko gestures. The HMM and NB classifiers performed similarly for the audio analysis. We report a summary of our results in Table 1.

Audio Analysis of Taiko Sounds

In our analysis of taiko drumming audio classes, we generated two separate sample types for NB testing: the full audio sample without normalization (Audio1) and a shorter, attack-focused sample that was normalized with a 'room noise' spectrogram (Audio2). For the Audio 1 test we used a window size of 512, with 256 overlap. For the Audio 2 test we



(a) Audio 1 Don (b) Audio 1 Tsu (c) Audio 2 Don (d) Audio 2 Tsu

Figure 2: Plots of the square root of the magnitude of the spectrogram. Audio 1 depicts the entire duration of the sound (truncated to a range of 20hz). Audio 2 depicts a single window (only the attack).

Tests	Gear/Level	Audio1 (NB)	Audio2 (NB)	Visual (HMM)
Don/ Tsu	2/4	1.00	1.00	0.97
	3/4	1.00	1.00	0.97
	4/5	1.00	1.00	1.00

Table 1: Initial results of audio and visual analysis of Don and Tsu strokes: a total of 242 samples for Audio (81 samples for 2/4, 82 samples for 3/4, and 79 samples for 4/5), and 20 samples for each gear/level combination of the visual data. Audio1 = 2s length, not normalized, Audio2 = 0.045s length, spectrally normalized, and visual samples are manually segmented (starting from raising the drumstick and ending up to 10 frames after the stroke).

used a window size of 2048 with no overlap (See Figure 2). Both audio tests used leave-one-out cross validation.

Both of our tests achieved 100 percent classification accuracy in distinguishing between Don and Tsu sounds played in different gears and levels. Furthermore, we found that even with amplitude measures minimized through normalization (Audio2), classification accuracy was not lost. This suggests that Don and Tsu sounds vary in both timbre and amplitude.

Visual Analysis of Taiko Movements

In order to analyze the style of movement when performing Don and Tsu strokes, we analyzed the average velocity of wrist movement during both the attack and recovery of the drum-strokes. Since there are only two major axes involved in performing the basic taiko drum-strokes, we analyzed the velocity in the Y-axis (vertical) and the Z-axis (camera). In the Kinect coordinate system the device is positioned at the origin, and the Z-axis represents the distance of the body from the Z-plane of the camera.

We found that the velocity of movement was the key feature in distinguishing between Don and Tsu drum-strokes. We used HMM to model and classify the wrist movement in Don and Tsu strokes. Each sample of the motion data is manually segmented, starting from raising the drumstick and ending up to 10 frames after the drum-stroke. For each gear/level combination we used 20 samples, with 70% of them for training and 30% for testing the model. We computed the accuracy through 10-fold cross validation (see Table 1) and used various features of the motion data to train the HMMs such as velocity, acceleration, and speed. Our experiments showed excellent classification of Don and Tsu gestures.

Figure 3 compares the average velocity of the Don and Tsu strokes in Y and Z directions. On the Z-axis we observe positive average velocity when attacking the drum, and negative velocity after the drum-stroke. This suggests that both actions are performed by moving the arm towards the body. We can also observe that in comparison with the Tsu strokes, the Don strokes have lower velocity in the Y-axis and higher velocity in the Z-axis. We can interpret this as the drumstick in Don strokes tends to hit the drum tangent to the surface, while the Tsu strokes use more force in the vertical direction. These findings align with the taiko performer's description, describing Don as having more "bounce" than Tsu and Tsu being more "controlled." These findings also closely relate to previous work by Dahl and Altenmüller that found correlations between stroke velocity, rebound, and the perceived timbre quality of the sound produced (Dahl and Altenmüller 2008).

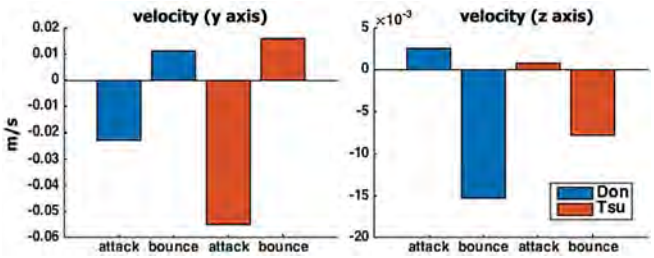


Figure 3: Comparison of the average velocity of performing the Don and Tsu sounds

Visualizing Expressive Features of Taiko

Through artistic visualizations we can mitigate the gaps between literature and artistic practices. In order to understand the expressive components of taiko from another perspective we created **visaphors**, meaning "visual metaphor" (Cox 2006).

The visaphors described below allow us to re-contextualize expressive components of taiko technique and will facilitate interactions between the audience and performer in *3 Movements in Translation*. Below we show a prototype of each visualization and describe how it was informed by var-

ious perspectives. A video of these visaphors is available at https://vimeo.com/130595155.

Visualizing Expressive Arm-Movements

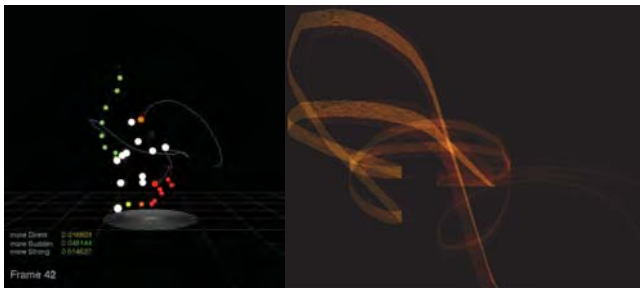


Figure 4: Visaphor 1: The trajectory of two wrists draw flaming ribbon strokes over time. ©Kyungho Lee 2015

The first *visaphor* was inspired by Kimberly Powell's phenomenological account of practicing taiko depicted in her published work, "The Apprenticeship of Embodied Knowledge in a Taiko Drumming Ensemble." Powell states, "I imagined colorful long ribbons trailing from my bachi [drumstick], as I snap my wrist upward and then extend my arm diagonally across my body down to an imaginary drum" (Powell 2004).

To depict this vibrant energy of taiko we used the trajectory of the performer's right-wrist and the velocity to change the form of a flaming ribbon (See Figure 4). The flames expand the space of the arm's trajectory, alluding to Powell's sensation,"I felt a sensory shift in the way I perceive the boundaries of my body in relation to space. I am aware of a different sense of my body, the way it occupies positive space against negative space" (Powell 2004).

Visualizing Don and Tsu

The second *visaphor* depicts differences between Don and Tsu. As mentioned previously, Don and Tsu sounds are distinguished in taiko as loud and soft sounds respectively. However, the difference between Don and Tsu goes beyond amplitude as shown both in our machine-learning audio results and as implied by the phonetic vocalizations of taiko sounds. As indicated by the machine-learning HMM analysis, velocity also played an important role in distinguishing between Don and Tsu gestures.

We chose to visualize the difference between Don and Tsu through a spherical representation. The sphere's surface is distorted by the momentum of each stroke. The more powerful the stroke is, the larger the displacement of the sphere and the darker the color. Figure 5 shows the Tsu stroke has less distortion than the Don stroke and is lighter in color.

Conclusion

We describe research undertaken to support the creation of our interactive performance and installation work *3 Movements in Translation*. In this work we seek to create a cross-cultural performance that translates expressive components of taiko performance into multiple forms that a broad audience can kinesthetically engage with and understand. We

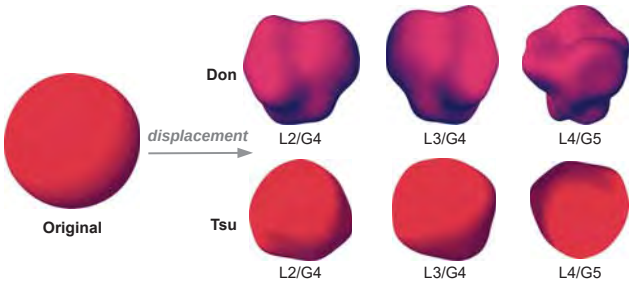


Figure 5: Visaphor 2: The original sphere's surface is transformed by the parameters extrapolated from drumming strokes: Don and Tsu ©Kyungho Lee 2015

shared initial findings in machine-learning analysis and combined these findings with the performer's perspective to create visaphors of important expressive features in taiko. We will use these visaphors in our interactive installation as a way to motivate audience members to partake in expressive movements that are important in taiko performance and to inform the translation process between the performer, audience and machine.

Acknowledgements

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'Splitting Centre': directing attention in trans-media dance performance

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Abstract

In theatrical vernacular, the term 'splitting centre' refers to two performers staged at an equal distance from a centre point and sharing the focus of the audience. This term encapsulates the notion that two people (or, in the case of trans-media dance, two or more performance entities) are dividing the attention of the audience, operating as equal collaborators in a performance context. The augmentation of live performance with 3D projected scenography and mobile devices offers a starting point for discussions on the potential for dramaturgy, choreographic process, and changing expectations for audience behaviour in the theatre. In 2014, Deakin Motion.Lab premiered *The Crack Up*, a trans-media dance work that incorporated live performance, 3D digital scenography, and *The Crack Up App*, an app for mobile devices that audience members were invited to interact with during the performance. This investigation into the potential of trans-media dance performance, (defined here as a live performance in which both the digital and biological elements are choreographed as artistic equals within the theatrical context) with the addition of a mobile device raises questions about how the makers of trans-media dance might direct the attention of their audiences when the work is performed simultaneously across multiple platforms.

Keywords

Dance, trans-media performance, digital and virtual environments, mobile devices, interactive apps, tweet seats

The integration of digital imagery with live performance is becoming increasingly common in Australia and overseas with artists such as Wayne McGregor, William Forsythe, Robert Lepage, Klaus Obermaier, Garry Stewart and Gideon Obarzanek among others creating work that enmeshes digital and biological performance entities within a theatrical context.[1] The works by these artists draw on a range of technologies, from interactive and motion tracking systems to registered projected video, motion capture, 3D scenographic landscapes and more, exploiting the possibilities of emergent technologies. As Dils & Naugle suggest, "the scope of dance is not narrowing towards digital, rather, it is expanding."[2] In 2014, artists at the Deakin Motion.Lab premiered *The Crack Up*, a new full-length trans-media dance work, (trans-media dance is defined here as a live performance in which both the digital and biological elements perform simultaneously as artistic equals within the theatrical context), directed and choreographed by Professor Kim Vincs.[3] Inspired by F. Scott Fitzgerald's 1936 short story of the same name, *The Crack Up* integrates performances by five dancers immersed and superimposed in 3D projected scenographic landscapes.[4] The creation of imagery rich environments augments Fitzgerald's first-person story about a man losing his grip on reality. 'Cracking' landscapes and crumbling digital characters provide a visual reflection of the ambivalence and despair of the text, reflecting on the notion of fragmentation.[5] *The Crack Up* also exploits the sense of 'cracking' (or dividing) the attention of the audience by introducing *The Crack Up App*, a universal app for mobile devices that audience members were invited to download prior to attending the show.[6] In theatrical vernacular, the cue 'to split centre' refers to two performers at an equal distance from the centre point of the stage. With lighting and set design, as well as within the frame of choreographic practice and dance training, to 'split centre' carries a meaning beyond a staging one. It is the notion that two people (or, in this case, two or more performance entities) are splitting the attention of the audience, operating as equal collaborators in a performance context. In essence, *The Crack Up* 'splits centre' across its multiple platforms, with the direction of focus shared between the screen on stage, the dancers on stage, and the mobile devices. This paper investigates the potential for augmenting live performance with 3D projected scenography and mobile devices, and offers a starting point for discussion on the potential for dramaturgy, choreographic process, and the directing of audience attention within trans-media dance performances.

Figure 1. Screenshot of *The Crack Up App*.

Activated within the theatre and with high-resolution imagery running parallel to the action on the stage, the content on *The Crack Up App* follows its own unique narrative trajectory, while contributing to the larger

visual story of the work as a whole. Drawing on the common usage of mobile devices for tweeting and texting, *The Crack Up App* quotes Fitzgerald's *The Crack-Up* (as well as other writing by and about Fitzgerald) and places these texts within visual contexts that reference and comment on the action on the stage and 3D projection screen. Although the content of the scenography and the imagery on *The Crack Up App* was largely pre-determined and fixed (aside from some audience interaction capability), the movement from scene to scene across the platforms was live. In this way, the performance of *The Crack Up App* happens in concert with the action onstage, with the work taking place simultaneously across multiple platforms and with multiple points for audience access. This offers a kind of 'choose-your-own-adventure' experience of trans-media performance, with the audience's decisions about where to look divided between three distinct options: 1) the larger-than-life imagery projected onto the stage screen; 2) the dancers standing within, in front of, and beneath the imagery, or 3) The content on *The Crack Up App*. As Vincs has argued, there is no 'right' place to look at any one time during *The Crack Up*; rather the work simply exists in multiple forms, simultaneously, with a multiplicity of experiences. By consciously drawing the attention of the audience away from the stage and actively encouraging some freedom of experience (i.e. only parts of *The Crack Up App* are interactive) *The Crack Up* utilizes a mode of dramaturgy akin to site-specific or gallery-based work, or perhaps work in which audience members are free to roam around the performers or where the parameters for performance are set, but are left relatively open and uncontrolled.

The challenges with dividing the attention of the audience across multiple platforms are fundamentally dramaturgical and technical ones, with the creation of a "performance that is no longer designed for a 'normal' three-dimensional space, but which must speak within an artificially constructed volume."[7] In other words, the traditional performance area for live performance (the stage) is challenged by the "altered, augmented and perceptually distorted spatiality" inherent in trans-media dance, offering many new directorial and perceptual possibilities.[8] For directors of live dance performances, the decision about where to draw the focus is integral to the shaping of the performance. As Johannes Birringer suggests, this is fundamental to the nature of the integration of digital bodies with live bodies in a performance context because "digital performance with real-time media always involves projectional activities at the same time, i.e., simultaneous and deferred image, sound and light movements and 'micro-tonalities' which happen in continuous contingent (causal and non-causal) interrelationship with each other in total architecture."[9] With lighting designed to direct the eye of the audience to the most important, the brightest, and the most lit form, the body at centrestage becomes, literally, the most visible object on the stage. However, *The Crack Up* takes place across multiple platforms simultaneously, with the moments of performance not solely beginning and ending within the geographical space of a proscenium theatre, but offering a performative example of convergence culture.[10] The 'stage' for *The Crack Up* is both the space beneath and within the proscenium, but also on the individual screens held and activated by each individual audience member.

Within trans-media dance productions, the 3D projections are literally made of light and, in the case of *The Crack Up,* are projected six meter tall screen. This offers an enormous visual draw for the audience, and, even without the presence of *The Crack Up App*, challenges some of the conventions that might govern choreographic practice. How the different performative elements are integrated provides a dramaturgical challenge, particularly when the components are not seen in terms of a theatrical hierarchy in which either live performance, or projection might be privileged. As Beckwith & Vincs have argued, the use of 3D scenography within a digital performance environment, while offering untapped potential for the telling of physical stories, also poses a number of challenges in terms of cognitive synthesis for the audience, including reconciling the "inherent disjuncture between the spatial objects" such as live bodies and digital entities within the same geographical space.[11] Beckwith & Vincs propose the use of Kurt Koffka's Gestalt theories as a means of "creating perceptual wholeness" for the endless stereoscopic possibilities.[12] The addition of a mobile app, which intrinsically draws the attention of the audience away from the stage and down to their devices, further challenges the cognitive synthesis of watching trans-media performance. However, it is perhaps less important how the components of the work are integrated as individual elements than it is how they cohesively translate a theatrical meaning to the audience.[13] This demonstrates that the entire notion of 'direction' with performance art that enmeshes digital and biological content/bodies questions the accepted norms of theatrical dramaturgy. This collision of traditional stagecraft with new technology fundamentally shifts the dramaturgical requirements of creating trans-media dance. In this way, *The Crack Up* perhaps draws on American choreographer Merce Cunningham's work in de-centralising the notion of the stage centre in dance, but rather than abolishing the idea of the centre, *The Crack Up* instead divides it, quite precisely and consciously, between different perceptual, temporal and technological modalities.

The augmentation of live performance with mobile devices has been hotly contested in recent years, with the spectre of 'tweet seats' already challenging the sanctity, or rather the *perceived* sanctity, of the theatrical,

Western, concert space.[14] An audience member in a 'tweet seat' is 'allowed' to access and utilise their mobile device, tweeting or publishing immediate responses from within the theatre. The presence of 'tweet seats' undermines the traditional theatrical adage to 'turn off your phone,' while simultaneously raising concerns about preserving the 'mysteries' of a performance or what it means to have only a partial, or third-person experience of a performance. For avid tweeters, or for those audience members unable to be physically present in the theatre, live tweeting during a performance adds an interactive and responsive dimension to the experience, colouring the social act of attending the theatre with the faceted and multi-layered experience of social media. Opponents to the inclusion of social media within the performance space, such as Alex Roe, Director of New York's Metropolitan Playhouse, have suggested "outside interaction, even of virtual kind, might keep people from getting lost in a good play."[15] According to Roe, "'Part of the whole theatrical experience is the thought of being present in the company of the rest of the audience and the actors… [and] the thought of encouraging people to tweet during a performance is necessarily a violation of that agreement.'"[16] In other words, live tweeting during a performance where it is not part of a dramaturgical design, would cause an unwanted 'splitting of centre' for the audience.

The difference with 'tweet seats' and *The Crack Up App* is not just a matter of content, nor is it a matter of a dramaturgical effect. Although *The Crack Up App* takes place on interactive devices, it limits the amount of control and interactivity the audience has over the content. However much freedom is offered to the audience, it's inclusion begs the question of how focus and attention may be diverted or controlled for theatrical purposes. In the triad of live performers, stereoscopic imagery and mobile devices, the process of 'splitting centre' in *The Crack Up* is not a battle between two performative entities, but three of them. *The Crack Up* addresses this issue by creating a three-way split between perceptual modalities that remains consistent throughout the work rather than introducing digital elements in discrete sections, and by tying the digital content more directly to the conceptual development of the work. However, there remains a fundamental disjuncture between views such as Roe's, that see any engagement outside the on-stage performative world as a detraction from the performance experience, and works such as *The Crack Up* which view divergent sources of engagement as a means of enhancing and extending the conceptual scope and sensory experience of the work. Perhaps the broader philosophical issue this debate raises relates to how one approached the idea of divergence itself, whether of attention, or materiality, of biology versus technology. We argue that 'splitting centre' could be considered in relation to how one responds to the changing nature of attention itself in a digitized culture—to resist the multifocal and multiplicitious, or to specially embrace and cultivate it in a performance context. With the increasing development and availability of new technologies, as well as their increased incorporation into dance and live performance, there is room for further research into how the notion of 'splitting centre' could be exploited to create new and exciting performative possibilities.

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[1] In the context of this paper, the reference to 'biological performance entities' refers to human dancers.

[2] Ann Dils and Lisa Naugle, "Dance with the Mouse: Format for the Future," *Dance Research Journal,* 32:1 (Summer 2000), 163.

[3] *The Crack Up* was created as part of the ARC Discovery grant: *Building Innovative Capacity in Australian Dance Through New Visualization Technologies*, supported by the Australian Research Council through the Discovery Program (DP120101695). *The Crack Up* premiered 31 October 2014 at The Coopers Malthouse, Merlyn Theatre. Choreography and direction by Kim Vincs, Stereoscopic and 3D image concept design and creation by John McCormick, Daniel Skovli, Simeon Taylor, Kieren Wallace, Bobby Lin, Josh Batty, Peter Divers, *The Crack Up App* designed and developed by John McCormick and Kieren Wallace.

[4] F. Scott Fitzgerald, "The Crack-Up," *Esquire*, April 1936, http://www.esquire.com/features/the-crack-up.

[5] Kim Vincs, "Foreword by the Director—The Crack Up," Deakin Motion.Lab website, accessed 18 December 2014, https://blogs.deakin.edu.au/crackup/foreward-by-the-director.

[6] *The Crack Up App* was available for free download through the iTunes and Google Play stores.

[7] Vincs, "Foreword by the Director—The Crack Up."

[8] *Ibid.*

[9] Johannes Birringer, "After Choreography," *Performance Research*, 13: 1, (March 2008), 119. See also: Johannes Birringer, "Dance and Media Technologies," *PAJ: A Journal of Performance and Art*, 24: 1, (1 January 2002), 84-93.

[10] The notion of 'theatrical space' is a contested one, and one that is challenged by the potential of digital technology to redefine and create fluxuations in spatial relationships between people, digital entities, and architecture. See Benedict Anderson, "Out of Space: The rise of Vagrancy in scenography," *Performance Research: a Journal of the Performing Arts*, 18:3, (24 Sept 2013), 109-118. For a discussion of convergence culture, see Henry Jenkins, *Convergence Culture: Where Old and New Media Collide* (New York: New York University Press, 2006).

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[12] *Ibid*.
[13] Jerry H. Gill, "On Knowing the Dancer From the Dance," *The Journal of Aesthetics and Criticism*, 34: 2 (Winter 1975), 133.
[14] As Rupert Christiansen quipped in *The Telegraph*, the softening of the rules towards mobile devices may be "yet another concession to barbarity and further evidence of a catastrophic decline in the etiquette of audience behaviour." Rupert Christiansen, "Why theatre seats for Twitter junkies is a #goodidea," *The Telegraph*, 17 October 2014, http://www.telegraph.co.uk/culture/culturenews/11169040/Why-theatre-seats-for-Twitter-junkies-is-a-goodidea.html.
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[16] *Ibid.*

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Author Biographies

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Professor Kim Vincs is the Director of the Deakin Motion.Lab, Deakin University's motion capture studio and performance technology research centre, which she established in 2006. She has been a choreographer for over twenty years, and has focused on interactive dance technology for the last ten. Kim has five Australian Research Council projects in dance, technology and science, and has established numerous industry collaborations in motion capture, movement analysis and digital art.

Dr. John McCormick is one of the pioneers of new media dance, motion capture and telematics performance. John has worked with Motion.Lab for the last five years, researching movement visualisation and analysis, and with the Centre for Intelligent Systems Research for the past three years investigating machine learning of movement and its application in the performing arts.

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[Session 18]

Movement and Bodies

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From scripts to scores – movement as an embodied material for digital interaction

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Abstract

Today our environments are increasingly digitized and interactive. We generate data by the very way we move, from locative signals to accumulated traces outlining direction and intensity as well as computational and comparative information. These digital environments are currently being built, and ask us to decide which movements matter and which do not. In the design of movement-based digital interaction, movement becomes a material with which we may shape new expressions, functions and interactions. The borders and boundaries of decisions on movement that are set in binary code become a complex, meaning-making communication. I suggest that we need to visualize movement data together with movement expertise in order to harness an agency in movement itself, namely the kinesthetic, embodied sensation of movement as well as the relational ways we may move with data. I discuss several projects whereby code and the conceptualization of movement are explored jointly. The aim of discussing such processes is to find ways to tease out the rich communicative potential of full-body movement for digital interactions by enabling an explorative, creative engagement with movement data and, in turn, movement.

Keywords

Full-body Movement, Materialization, Digital Interaction, Design, Communication, Boundaries, Scripts, Scores.

Introduction

Today our everyday physical movements are increasingly tracked and traced by a variety of sensors, from simple signals registering time and location to accumulative records which in turn may feed back information. Software activates and instigates the dynamics between these: movement and sensors. This dynamic led Thrift to argue that today "software quite literally conditions existence" [22]. In particular, software requires a critical view on digital media in relation to physical movement. Pre-calibrated sensors can now track movement qualities such as direction and dynamics, posture and pace. Consequently, the scope of movement data is extending from registering the location of a person to tracking and analysing movements of the full human figure in real time [11].

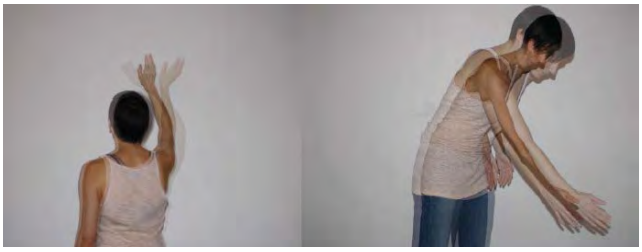

Figure 1. Performing our everyday life entails navigating invisible or immaterial structures and digital environments, where we physically have to explore what is 'seen' © Lise Amy Hansen

The main concern for this paper is the materialization processes where there are choices made as to which movements are made to matter. In other words, how physical movement is conceptualised in order to be processed by a digital medium. I am interested in the decisions made when writing such inscriptions, as this is about the laying down, in written form, a human and machine readable signal or representation of human movement. As Wood observes:

> A facet of digital technology, and of technology more generally, is not that they separate us from the world, but rather that they create within it distinct kinds of engagements [24].

We now live increasingly influenced by digital media. It is critical to understand the nature of movement data and the ways in which the data is set as code and how this code runs as software. As Kitchin observes, software actively shape "people's daily interactions and transactions, and mediate all manner of practices in entertainment, communication, and mobilities" [17]. These issues are of particular importance now, as the role of software is not settled:

> We are still laying down the infrastructure, structures and conventions, the uses, functions and ways of expression and communication [4].

Today programmers may alter the code and procedures for how we communicate; they can rewrite and implement a software's functions and effects. New code can be written in ways that affect the actions and behaviors of many. New movement may also impact on the code devised.

Movement material

Full-body movement is embodied in the sense that it requires a body. Thus it is cultural and conditioned, relational and gendered, lived and performed. It is also expertly perceived by others, acted upon and referred to. As a visual phenomena, full-body movement can be registered by digital media, typically to pre-set criteria. In effect, movement can be made digital in the sense that movement information is registered, calculated and stored disconnected from a specific body and thereby disconnected from a specific time and specific place.

Additionally, if we are to pick up such abstracted digital content referring to movement data, it must again be materialized. Following Blanchette, it must in some way or other be re-substantiated:

> However immaterial [digital information] might appear, information cannot exist outside of given instantiations in material forms [4].

So how may we get to grips with digital movement material? Creative projects that explore movement and digital media are predominantly collaborative and rely on the collaborators' ability to see material, expressive and functional possibilities in the fields of others. In order for movement-based interaction to explore kinesthetic agency and physical developments in movement, one needs to understand not only the way we currently move, but also the potential for change and repetition as well as subversion.

Berry has argued that in order to understand computation, we do not need to understand the writing of code alone but to analyze the different layers that make the code become software [3]. This distinction is relevant because of the way we generate data is by way of software. The moving body as a communicative source scripted via code provides a rich and complex communication potential. Movement material has been abstracted and then re-presented digitally. We need to be aware of the many pivotal decision we take when we choose which data to pull up, which sections of the body to foreground, and which speeds of which limbs to trace etc.

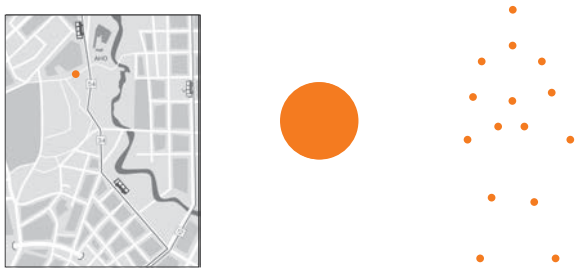

Figure 2. Granulation of movement data from the location of a singular dot marking presence in the world, to movement of a dot to several dots representing the body as a complex system © Lise Amy Hansen

These full-body movement centred perspectives are central considerations because data has no *necessary* form [9]. So for instance, the notion of age may be visually present in the way we move, or gender or culture and therefore may also be presented in the data. But if we do not look for ways of representing this as we work with the data, then we simply side step the issue of say, age and gender. Yet, we may write code based on assumptions on the intensity, the variety or the ability we have to move that in turn do hinge on notions such as age or gender or culture. Thus, a critical understating of how movement is formed is central for writing code that is based on or activated by movement.

Materializing movement

Motivated by the richness of interpersonal non-verbal communication, I am interested in exploring the way we move with, for and through movement data. My interest extends to finding ways to identify the switches and glitches in what is often envisaged as a seamless digital realm, whereby averages become the guiding measurement. The abstract borders and boundaries in binary communication quickly become physical and personal as we navigate, appropriate and communicate based on algorithms (see Figure 1). An everyday example of this is the automatic voice recorder: we change our voice according to how we think we might be understood by the identifying script running the automatic voice and we usually adopt a tone of voice that we would rarely use to address a person. Another example is the technology behind an automatic door. Here a person is recognized by a system that renders the movement (a person walking into a given area) into code, which then instructs machinery to open the door. This simplicity however is at odds with the sophisticated ways we leverage our movements to communicate intent and ability, such as whether we intend to enter the building or just pass by, or whether we're in a hurry or would need more time to enter. Thus intent and ability may partly be accounted for by considering the two movement qualities direction and speed.

A body typically has 240 moveable joints, each with six degrees of freedom, yielding 1380 in total. Thus we may quickly generate a wealth of information and the selection or granularity of this data is central (see Figure 2). Yet, higher precision and more detail may not give the kind of information that communicates nor provide the tools with which to work with or understand movement. New media is being developed towards an increased resolution, precision and capacity, yet there is a need to critically discuss how today's available technology is applied and the possibilities that come from how these new media already are applied or could be developed. When we find new ways to construe movement, I argue that we need to be aware of how we categorize and apply it, in the sense that when we alter this digital media, we may move *through* and not just *for* the media.

Switches & glitches

The 'on-off' character of digital information can take any form in the sense that digital files are indistinguishable whether they containing data from a movement phrase, a text document or an image. The digital properties of such media content come from the software used to create, edit, present and access this content [18]. In other words, we create the material simultaneously as we are figuring out how to create with it.

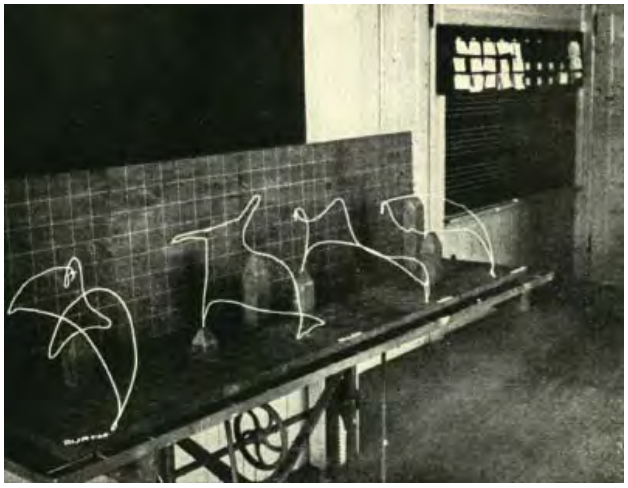

Figure 3. Gilbreths' movement studies of factory workers' routines in order to find unnecessary movements (Frank and Lillian Gilbreth, untitled motion models, c. 1913–14) Gilbreth Collection, National Museum of American History, Smithsonian Institution, Washington D.C.

Temporal data: new traces

When the Gilbreths used light photography inventively they were able to show a trace of actual movement abstracted from the body and traced over time. These traces were reduced to a still (see Figure 3). Now computation enables us to devise an added layer of information, whereby registered movement may also be calculated, compared or connected and again be made visible in near real-time.

Computational tools tend to focus on a detailed mapping, however, as Sheets-Johnstone writes, a description of an object's positions is not a description of movement [21]. Similarly, a music score does not contain information about the mechanisms or processes of performing beyond the 'formal characteristics' specifying the music to be realised [20]. A key question arises: What characteristics then do we need to find ways to represent in movement data?

Farnell points to a similar critique of representing a body when she asks Anthropology to consider the moving body, because 'the way human agency works is in terms of the signifying enactments of moving persons' [8]. In other words, the communicative qualities reflecting human agency occur temporally. This provides an impetus for the abstraction and conceptualization of these qualities also to be considered and represented temporally.

Dynamic visuals present time-based data the opportunity to be represented temporally and as there are aspects that otherwise would be lost in representing movement. We can now create expressions and functions around or for the way we *actually* move, rather than the way we *think* we would move.

Elusive data: WYSIWYG

We cannot perceive digital content as data is stored beyond our direct perception "below the 'threshold' of representation itself" [12]. This emphasizes the importance of choosing the relevant data or appropriate parameters for computers to compute or sensors to sense.

Exploring the concept of WYSIWYG (what you see is what you get), the *Synchronous Objects*[1] project addressed the notion of communicating potential of a choreographic idea, specifically away from the body. The sheer variety of representation developed showed the complexity of representing potential of movement. The resulting dynamic visuals of movement data are sketches and as such can be seen as a material anchor [14]. Arvola suggests that for complex creative concepts and their implications, such sketches can hold the design in place and make it 'stable enough to reason about' [1]. Following this logic, I argue that a material approach to movement data shifts the focus in a design process from objects to the communicative agency of our bodies. This is a meaning-making activity that has seen limited research to date.

By focusing on the dynamics of movement as it is expressed over time, shifts the focus, from comparing it or building a general systems of signification, to exploring how we may generate an understanding of movement through movement data [e.g. 2].

[1] http://synchronousobjects.osu.edu/

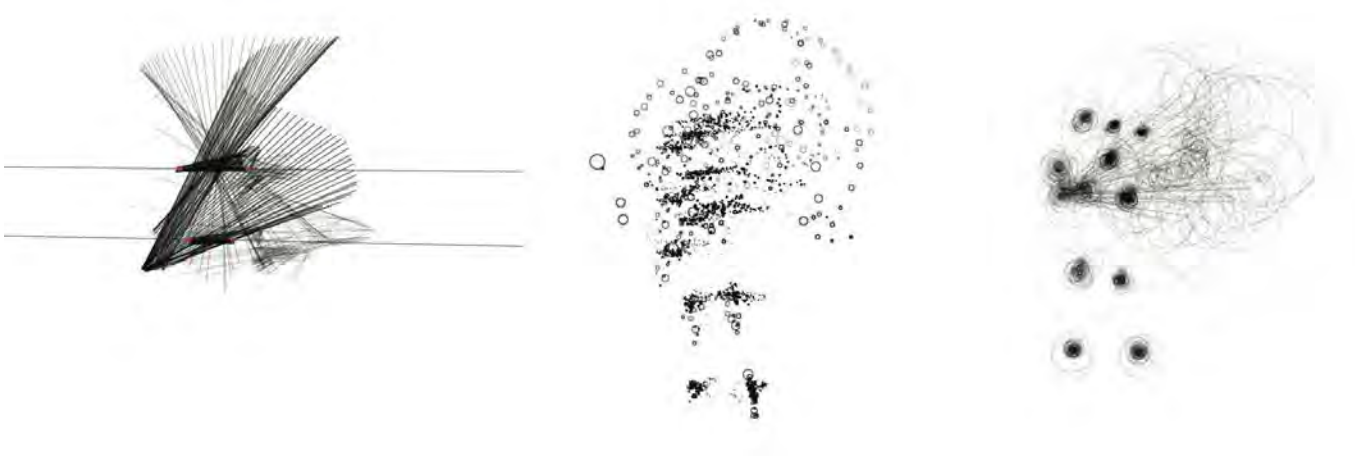

Figure 4. The *Sync* tool allows for movement data to be visualised live or repeatedly through recorded data. In this collage, a hand wave is visualised in three different ways. © Lise Amy Hansen

Corporeal data: *Sync*

I have investigated this potential through the co-design of *Sync*, a digital application, a tool that allows designers to visualize movement data [10]. *Sync* was developed with Hellicar&Lewis[2] to explore how corporeal qualities and dynamics in movement data could be presented in dynamic visualizations. (see Figure 4). *Sync* gives near real-time visualizations of movement, with a comparative video feed of the movement. In this way, one may see which data was captured in comparison to the performed movement. We get access to the ways in which movement data is different from physical movement. 'We always see less than is there […] We also always see more than is there' [5].

Sync currently draws on the data from Microsoft's *Kinect* and makes no distinction between whether the movement or the rate of change occurs on the x, y or z plane. Equally, it identifies where there is less or little movement. It has an option to show history, which is a visual trace of a point. Thus with little movement, one gets a build up of visuals, creating a denser mark the longer there is stillness.

The *Kinect* software uses depth data, i.e. a body outline to calculate, identify and track the various points to make up a human skeleton. However, as has been pointed out by several in performance studies [e.g. 25], the representation is not a skeleton in the sense that it is calculated based on information about how a body's outline changes – it does not act the way a skeleton acts.

There are further implications for creative practice here in that *Sync's* dynamic visuals can be seen as a mapping of variety and variation, whereby they inform design briefs for future designs. Drawing on Cosgrove, 'The map has a powerful recursive quality; it acts as a memory device that is also the basis for projective action' [7]. I mention these concerns because the implications of movement data being different to movement means there are advantages to articulating the agency of each, rather than optimizing one to the other [e.g. 22].

[2] http://www.hellicarandlewis.com/

From scripts to scores

Approaching digital movement as described above shifts the role of movement in creative processes of writing code from testing to co-designing. Or rather, the approach shifts movement from an 'end-user' role to a creative materials centred one, manifested in emerging material in and of itself.

Relational applications

Discussing software and materiality, Thrift points to the normative effect whereby software guides and guiles:

> "human embodied experience – that experience which is still so often considered to be a constant even as surfaces like screens and software have questioned its reach and meaning – is being decisively changed. Key human affordances are now being altered" [23].

In these challenges lie individual agency and freedom,. When they are anchored in code running our interactive environments, we need to understand how to build on the way we move.

ReacTickles[3] is a suite of applications that uses touch, gesture and audio input to encourage interactive communication (see Figure 5). These applications were developed in an inclusive design lab, with the overarching goal to generate ideas for technology interfaces that could engage and motivate people with poor verbal communication abilities, such as children on the autistic spectrum. Co-creating these various tools meant that important parameters, such as access and consistency, were identified as vital parameters in the design for engagement (as opposed to spectacle or immersiveness): "The simplicity and predictability of the application give the guests confidence that every action, however tentative, could be rewarded" [15].

[3] somantics.org

Figure 5. The Body Paint tool initiated an expansive variety of imaginative performances by the guests using their whole body movements and also clearly enjoying the calming sensory experience of the smoothing the projection wall © by kind permission Hellicar & Lewis

The project highlights that perception is not only about vision, but that it is also informed through our other senses as well as from the kinesthetic sensation derived from movement itself.

Relational code

The Reactor for Awareness in Motion (RAM) Dance Toolkit[4] challenges the expertise of dancers as it extends their movement skills and the formalised practice of these through customisable visualisations. The toolkit provides visual information of how movement may be traced and the ways in which the scripted data can in turn generate new movements and new movement expressions. This is a creative coding toolkit which allows for the creation of a set of different environments called "scenes" for dancers, where movement data is visualised and is made available in real-time by a digital interpretant known as the "actor".

The tool generates environments for enhancing ideas for dance and the variety of scenes provides comparison of how movement data can be played out, by way of scalable visuals or choice of couplings in the data, for instance. By teasing out ways to address variation in movement, by way of dynamic visualisations such as these mentioned, we may reconsider the role of movement in interactions and the body not only as a given and mapped object but as a sensate origin of action [8].

By exploring materialising processes - conceptually and practically - we may gain an understanding of what underlying motives are at play, As I have argued, this is important because with computational material, meaning is not a given – both the material itself and its meaning is continuously made.

[4] http://interlab.ycam.jp/en/projects/ram/ram_dance_toolkit

In a sense, then software is continuously re-scripted. Thrift writes of software as 'a means of sustaining presence which we cannot access but which clearly has effects' [24]. In order to understand how we shape and influence software, despite its inaccessibility in everyday life, we need language to address aspects, elements or qualities of software as well as tools to explore what is yet to be named or what may be addressed. This is particularly pertinent when it comes to movement, another phenomena resisting traditional descriptive modes such as the written word or through photography or film.

Relational variables

With few conventions to rely on, there is a need to attend to what can change or what can be changed in regards to movement data and how it is applied through code. Exciting developments take the form of *Choreographic Coding Lab*[5] *(CCL)* focused on 'translating aspects of choreography and dance into digital form and applying choreographic thinking by working with patterns, structures and movement through finding, generating and applying them. The results range from 'prototypes for artworks to new plug-ins for working with dance related datasets'. The CCL format originates from *Motionbank*[6], a research project of the Forsythe Company[7].

The *CCL*, together with the examples above, *Sync, ReacTickles* and the *RAM Dance Toolkit*, provide an argument for a movement-sensitive approach to computer expertise. If new media is to truly draw on movement as a source of information and communication, then we need to find ways to communicate movement expertise. This is important, following Kirsh, as

> we can interact with digital elements by gesturing and body movement, by manipulating everyday objects, and even by training brain activity to control interfaces. To understand the design principles of such a world requires that we become familiar with the ongoing developments in embodied, distributed, and situated cognition, and build closer relations to their research agenda [16].

Everyday performance

In this paper I have outlined concerns and considerations of handling movement data a creative act. I argue, as Noland says, that

> gestural routines of inscription yield a kinesthetic experience that is a resource in its own right, a resource of sensation capable of subverting institutions of inscriptions by promising new, unmarked material to record [18].

[5] choreographiccoding.org
[6] motionbank.org
[7] theforsythecompany.com

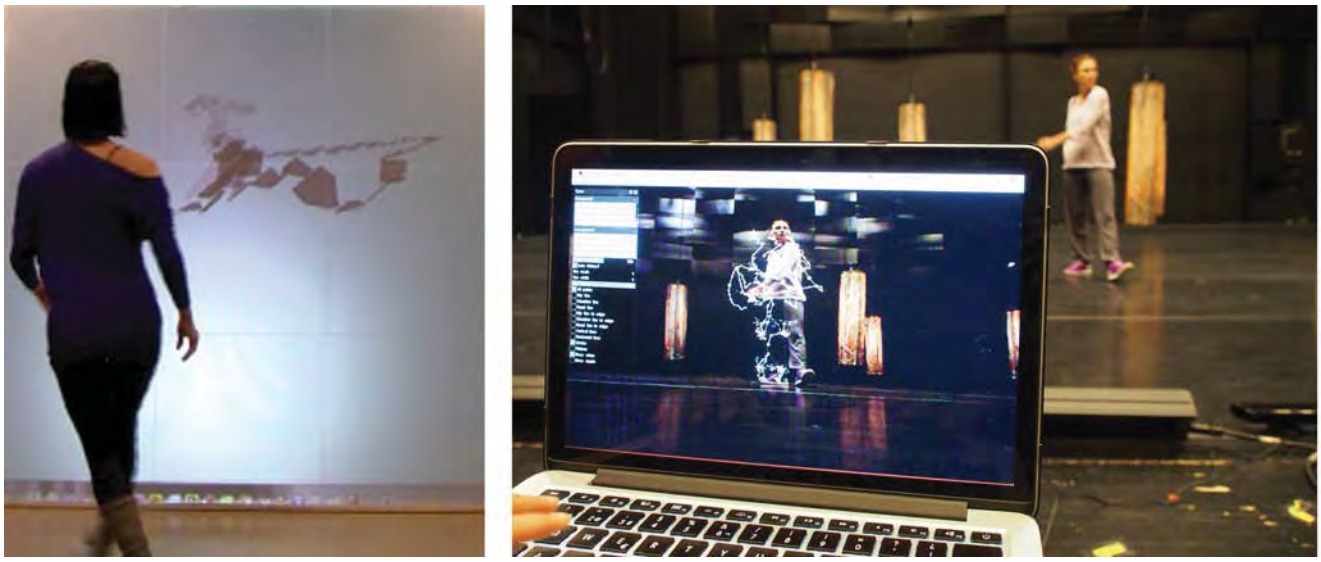

Figure 6. By moving with the data and toying with the possible effect in the generated visuals whilst simultaneously being influenced by them, movement scripts can be acted out in real-time © Lise Amy Hansen

With real-time visualizing tools, temporal qualities may be viewed, identified and named as well as felt and experienced (see Figure 6). Today, we are being badly choreographed by digital media as we perform our everyday lives. If we are to understand what is at stake we need to not only look at the effect of current digital media, but to explore the material possibilities brought about by new digital media as this media is still pliable, and it is clearly still in the making. Through such a material approach, I suggest that it is possible to explore movement as a digital material and thus leverage our complex movement knowledge.

This relates to both perception and performance, rather than allowing media alone to dictate or automate our movements. This development needs a critical approach, as Wood points out:

> The numbers of technological interfaces that frame how we see the world are rapidly expanding their influence, and there are questions to be asked about who controls and creates those interfaces and for what reasons [23].

By exploring what is particular to full-body movement and what is particular to movement data, by way of digital tools, we may leverage the high resolution with which we perform and perceive movement and enable digital media to go from 'replacing reality to shaping reality' [6]. As Haraway proposes, by reflecting on where our seeing is located 'we might become answerable for what we learn how to see' [13].

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Technologies of Self-Fashioning: Virtual Ethnicities in New Media Art

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Abstract

This paper proposes a theoretical framework with which to discuss the critical engagement of media art projects in Second Life with racialized self-representation, fashion and ethnic dress. Examining Montreal-based Mohawk artist Skawennati's machinima series, T*imeTraveller*^{TM} (2008-13), a project of self-determination, survivance and Indigenous futurity, it argues the critically-aware act of 'virtually self-fashioning' racialized born-digital identities, or virtual ethnicities, disrupts ways in which today's vast proliferation of self-technologies enabling the creation, recreation and management of multiple selves, would otherwise remain complicit with neoliberal colour-blind racism.

Keywords

Self-fashioning, fashion, ethnic apparel, race, gender, coloublind racism, Second Life, virtual worlds, SLart, Skawennati, *Time Traveller*

Introduction

This paper discusses the possibilities of born-digital identities in Second Life created by artists of colour and Indigenous artists, to address the politics of racialized representation related to fashion and its Other—ethnic dress in-world and offline. Specifically I argue the critically-aware act of what I describe as 'virtually self-fashioning' racialized born-digital identities, or virtual ethnicities, disrupts ways in which today's vast proliferation of self-technologies enabling the creation, recreation and management of multiple selves, would otherwise remain complicit with neoliberal colour-blind racism, or neoliberal racism, as social critic Henry Giroux calls it. The paper is divided into three sections. The first section introduces the context from which this discussion emerges, namely scholarship concerning depictions of the racialized and sexualized body in Second Life and mixed reality performances that dispel the illusion of colourlessness in not only the fashion world but virtual worlds. Bringing together feminist interpretations of Foucault's theorizing on technologies of the self, critical race studies, fashion theory and postcolonial digital visual culture critique, the second section elaborates on how acts of virtually self-fashioning, allied to critique, help make critical distinctions between the ways in which selves are made and remade within and by the technologies of fashion and self-care, and the ways new media is used in artistic practice as potentially disruptive technologies that critique and redress the former. Why? Because the bodies engaged are themselves potentially disruptive, particularly when it is up against hegemonic social norms and conduct, of which dress is a significant marker. One of the artistic strategies is to facilitate the online critically-aware remediation of ethnic apparel (the entire outfit from makeup and hairstyles to clothing and accessories—even behaviours). Elsewhere I have argued that 'ethnic dress' (and its variants—'national dress' or 'world fashion') exist only because of the persistent Eurocentric perception of fashion as a purely Euro-American invention. 'Ethnic apparel" is thus used as a critical term whenever possible to underscore sartorial interventions cognizant of prevailing racist ideologies and discourses. The paper concludes with an exploration of Montreal-based Mohawk artist Skawennati's machinima series, *TimeTraveller*^{TM} (2008-13), as an example of the complex processes of cultural negotiation involved in the virtual construction of "Indian Country" in Second Life. A central aspect of the project is the artist's resourceful endeavours to create original Indigenous avatar skins and clothing, in addition to culturally-appropriate objects and environments, not readily available in the user-created online environment. It is safe to say that today, as art historian Martha Buskirk discusses in her book, *Creative Enterprise: Contemporary Art Between Museum and Marketplace* (2012), "contemporary art has become deeply embedded not only in an expanding art industry, but also the larger cultures of fashion and entertainment," referring to the art and handbags of Sylvie Fleury, Takashi Murakami and Fred Wilson. 1 With the Internet, this expansion has led to new relationships between new media art, new technologies of self-making and the virtual fashion and entertainment designed specifically for end use in virtual worlds.

Second Life Fashion and Ethnicity

> If in Real Life, you re Asian American, Asian Pacific American, fill-in Asian or Pacific Islander ethnicity American, please join this group Whether your passport says you re American or not does not matter. ou do not have to be Asian (or even human in SL) to join. 2

At the end of last decade (i.e. late 2010s) when the phenomenon of Second Life (SL) was still somewhat awesome and just days before the US would inaugurate its first

Black president in Barack Obama (January 20, 2009), SL scholar James Au Wagner asked: "Why s It Still Hard to Find a Good Ethnic Avatar Skin?" Fruitless searches in top SL fashion emporiums will only turn up "skins that are just darkened versions of light ones, or come without hair selections popular in black/Latino communities." 3 In fact, *Second Life Newser* reported that: "One kind of item that some residents complain they can't seem to find are ethnic avatars" which is why Tellaq Guardian created his SL store: "I couldn't find any good black skins for myself. As you can see in the store, there are many Afro skins"—there are also "some white, and one Asian." 4

In 2015, things haven't changed that much in terms of virtual diversity. The times in fact reflect more acutely the ascendancy in dominant public discourse of neoliberal ideology as well as its discontents. In a recent controversial 2014 study at Ohio State University on how racial diversity among virtual avatars in Second Life affected the experience of both white and Black users, Communications Studies scholar Jong-Eun Roselyn Lee "found that low-diversity representations of 'Second Life' dominated by white avatars led black players to create virtual avatars that also appeared whiter," and that "such circumstances even made black players less willing to reveal their real racial identity through their avatars"—the study did not "encompass other racial or ethnic groups such as Hispanics and Asians." 5 (It's just as bad for Asians, there are a lot of Harajuku and other favourite anime characters but not many human avatars expressing offline Asian identities.) 6 Lee's study is remarkable in what it says about "how strongly racial minority individuals identify with their particular race or ethnicity"; the appeal of SL's capacity, its openness for self-customizations for users to create avatars reflecting their true selves, is, as in video games, trumped by the fact that skin colour "still matters for the player's experience," enough that they will downplay, if not outright suppress the expression of their offline racial identity. 7 In contrast to gameworlds, user-created communities in Second Life have neither goal objectives nor pre-established game narratives, "relying instead mostly on the social interaction of users as well as an economy of user-generated content." [8] Despite how Lisa Nakamura has argued that "the adoption of the Internet by many more women and users of color since the nineties has occasioned innumerable acts of technological appropriation" 9 (and it has to a degree), this study and other recent scholarship on virtual diversity and cyberethnography in Second Life indicate there are still significant intersections of offline and online materializations of raced and gendered identities that underscore how experiences of racism, sexism and other forms of xenophobia in real-life, or worse, internalized forms of such ideologies of oppression, often impinge on the decision of SL users to self-represent their ethnicity, gender or nationality online, contributing to the ongoing lack of virtual diversity in the digital visual culture of Second Life.

Equally telling of the neoliberal tenor of the debates was the outcry against Lee's article, from arguments based on "design challenges" (that the lack of ethnic skins mainly has to do with "darker skins being far harder to give life to in a world like Second Life the textures don't stand out as much and therefore fewer content creators want to make them and fewer customers find them appealing" 10) to arguments based on market (there are few ethnic skins because there is no market for them, i.e. people who join online communities want to be someone or something else, certainly not identify with "races" marginalized in Real Life). The contention that scarcity of ethnic avatar skins is because they are simply not "appealing" to either ethnic or non-ethnic SL users, never mind SL residents, resorts to "race-neutral" discourses of neoliberalism that reduce racial problems to privatized concerns and issues of individual character and cultural depravity, and "human agency as simply a matter of individualized choices, the only obstacle to effective citizenship being the lack of principled self-help and moral responsibility." 11 Counter-arguments inevitably are rebuked with, as Giroux puts it, "power-evasive strategies such as blaming minorities of class and color for not working hard enough" (or too incompetent or unskilled to do so) and "refusing to exercise individual initiative." 12 (For Skawennati s *TimeTraveller™*, as we shall see shortly, this is simply not the case.)

And then there is the prevalence of "fashion anti-intellectualism" (anti-intellectual discourses about fashion), which, according to Minh-Ha T. Pham, is witnessed "any time a fashion designer, editor or retailer offers a non-apology about a racist, sexist or classist runway show or fashion shoot that begins with 'I m sorry if anyone was offended' and ends with 'but it s just fashion, don t take it so seriously.'" [13 One of the intellectual projects that fashion anti-intellectualism diminishes, notes Pham, is the understanding of "the social, cultural and socio-psychological relations between the body and clothing," or "enclothed cognition," an emergent field of study under embodied cognition studies spearheaded by cognitive psychologists Hajo Adam and Adam Galinksy: what you wear affects how you think of yourself. 14 It may seem this scientific conclusion was already figured out a long time ago, but even more surprising is how little discussion there has been about how affect pertains to the relationship between ethnic identity and dress, as well as the preconceived ideas associated with them.

Fashion (avatar apparel), specifically ethnic fashion as it is understood by the majority of SL residents, in contrast to ethnic 'skins', is much more easily obtainable in Second Life in any number of virtual outlets near you. While ethnic avatar skins are available in a limited fashion, it is the practice of "dressing up" or "going native" that is the more lucrative as sartorial commodities. In Second Life, users can dress up their avatars in the latest 'virtual world' fashions as well as in the latest 'world fashions' but one obvious observation is common, the majority of avatars, those that are human, whether dressed in "ethnic fashion" or not, are white and non-ethnic (there is more gender-bending than racial bending in Second Life). If one were to follow Adam and Galinsky's enclosed cognitive formulation, the

wearing of ethnic fashion does something to the psychology of the wearer that has no connection to the fact that the clothing isn't being worn by those whose ethnicity they are associated with.

This racial disparity in the phenomenon of ethnic chic isn't much different than what has been happening in Real Life where international fashion shows, and the models who walk the runways in them, are overwhelmingly white. While there was a spurt in the fashion industry in the 1980s and 90s when designers like Calvin lein, Gianni Versace and ves Saint Laurent routinely cast Black models without question, by the end of the supermodel era, fashion shows are as dominated by white models as they have been since the late 1990s. In the last decade that number has dropped and been replaced by obvious tokenism 15 (of a few size zero high end ethnic models) and the increased appearance of Asian models (in actuality, between 2008 and 2013, they "never comprised more than ten percent of turns on the runway. In five of the nine seasons, Asian models have *less* representation than Black models" 16) which is explained "specifically in terms of appealing to luxury customers in China. […] What is happening on the runways is the result of a very Eurocentric aesthetic that has taken over for the last 10 years and that has excluded other races." 17 What of Indigenous models? I could ask the same thing.

To change things, "the times need a real hard line drawn"; in the sixties, you would boycott," but today, says the iconic Iman, former supermodel and ves Saint Laurent muse: "If you engage the social media, trust me, it will hurt them in their pockets. If you take it out there, they will feel the uproar." 18 Twitter, other forms of social media, and an array of new fashion media communication technologies (blogs, vlogs, and mobile device apps) can revive the debate about race and fashion, but the fact remains: "There have been no obvious repercussions for those who still see colorless runways as an acceptable form of artistic expression. […] there are still many designers and casting agents who remain […] unmoved by the perception that fashion has a race problem in the first place." 19 Despite how luxury fashion has become a global business with an unfathomable number of consumers watching runway shows online, even virtual fashion shows are overwhelmingly white, as Pham's case study of the "Burberry Prorsum Autumn/Winter 2011 Hologram Runway Show" in China which marked the opening of Burberry's flagship store in Beijing, demonstrates: "Rather than spotlight Chinese supermodels or at least use them as prototypes for the digital models, white models overwhelmingly outnumber non-white models on this virtual fashion runway – just as they do on real runways." 20 Once again, the reproduction and (re)configurations of race, ethnicity, and gender in real life carry over in digital spaces, and in the case above acutely exemplified at the intersections of fashion and virtual identity play.

In this regard, the ongoing scholarship on race, ethnicity and diaspora in new media by Lisa Nakamura, Wendy Chun, and increasingly more other academics, are fundamental to understanding what is happening in new media art when it comes to talking about virtually self-fashioning racialized subjectivity online. "Racial formation theory has not often been used in reference to new media, partly because the frame of reference is so different and because the early utopian bent to Internet criticism meant that discussions of difference, especially if viewed as 'divisive,' were avoided." 21 While earlier racial formation theory assumed that racial projects "were ongoing and differential but nonetheless worked in a more or less one-way fashion," today, Nakamura writes, "new media can look to an increasingly vital digital cultural margin or counterculture for resistance." 22 Morever, vital to moving forward digital visual culture critique are intersectional critical methods that "read both race and gender as part of mutually constitutive formations." 23

Technologies of Self-Fashioning

> The self is not clothing, tools, or possessions. It is to be found in the principle which uses these tools, a principle not of the body but of the soul.
>
> – Michel Foucault 24

For the purposes of this study, "technologies" is understood in terms of what French philosopher Michel Foucault posited as "technologies of the self" and "care of the self" wherein the self is the *object* of both the technology and of the concern. Foucault defines technologies of the self as practices and strategies "which permit individuals to effect by their own means or with the help of others a certain number of operations on their own bodies and souls, thoughts, conduct, and way of being, so as to transform themselves in order to attain a certain state of happiness, purity, wisdom, perfection, or immortality." 25 Foucault did not write about fashion or dress but his ideas are useful to discuss how discourses about what we wear are internalized to the point that the relevance of lived experiences and alternative, non-hegemonic practices are often dismissed. His later writings are a reminder that "one has to take into account not only technologies of domination but also technologies of self." [26] Importantly, his method of inquiry into self care is "thinking with attitude": "thinking with attitude . . . generates the conditions of possibility necessary for subjects to cha[lle]nge their identities." 27

Only *critically-aware* acts of *virtually self-fashioning*, however, can intentionally and purposefully subjectivize the self who then becomes the one that is constructing the technologies *and* the self, and doing the concerning of itself as Moya Lloyd suggests, "self-fashioning, *when allied to critique*, can produce sites of contestation over the meanings and contours of identity, and over the ways in which certain practices are mobilized." [28 When self-fashioning involves race, itself a powerful technology, avatar identities run into what new media studies scholar Wendy Hui Kyong Chun posits as "race *as* technology," "a strange, and hopefully estranging formulation" that crucially "shifts the focus from the *what* of race to the *how* of

race, from *knowing* race to *doing* race by emphasizing the similarities between race and technology." 29 Of concern when it comes to talking about ethnic dress (and fashion in general), are two technologies of the self in particular: the technologies of self-esteem and of the market in which the technologies of desire and identity are intertwined through consumption. The former, self-esteem is closely linked to the technology of norms which produces certain kinds of selves. In order to be empowered, it is necessary to think of self-esteem as having more to do with self-assessment or self-worth than self-respect as can be surmised by the huge variety of self-help books, tapes, videos and other paraphernalia available for purchase. Nearly all the psychological technologies borrow from technologies of the market, namely consumption, which in turn borrows from technologies of the self because it uses the power of goods to shape identities. For our purposes here, falling under the illusion of having only the choice between off-the-rack/pre-fab brand avatar apparel and virtually-designed haute couture, as opposed to self-designed apparel, reflects upon the Second Life user's buy-in, or, if they are fortunate enough, buying power to show (off) who they are or want to be, communicating to others ultimately how they want to be perceived as the market would have it so. As certain traits are associated with certain clothes, deciding to don and wearing certain pieces make individuals feel good (enclothed cognition), changing personalities to incorporate those traits into one's behaviour—the question is: in whose hands is (given) the power to shape the identities in Second Life that users desire?

TimeTraveller™

> The Montreal-based Mohawk artist Skawennati offers the tremendous "TimeTraveller™" (2008-13)—nine machinimas (films made by using computer graphics engines) featuring two smart, sexy and utterly cool Mohawks who use magical glasses and computers to visit often harrowing past events (including an Aztec sacrificial ceremony and the violent 1862 conflict between Dakota Sioux and white Minnesota settlers). Ultimately, they relocate to a spectacular future in 2121.[1] 30

Exhibited as a projection-based work in the 2014 Biennale de Montreal (BNLMTL 2014), Skawennati's *TimeTraveller™* (http://www.timetravellertm.com/) is a multi-platform work featuring a website in which the main component is a nine-part sci-fi/cyberpunk machinima series (movies shot in virtual environments, in this case, in Second Life on AbTeC Island). As with her earlier 2005 web-based paper doll/time-travel journal *Imagining Indians in the 25th Century*), *TimeTraveller™* depicts Indigenous people living in the future as a vibrant, integral part of it, rather than in an idealized past. 31 The machinima tells the story of Hunter, an angry, disillusioned young Mohawk man, fashionably punk and jet-packed, living in the twenty-second century—a Montreal in 2121 of soaring skyscrapers and hyper-commercialized surroundings—"a dystopian exaggeration of contemporary Western neo-liberal society." [32] Hunter is able to time travel thanks to the special ultra-light *TimeTraveller™* 3D virtual reality device (available for purchase soon, according to the *TimeTraveller™* website) that allows him to visit (as well as engage in gameplay with) famous people, places and conflicts in Indigenous history (such as the riveting Episode 03 of the Mohawk Oka Crisis in 1990 in uebec) and embark on a vision quest without ever leaving his futuristic, technologized world. (The "look" of Hunter's world, and Hunter himself was inspired by Neal Stephenson s widely read 1992 novel *Snow Crash* and its Indigenous antagonist, the hacker Raven.) Strong female characters appear throughout the machinima, including key historical figures. As the story unfolds, the female protagonist, arahkwenhawi (who first appears as a baby in Episdoe 03), meets Hunter and they fall in love, debunking all real-world theories of space-time continuum. As Mohawk activist Ellen Gabriel once said to Skawennati: "Our people have always used time travel to figure out the problems of today." 33

The story of the making of *TimeTraveller™* and inhabiting of AbTeC Island is self-admittedly inundated with multiple layers of irony and parody. Already early on in 2008, Skawennati's project team virtually confronted how "on top of the existing irony of Indians buying virtual land and then colonizing it, there was now an additional irony of having to enclose that land to protect it from counter-colonization by a … somewhat belligerent group of technological adepts"—virtual squatter-pirates stealing their prims (primitives) which are needed to build 3D objects in Second Life. 34 I would suggest however that given the teleology of the Internet as the last but most permanent thus far of the Wild West frontiers, it might be more accurate to see the efforts around *TimeTraveller™* as ironically part of the larger project to decolonize cyberspace or take advantage of the critical purchase of a territory already colonized by a neoliberal techno-meritocracy, with varying degrees of successes and failures—one has to, after all, pay for virtual land to occupy it. Fundamentally the project exemplifies one of AbTeC's core arguments, "that the era of networked digital media presents a unique opportunity for Aboriginal people to present a self-determined image to the world," both in Real Life and in-world—"even on the Internet, Native people need a self-determined place to call home." 35

[1] Born in anahw :ke Mohawk Territory of mixed Italian and Mohawk heritage, Skawennati (Tricia Fragnito) (1969-) holds a BFA and graduate certificate from Concordia University and is Co-Director with Jason E. Lewis of *Aboriginal Territories in Cyberspace* (AbTeC). She co-founded the collective *Nation to Nation* in 1994 and co-created and curated *CyberPowWow*, an Aboriginally-determined online gallery conceived in 1996 which eventually culminated in the establishment of AbTeC in 2008. Developed with the support of the AbTeC research network, and winning the *imagineNative Film and Media Arts Festival*'s 2009 Best New Media Award, *TimeTraveller™* has been shown in numerous configurations. http://www.skawennati.com/

"Call It a Vision Quest"

> Interfaces inform all media—videos, television, literature—and as this happens we are witnessing the creation of new power differentials in visual capital. 35
>
> We can be the storytellers, not just have stories told about us. 36
>
> I mix history, Indigenous knowledge, pop culture and science fiction to create alternative realities and possible futures that provide touchstones to discuss our resistance, survivance and success.
>
> – Skawennati

In their essay, "Call It a Vision Quest," Elizabeth LaPens e and Jason Edward Lewis argue that *TimeTraveller*™ is an example of culturally-critical machinima as First Nations survivance—survival by resistance—a concept popularized by Anishnaabe writer and poet Gerald Vizenor who emphasizes the continuation of "Native survivance stories" and "reinforcing the existence of living indigenous culture in contemporary society." 38 One particularly strong dimension of this in effect in *TimeTraveller*™ is how the artist and her team have had to make their own customized First Nations skin tones and hair styles, hence developing a "rich set of First Nations characters in Second Life, an act which constitutes a powerful contribution to self-determination in cyberspace" (if ethnic avatar skintones are rare today with very few Indigenous characters around, they were even more limited when Skawennati first joined Second Life in 2007). 39 "Customization in machinima may involve making assets such as animations, textures, objects, and sounds" – hairstyle assets were purchased and modified to complement the ones the artistic team made themselves. 40 Among the many customized objects in *TimeTraveller*™, from sacred objects such as wampum belts and beads to accessories, props and the virtual sets and even customized moves (drumming, jingle dancing), was clothing. As is the case for ethnic avatar apparel, "finding culturally appropriate clothing for characters provided to be a challenge, since most of the depictions of First Nations culture in Second Life stem from romanticized pan-Indian stereotypes. […] As a result, the team created much of the clothing for the characters, such as ribbon shirts, fancy dresses, and jingle dresses." 41

As LaPens e and Lewis suggest, the lack of a predefined narrative in the making of machinima in Second Life facilitated the objective to create *TimeTraveller*™'s original narrative context "that looked to First Nations culture and science fiction as its main reference points" 41 —the outcome of which I suggest can be described as a conscious act of virtually sef-fashioning Indigenous presence in Second Life. "The first episode took two years, as we had to learn everything —how Second Life worked, how to move in it, how to dress people, how to make them look Indian." 42

Ethnic Ribbons and Regalia

> In the future, what will we wear as regalia? What kind of agreement would we honour with a wampum belt? 43
>
> The continuance of both ceremony and creativity is at the heart of cultural and political survival. 44

In Episode 04, we meet arahkwenhawi, a young university student from our present visiting the Saint Francis Xavier Mission Church in anahw :ke, uebec, to do research on the "Lily of the Mohawks," Blessed Kateri Tekakwitha, the first indigenous Canadian saint (posthumously in 2012), for her art history paper on representations of Indigenous people. She finds a pair of the TimeTraveller™ glasses and visits a spectacular futuristic powwow extravaganza in 2112 at the packed Winnipeg Olympic Stadium where the long-haired MC is like a rock star and jingle dancers take centre stage (fig. 1). 45 Not only is the head female dancer, Miss Universe 2111 and featured on the cover of Italian Vogue, later in the program, beautiful Indigenous female models take the catwalk in haute couture "Ovoid" gowns. Importantly, Karahkwenhawi gets to meet and interact with ateri Tekakwitha through to Episode 05, finishing her essay. She finally hooks up with Hunter at Alcatrez in Episode 06 and continue together to find out more about the history of Turtle Island and in the process themselves.

Figure 1: Jingle Dancers Assembled, TimeTraveller™ Production Still, 2011. Courtesy of the artist.

Three items struck me about fashion, ethnic apparel and self-fashioning self-determined representations watching these particular episodes in which not only Hunter, but arahkwenhawi (who later goes on her own vision quest), technically-speaking, avatars of avatars, become subjects of history surrounded by, if not interpellated through apparel. The first is, not to state the obvious, that the very ability to literally *move* the narrative temporally and spatially (with a click of a button) and metaphorically (to bear *witness* to historical moments of Indigenous resistance and *take part*) is, in fact, a engineered piece of fashion apparel—a pair of stylized (and stylish) designer eyewear, created by an *artiste*, branded and comes in limited editions. A

similar device is the cell phone whose ring reminds us arahkwenhawi is in our present even as she travels back to 1680 to meet the tragically small pox-stricken Saint a-teri in the "flesh." Phones are fashion these days. On the market today are cellphone accessories and apparel as well as cellphone clothing (to conceal your cell so you can pay attention to other things) in the 'coolness factor' wars. In *TimeTraveller*™, these objects of many prims, however, are more than just chic fashion accessories they are emitters of hip, tech-savvy identities as well as conduits to Indigenous lives past and present. In this in-world, they are specially-designed, transformative, disruptive technologies.

The second is how the powwow event is a particular moment in the series in which mainstream conceptions of pan-Indian dress is remediated and re-appropriated from pop culture, mainstream mass media and historical accounts. In reference to *Urban Indian Series* (2006) by Terrance Houle in collaboration with Jarusha Brown, which capture the artist going about his daily life but in full powwow regalia, curator and art historian Richard William Hill writes that: "It is when we ask ourselves 'why?' that the work does its real damage. Do we really assume that the visible signs of 'Indianness' are antithetical to ordinary contemporary experience, even when worn by an indigenous person?" [46 The careful attention and effort to fashion a rich set of First Nations characters in *TimeTraveller*™ ostensibly carves out and place-holds a critically-aware transhistorical space where self-determined Indigenous fashion, with its diversity in varying scales of production, indeed exists. This favourable condition of possibility, I argue is what acts of virtually self-fashioning born-digital identities are aligned with and aspire to.

Finally, although not discussed in this paper, at least a brief mention should be made about how virtually self-fashioning gendered identities is also realized in *TimeTraveller*™ not just in these episodes but through to the end. In Episode 09 arahkwenhawi visits at art gallery in 2121 (Hunter's present in which he is rich and famous having won the Extreme Time Traveller contest). In this future, arahkwenhawi would be an award-winning, successful art historian of the twenty-first century Indigenous art that are displayed on the walls of the futuristic gallery (fig. 2). She is as comfortable in her own skin as she is in the jingle dress that magically adorns her at the stadium powwow, a pair of jeans and t-shirt or a professional business suit and slick hairdo, and apparently very, very youthful still in 2121. arahkwenhawi decides to move to the year 2121 permanently, for love and the prospects of what an empowered decolonial future can bring despite the familiar spectre of neoliberal capitalism at every turn. As Sasha Sobrina suggests, the hyper-commercialized surroundings are how Skawennati connects 2121 to present-day reality in 2015, inviting viewers to imagine with her how the attainment of such a future is not entirely fantastical. 47 Notwithstanding, survivance needs to remain an ongoing project.

Conclusion

The born-digital fashioned body is always already embodied and always already performed. Self-depictions of born-digital identities are always mitigated by and remediated through the experiences and aspirations of their real-life creators. For people of colour and Indigenous people, the decision to create or choose avatars that self-represent their ethnicities however come with challenges of which not the least is how virtual worlds are hardly the utopian, democratic, race-neutral, post-racial spaces they are sold to be, beginning with the default choices of skin colour. This paper has argued that critically-aware acts of virtually self-fashioning racialized born-digital identities through ethnic avatar apparel—skins, ethnic dress, accessories—evident in Second Life art projects such as Skawennati's *TimeTraveller*™, constitute acts of resistance against persistent colourblind injustices online and off. In visualizing, affirming and ultimately empowering the vitality of self-determined histories, identities and the fashioned body, they call attention to how selves are made and remade within and by the visual and conceptual technologies of fashion, new media and self care always for a purpose.

Figure 2: Epiphany (featuring Hannah Claus's *cloudscape*), TimeTraveller™ Production Still, 2013. Courtesy of the artist.

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Capturing and Recognizing Expressive Performance Gesture

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Abstract

A better understanding and control of expressive performance gesture potentially could have a large and disruptive impact on electronic media and movement performance practice. We use digitally captured positional data, features extracted from this positional data, and a variety of machine-learning algorithms, to improve the accuracy of recognizing expressive qualities of performance gestures, using concepts derived from Laban Movement Analysis (LMA). Through these methods, we seek to develop better human-computer interfaces, to expand expressive movement vocabularies, and to shift movement aesthetics, by empowering users to exploit their full performance capabilities.

Keywords

Machine Learning, Expressive Performance Gesture, Expressive Movement Recognition

Introduction

Human-computer interfaces rely on merging user abilities and technological tools to form an enhanced performance environment. While advances in technology have allowed users to perform more complex tasks with greater ease, the added technological challenges can hinder the movement and expressive capabilities of the user. This interference limits functionality and compromises the diverse pallet of expressive movement qualities. We aim to create a more cognitively transparent computer interaction system that maximizes embodied knowledge based on movement, quantifiably capturing and recognizing expressiveness present in performance gesture.

Gesture in performance couples the functionality of achieving a task with the expression of aesthetic qualities, creating a dynamic and complex dual role. Our belief is that the expressiveness in performance gesture comes from subtleties of movement, extending beyond its practical function (i.e., "how a gesture is performed"(Caramiaux, Donnarumma, and Tanaka 2015). Musical conducting provides an excellent example of a gesture system that gleans expression from nuanced gesture, expanding the range of a conductor's performance from micro cues to a grandiose breadth. The work done in (Kolesnik and Wanderley 2004), (Maes et al. 2013), and (Morita, Hashimoto, and Ohteru 1991) all point toward taking advantage of this broad vocabulary, driving different technologies through movement. Our work similarly attempts to dissect a performer's gestural range, discovering the subtleties and range of their movement through feature extraction, statistical measures, and machine learning. Through this analysis, gestural nuance can be applied to technological interactions with greater control and more expressive means.

We describe the current state of our research in capturing, analyzing, and applying expression in performance gesture. To apply machine-learning algorithms to performance gesture, we needed to develop a vocabulary to clarify the movement qualities we wished to quantify. For this purpose, we chose Laban Movement Analysis (LMA)(Laban and Ullmann 1966) and used it to inform and guide the creation of our dataset and our methods of feature extraction. We describe these features and our use of several machine-learning algorithms (specifically k-means clustering, Hidden-Markov Models (HMM), and autoencoders), followed by a discussion of the results and implications of these approaches. Finally, we will offer conclusions and future directions we wish to pursue based on this research.

Classifying Movement through Laban Movement Analysis

Laban Movement Analysis is a method and language created by Rudolf Laban (1879-1958) analyzing, describing, and explaining movement in terms of functionality, tendencies, intention, and expression. The method is principally used by dancers and choreographers as a way to gain insight into movement from an expressive and intentional realm, but has expanded as a descriptive vocabulary for movement itself (Maletic 1987). We are centrally concerned with the goal that Laban states:

> Basically one has to start with the description of movement .... Our aim is thus the mastery of movement through explanation. (Laban and Ullmann 1966)

The 'mastery of movement through explanation is executed in our work by utilizing LMA as a framework from which we can build a classifiable dataset of labels that encompasses our movement capabilities. From this data set, we can perform digital analysis using machine-learning techniques. Using concepts from LMA, we develop a structure to represent

movement, intention, and expression.

LMA has five principal components that collectively create a comprehensive symbolism for movement: Body, Space, Effort, Shape, and Relationship. In our work, we focus on Effort, which relates most directly to expressive characteristics we are seeking.

There are four distinct components of Effort: Space, Weight, Time, and Flow. In our work, we focus on the first three components, omitting Flow, which tends to be based on the interconnection of other movement qualities. Each Laban Effort Component represents a continuum between an *indulging* and a *fighting* Basic Effort Factor (BEF). Space can be represented on an axis from direct (fighting: focused, channeled) to indirect (indulging: multi-focused, all around awareness). Weight can be represented on an axis from strong (fighting: forceful, firm) or light (indulging: fine touch, buoyant). Time can be represented on an axis from sudden (fighting: urgent, instantaneous) or sustained (indulging: lingering, gradual).

Through the combinations of these limits, eight Basic Effort Actions (BEA) can be created: Float (sustained, indirect, light), Flick (sudden, indirect, light), Wring (sustained, indirect, strong), Slash (sudden, indirect, strong), Glide (sustained, direct, light), Dab (sudden, direct, light), Punch (sudden, direct, strong), and Press (sustained, direct, strong) (Hackney 2003)(Laban and Lawrence 1947). These BEAs are the vocabulary upon which our model is built and establish a framework from which we can build a quantifiable, labeled dataset of expressive movement.

Data Capture System and Feature Extraction

In order to analyze BEAs, we turned to digital movement analysis. For our corpus, we asked 8 performers (6 non-experts and 2 with LMA training) to perform each of BEAs in isolation and used the Microsoft Kinect to capture the gesture data. From the captured data, we derived a skeleton using the x, y, and z position of 21 distinct joints of the performer, of which we focused on the right wrist.

The positional data was transformed into higher-level features such as velocity and acceleration. We also extracted comparative features to measure movement curvature, such as the dot product between successive positional or successive velocity vectors. Additionally, we applied Fourier transform to each of these features. All of these features were used singularly or in combination to create different views of the dataset through the features. These computations allowed us to view performance gestures as a series of feature segments, giving us a means to explore the expressiveness of each performance gesture.

In addition to using these features in their raw form, we turned to dimensionality reduction using Principle Component Analysis (PCA) (Wold, Esbensen, and Geladi 1987) and Independent Component Analysis (ICA) (Hyvärinen and Oja 2000) in tandem to isolate the features that contained the most representative aspects of the gesture. We also used unsupervised learning, specifically autoencoding (Ng 2011), to find machine-derived feature combinations that could optimally represent our dataset.

Recognition of Gestures

We applied a variety of machine learning algorithms to our extracted features in an attempt to best classify and recognize performance gestures. We experimented with k-means clustering, hidden Markov Models, and using autoencoding features with logistic regression models and support vector machines . Within each of these models, we attempted classification at varying time windows and with varying feature sets

K-Means Clustering

The k-means clustering algorithm allows us to categorize data with similar characteristics into discrete clusters. After generating a number of cluster centroids using the algorithm, we are able to characterize the data by its nearest centroid (Arthur and Vassilvitskii 2007). For a given BEF, a normalized motion profile histogram is created by tallying the nearest centroids of all the training BEFs data points, creating an average histogram over the number of samples. These motion profiles are then compared to input data histograms and classified as whichever BEF motion profile it is closest.

Through empirical evaluation, we found the best classification generating 32 distinct clusters using the combination of the velocity and normalized dot product of changes in positional data.

	Weight	Space	Time
Indulging	0.60	0.80	0.83
Fighting	0.72	0.45	0.55

Table 1: F1 scores of BEF classification with K-means clustering with 32 clusters using 8 frame feature windows of velocity and normalized dot product data

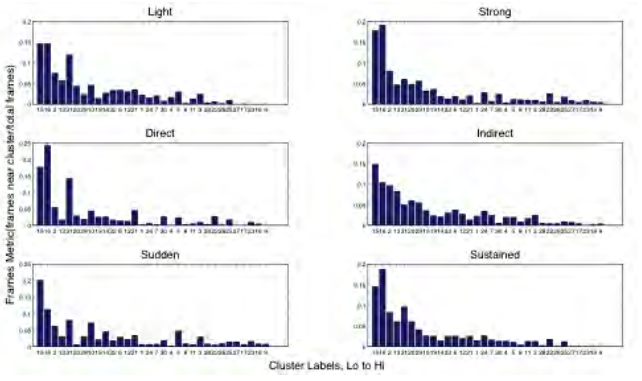

Figure 1: Motion profile histograms generated from k-means algorithm and velocity data

While using k-means clustering did not produce the highest F1 scores, it was an important step towards real-time movement analysis and provided direction for using more sophisticated algorithms.

Hidden Markov Models

Hidden Markov Models (HMM) have been widely used in modeling sequential data such as movement, and particularly, speech (Rabiner 1989). The model assumes that a hidden process with a finite number of states controls the observed data and assumes that the probability of being in a state at each time only depends on the state of the model at the previous time. Using these stipulations, the algorithm models a latent distribution of the data in each state of the model. Given a trained HMM, we can identify the likelihood of observing the input data within that model.

Like the template-matching model used with the k-means clustering, Laban Effort Component classifiers were made with two HMMs, each modeling the indulging or fighting BEF of the Laban Effort Component. We compared the likelihood of the input gesture to both HMMs and chose the model that resulted in the higher likelihood. Through empirical evaluation, we determined that using a moving average filter (Smith and others 1997) with 12 frames width on velocity resulted in the most representative feature of the data. We sliced the sequences into non-overlapping segments of 16 frames and trained HMMs with 8 hidden states. In order to predict the BEF of each frame of the test data, we sliced them into segments of 16 frames with 15 frames overlap.

	Weight	Space	Time
Indulging	0.71	0.81	0.87
Fighting	0.70	0.79	0.67

Table 2: F1 scores of BEF classification with HMM using 15 frame feature windows of velocity data

When testing HMM classification with different features, we noticed that the Fourier transform of features performed worse than non-transformed features. We decided to investigate how the Kinect was smoothing or filtering out information from our gestures.

To test this, we performed a hand movement moving periodically up and down at a rate of one beat per second (1 Hz) and gradually increased the rate to our maximum capability. We simultaneously recorded the movement with the Kinect and the accelerometer within a Nintendo Wiimote and compared the two. The Wiimote's accelerometer recorded the increased frequency throughout the recording. However, the Kinect stopped showing the increased frequency around 6 Hz and began to filter out a majority of the information (see Figure 2), potentially removing several important features of our data. The smoothing of the joint data can be altered within the Kinect Software Development Kit (Jana 2012) and will have to be further investigated if we wish to use FFT analysis to its fullest capabilities.

Autoencoder Features

In addition to utilizing algorithms for classifying, we were also able to obtain a machine-based representation of the data through unsupervised learning, specifically autoencoder

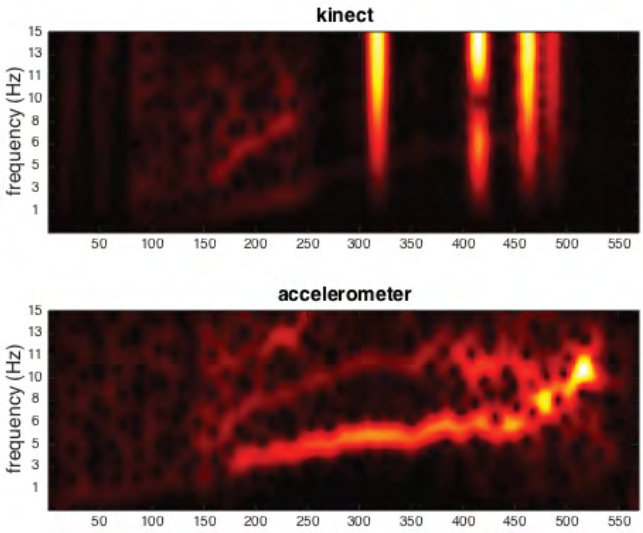

Figure 2: Comparing the Fourier spectrogram of kinect and Wiimote accelerometer as we increase the frequency of hand movement

	SVM	SVM w/AE	LR	LR w/AE
Sudden	0.78	0.81	0.49	0.57
Sustained	0.72	0.71	0.61	0.75
Strong	0.51	0.57	0.54	0.58
Light	0.68	0.69	0.46	0.55
Direct	0.52	0.56	0.52	0.60
Indirect	0.67	0.67	0.49	0.51

Table 3: F1 scores of BEF classification with support vector machine (SVM) and logistic regression (LR) classifiers using 16 frame feature windows of velocity data and activations from autoencoder (w/AE)

activations. Similar to principal component analysis, autoencoders generalize datasets to a representative collection of features, allowing us to reduce dimensionality and present a non-linear representation of our dataset (Hinton and Salakhutdinov 2006) (Ng 2011).

Using windows of 16 frames on velocity data as source data, we generalized our movement using 48 activation states. Using these activation states, we created training and testing feature sets from our LMA recordings. These feature sets were then fed to logistic regression and support vector machine classifiers. (see Table 3).

Discussion of Results

While the overall accuracy of our tests did show some level distinction between LMA gestures, the levels were not as high as we anticipated. This could be due to several reasons.

The windowed segments of the data could be less distinc-

tive than the labels imply. In preliminary tests, classification was attempted on the entirety of gestures rather than windowed segments. This resulted in much higher accuracies, but was not done in real-time, our ideal system setting. This suggests that there are distinctive elements within the gestures, but our windowing was unable to isolate those elements from the rest of the data. Steps must be taken to consider the balance between considering the whole gesture versus a real-time computing system. Using infinite impulse response filters or segmenting by specific points of interest in the gesture may provide a more ideal compromise between optimizing our data usage and working in real-time.

The features from a singular joint may not contain enough information to provide clear distinction between gestures. In our tests, we used only a fraction of the total features and only derived those from the right wrist. Testing with more features from additional joints in combination could lead to higher classification scores.

Autoencoding activations were used in replacement of velocity features for our tests. Alternatively, these activations could be concatenated with the original features, creating combinatorial feature representation of both sets, potentially improving accuracy.

Conclusions and Future Work

Our research in recognizing nuanced expression in gestures is beginning to show promising results and has directed our plans for future investigation. The combinatorial nature of feature representation still needs to be further explored in order to find the best representation of the data. A more generalized movement vocabulary that is simpler and more basic than LMA could allow for a more fundamental approach to movement, reducing intentional context. Locating and focusing on the most essential data segments rather than all segments could direct our research to the most representative gesture elements. While autoencoding has generated better feature representations of our data, that representation has only been used with select algorithms and should be used with others including HMMs or deep-belief networks. Kinect filtering will lead us into exploring the internal configuration of the latest release of Microsofts sensor in hope of manipulating the filtering that affects Fourier transforms of the data.

While there is still much work to be done, we have found promise in our current research. Through understanding the basic building blocks of performance gesture through machine learning, we can begin to more effectively understand and generalize that gesture. Through this understanding, we can start taking full advantage of our full physical capacities in human-computer interactions.

A deeper understanding of the expressiveness within performance gesture could lead to more efficient, liberated, and expressive human-computer interactions, which would foster user-driven innovation, providing more refined and robust methods of information control and exploration. This expansion of expression could redefine the very fundamentals of movement performance practice, disrupting the current paradigm and forcing a new approach to technology and movement aesthetics. Using digital feature capture, data analysis, and machine-learning algorithms, we seek definable expression and intention in performance gesture to realize this paradigm disruption.

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Aesthetics of Immersion in Interactive Immersive Installation : Phenomenological Case Study

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Abstract

This paper examines the aesthetics of immersive experience in *Light Strings,* an interactive immersive environment. One of prominent aspects of Interactive Art is the notion of immersion. The concept of immersion is generally defined as a viewer "forgetting" the real world outside of the virtual environment and by a sense of being in a make-believe world generated by computational hardware and software. As an interactive artist and researcher, I conceive of immersion as any experience where integrated bodily, conscious, and pre-conscious states thoroughly intertwine with the world. Moreover immersion is where mind, body and environment interweave and communicate with each other inside of technically-mediated, spatially enclosed, and sensuously-interactive computational environments. *Light Strings* was created based on my previous art practice and research into immersion as a way to study participants' experiences with the artwork. In the participant study of *Light Strings*, participants were encouraged to describe the felt experiences of the installation through phenomenologically oriented research methods. As a result, an experiential model of the participants' experiences was developed by exploring bodily, spatial, and contextual consciousness with temporal considerations.

Keywords

Immersive installation, aesthetics of immersion, immersive Consciousness, audio-visual, case study

Introduction

One prominent aspect of Interactive Art is a notion of immersion. Immersion has been historically explored mostly by literary and film theorists and more recently, by Virtual Reality (VR) scientists and artists. It is generally defined as a viewer "forgetting" the real world outside of the virtual environment and by a sense of being in a simulated world generated by computational hardware and software. Most research into immersive experience has been conducted from a scientific perspective. The scientific research tradition typically standardizes or objectifies results and doesn't focus on the meanings and qualities of experience. Similar to other scientific studies, immersion researchers have largely used quantitative/empirical methods, such as measuring physiological data and conducting surveys after the participants' experience. [1-3]

In a movement parallel to Computer Science research, many Interactive Artists have also explored immersion within VR environments in collaboration with computer scientists in many times. Their general approach to immersion is somewhat different from those of scientists. Artists have explored full-body, sensory immersion through their artistic creations. [4-6] Their approaches countered the disembodying tendency of virtual reality discourses and their artistic pursuit was centred on creating immersive experiences using new technology (new hardware or complex systems). Rather than quantifying the participants' immersive experience, their focus was on creating new immersive experiences.

As an artist, I create interactive immersive installations exploring the idea of embodiment and materiality. My artist skills and interests have led me to experimenting with soft materials and light to create immersive environments. From over 15 years of experience with digital technology in Interactive Art, I believe that technology can help us to experience nostalgia and relive our memories, reawaken habituated senses and provide opportunities to perceive new things in a creative way. In this study, I created an interactive immersive installation, *Light Strings* and conducted participant study to examine how participants experience immersion, how immersion is constructed in my installation and what the main qualities are of the environment. This paper analyzes aesthetics of immersive experience collected from a case study. Participants were encouraged to describe their felt experiences through phenomenologically-oriented research methods. This allowed me to gather various data on participant experience.

Background

Understanding Immersion

The sense of immersion has been explored for a long time but there is no set or universally agreed upon definition for this term because all approaches converge on the word immersion from different knowledge areas. The term is widely used for describing immersive virtual reality, installation art and video games, but no one meaning dominates. Its meaning remains vague, but common to each meaning is the connotation of being absorbed, engaged and embraced. Different disciplines use these differ-

ent definitions. This means that immersion has multiple, flexible qualities that can be applied in different situations.

Contemporary Views

Immersion in New Media

Since the 1990s, more in-depth research on immersion has been conducted in the Arts and Humanities. The result is two streams of scholars and artists. One stream explores various immersive experiences in different realms: videogames, narrative, and human experience. The other stream focuses on building immersive experience within immersive VR spaces.

Salen & Zimmerman call immersion "double consciousness," that the game player is fully aware of the character as an artificial construct. They argue that this makes character-based game play a rich and multi-layered experience. [7] For Bolter and Gromala, a participant's awareness oscillates between feeling immersed and being aware of an immersive environment. However participants most of the time are still aware of the real environment and get immersed from the interplay between real media and virtual contents. [8]

Many other researchers have focused on the desire to use technology as the defining factors in immersion; they describe the term "immersion" as immersion into presence, a state of being engaged; in this way presence is a psychologically emergent property of an immersive system. Immersion describes a condition; presence describes an associated state of consciousness. [9] Carol Manetta and Richard Blade defined immersion as an observer's emotional reaction to being part of a virtual world. [10] They consider immersion as mental process created during the use of immersive VR systems that include HMDs and other equipment. Immersion can be stimulating process, but in most cases immersion "absorbs and provokes a process, a change, and a passage from one mental state to another". [11]

Immersion in Interactive Art

Immersion is in part a spatial experience, in the sense of enveloping the participant in a discrete and panoramic space. Moreover, it is also a temporal experience when combined with computational components. It creates an intimate connection as "a constitutive element of reflection, self-discovery, and the experience of art and nature". [11] Immersion is considered paradoxically as distance, as absorption, and as space and time blur in the immersive environment. The pioneering immersive artist Davies explored the concept of immersion using the metaphor of scuba diving (submersing in water) and using a concept of cognitive absorption in her projects [4]. Around the 1960s, early new media artists conducted experiments related to immersion. Artists and designers have new possibilities for interactive immersive works become more accessible and more powerful with programming tools. In relation to VR art, the sense of immersion is being explored in art projects that encourage the active involvement of the participant and evoke senses and/or fully engage with attention. Interactive artists often try to use limited, inexpensive technology but in creative ways to examine the sense of immersion because it is hard for them to use very expensive equipment and because the sense of immersion does not require photo-realistic or technologically complex multi-sensory environments. Immersion can be created from perceptual cues. [12]

Immersion in Physical Environment

Immersive spaces create subliminal awe [13], helping the viewer/participant become aware of inherent or internal body senses. Physically immersive environments expand the boundary of our vision and create imagination evoking immersive feelings from materials that affect with perceptions of dimension. Physical installations do not include normal architectural rooms or spaces where we live in the everyday life. Even though we are physically surrounded by a room or nature and may be engaged to something in the space, it is hard to call the phenomenon immersion. When we are habituated to the space, we are rarely aware of our connections to the environment and the reciprocal relationships within the space. In my study of immersion, it is critical to recognize that immersive consciousness is constructed through embodied experience in the relationships among body, mind and the world.

Methodology

Methodological Background

Art has been acknowledged as research among practitioners, theorists, and educators. [14] In contrast to academic and scientific research emphasizing the generalizability and repeatability of knowledge, art research expresses a form of experience-based knowledge [15] and explores subjective qualities of experience. Artists identify researchable problems discovered in practice, and respond or solve them through professional practice. Therefore, artists know their works and the questions around the works better than any other researchers. An artist is a researcher who has multifaceted roles: material experimenter, space designer, fabricator, critic, documenter and audience. [16] In other words, it is ideal that artists take a lead role in the research of their works, rather than being separated from the research process. In that respect, artists' research activities seem to be appropriate for Baumgarten's classical definition of the aesthetic domain.

Phenomenological Approach

In the realm of art research, there has not been much work dealing with research methods because artists' interests often lean more towards creating new works than investigating the aesthetic qualities and meanings of participant experience. However recent movements in interactive art indicate that some interactive artists put value on the quali-

ties and meanings of participant's experience with their works as well as the process of artistic creation. Phenomenology, especially as contained in Merleau-Ponty's work, has been acknowledged as an appropriate research method by contemporary new media artists. Phenomenology is not a single method. Phenomenological methods have been adopted and developed in many disciplines and are being actively explored in Cognitive Science and Human Science including Nursing. Because of the nature of phenomenology, there are multiple interpretations and modifications of phenomenological philosophy and phenomenological research methodology. However the focus is always to get descriptions about subjective experience from the first-person perspective "in their fullest breadth and depth". [17]

Phenomenological Case Study

Concept of *Light Strings*

Bodily Experience

The idea of considering the body as a main felt medium inspired by phenomenologists, Merleau-Ponty [18], Varela [19], and Johnson [20] has been a strong motivation for me to create interactive environmental works. Treating "Body" as not separated from the being who experiences an interactive work was critical while I developed my ideas of immersion. In *Light Strings*, bodily and sensorial aspects of the immersive experience were emphasized as one of the key properties of immersion. The participant's body connects to the physical and virtual world through movement. Movement that occurs within an environment makes intimate connections and interactions with aspects of that environment. I built an immersive environment that makes an immediate connection to the body. There is no direct sensory mapping for interaction. Any kind of bodily movement affects the environment and computational system, creating unique but varied qualities. To pursue this concept, I focused on the creation of a physically immersive installation.

Physically Immersive Space

In *Light Strings*, I tried to create a physically embracing space that is flexible and open, and provides participants with free movement in the space. Participants and multimedia agents co-exist and meet in *Light Strings* through touching and using their whole bodies. Full freedom of physical body movement, creating relations to the physical installation and a virtual world is a critical condition of *Light Strings.*

Since I create physically immersive environments that engage bodily experience, materials are very important for me as an artistic media. Physical materials are simple, direct, and apparent in and of themselves. Once they are combined with digital technology, materials are no longer simple. They become complex, integrated and interconnected and these new relationships create their own beauty. When they move, responding to the participant's motion in varying scales from wearables to environments, they can provoke a strong visceral feeling. The branching and joining of physical material and technology in my work echoes the symbiotic relationship between human and technology, exploring the idea of "hylozoism" [21] or life from material. In the process of art creation, fiber optics are not simply cold plastic strands to me. They live in the space the same as other computer generated interactive elements and participants as well as myself. This encourages active, self determined relationships within a work of art.

Implementation of *Light Strings*

The physical space of *Light Strings* (Figure 2) consists of over 2500 strands of fiber optics hung from the ceiling. I used custom produced, straightened fiber optics. Each end of the fiber optic strand was directly mapped to a point in the projection grid.

Figure 1. Audience Interaction with *Light Strings*

The interactive system design began with observations of participant experience. First of all, I tried the environment by myself with my collaborators. This exploration provided an ability to understand the range of movement possible in the space. Then, I invited a participant and observed their movement in the space without any interactive elements. I was able to classify their movements into four categories: ambient, exploration, play, and meditation.

- Ambient mode: no audience in the space.
- Exploration mode: slow walking
- Play mode: very active, fast movement
- Meditation mode: very slow or static movement

Based on this categorization, my sound collaborator and I started design behaviours for virtual agents (visual and sound) responding to participant behaviour by referencing the modes of movements. In addition, the agents' own behaviours were also designed. Similar to other living beings' behaviours, they come together, fight, and ignore each other sometimes.

Interactive System Design

The setup of *Light Strings* is a combination of three groups of equipment: a motion tracking system, a visual system, a

sound system as well as a fiber optic structure. The motion tracking system consists of a computer (Macintosh), two video converters and two infrared (IR) cameras hung on the ceiling grid. The computer continuously tracks participant's movement in the space, and analyzes the movement and sends the movement data to the visual and sound systems. The visual system consists of a computer (PC) and a projector that projects visual data on the grid of fiber optics bundles. The sound system has a computer, the audio interface and four speakers. M-Audio, an audio interface, spatializes the sound processed through the four speakers.

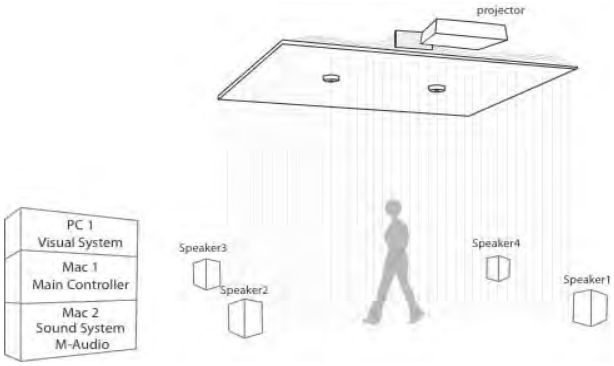

Figure 2. Technical Setup for *Light Strings*

Motion Tracking System
Two IR cameras detect the participants' motion in the installation. The light emitted by the fiber optics has a low level of infrared spectrum. This allows the use of IR cameras for tracking the movements of visitors in the space. Video images from two IR cameras were stitched together and the custom created application provided variables to produce interactive virtual agents. The visual and sound system received these values over the network and generated the interactive multimedia.

Visual System
The visual system consisted of a PC and a projector. The graphical aspect of visual agents was implemented using Processing. In the graphic environment, 8 to 10 visual agents are created and they move around depending on their characteristics and behaviours assigned to them initially. There are two kinds of visual agents: active and inactive. Two different colors (pink and blue) represent their characteristics. The pink ones behave actively and the blue ones are inactive. Their initial characteristics (color, size, movement, speed) may be changed in response to the participant's behaviour. All visual agents have circular shapes. Their sizes are randomly assigned between 80 to 100 pixels in diameter. The initial active agents (pink) are floating around in the space. They move faster than inactive agents (blue). They are curious and friendly beings and they explore the environment very dynamically. When they hit each other, they bounce off each other. The inactive agents are slow and less friendly beings. They tend to gather in one area. They are not interested in other beings in the same space. They don't care about the pink ones or the participant.

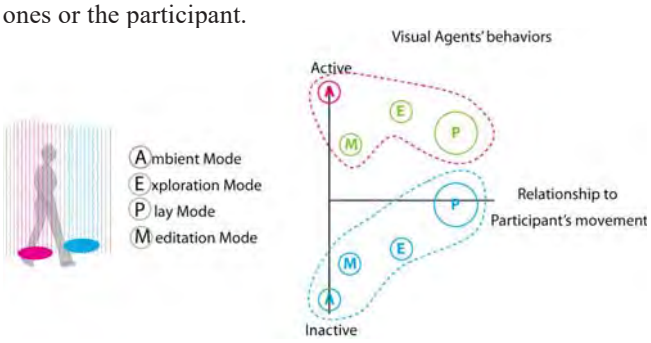

Figure 3. Diagram of the visual agents' behaviors

The images of the agents rendered by the system are projected on to the ends of a bundle of fiber optics. The fiber optic strands that fill up the installation space create a tactile light space allowing the light animation to move in the fiber optics hanging around the space. The behavioral movements of the agents create the illusion that they are alive.

Sound System
The sound system works along with the visual system to create an immersive environment. Our goal was to create natural but elemental sounds that respond to the participant's movement. They work as environmental sound agents similar to air in that they move around regardless of human existence and people can feel them through the movement of their bodies. The environment contains initial sound elements from white noise in Max, a visual programming language for music and multimedia. They are activated when the participant's movement is detected in the space and come and go while interacting with the participant.

Study Design

In the study, I focused on getting participants' experience from their first-person perspectives. To support the subjective first-person data, other data collection methods such as interviewing (second-person) and video recording (third-person) were also used. I used *Light Strings* as a case study to look at participants' qualities of aesthetics of immersive experience. The overall process can be summarized as 1) gathering a full set of naïve descriptions from participants who had experienced *Light Strings*; 2) analyzing the descriptions in order to grasp common elements that make the experience what it is; and 3) describing or giving a clear, accurate and articulate account of the phenomenon so that it can be understood by others.

Participants and Study Condition
16 participants were recruited through an open email call that was available to the general public. They were given ample opportunity to accept or decline. They were asked to

pay attention to their sensory experience and felt experience. The participants had a chance to experience *Light Strings* three times with different conditions (*Both*, *Visual*, and *Sound*). The physical environment was the same for all three conditions. In the *Both* session *Light Strings* had visual elements and sound elements. In the Visual session, the sound elements were taken away and the participants only experienced responsive light patterns in the environment. In the Sound session, there were no visual images, only a soundscape filled with fiber optic strings. Early test runs showed that the participants' experiences were affected by the order they experienced the three sessions. Therefore I used four different orders of the three sessions to structure the study (Table 1).

Table 1. Four different orders of participants studies

	Session 1	**Session 2**	**Session 3**	**Duration**
4people	*Both*	*Visual*	*Sound*	1:30-2h
4people	*Both*	*Sound*	*Visual*	1:30-2h
4people	*Visual*	*Sound*	*Both*	1:30-2h
4people	*Sound*	*Visual*	*Both*	1:30-2h

Procedure

Participants in the study were asked to experience *Light Strings*, three times for as long as they want to stay. They were free to do anything and there were no time limitations on how long they stayed in the installation. Participants experienced *Light Strings* aesthetically via the artworks' kinaesthetic tactile quality as well as visual and auditory qualities. While the participants were experiencing *Light Strings,* their movement inside of the installation was video captured. *Light Strings* was already capturing the participant's movement from above using two IR cameras to analyze movement in the space in order to create responsive virtual agents that the participants can interact with. Therefore, I was able to record the camera capture screen using another video camera. This video data was digitized and processed to investigate how the participants moved and behaved in the installation. I did not extract the video images from the motion analysis process because recording a video at the same time as analyzing it uses too much of computer's processing ability and made the entire system unstable.

After each session of experience, the light level of the room was adjusted for the next activity and the participant was guided to a writing station. Participants were provided a single card with three open-ended questions: "What did you experience?", " How did you experience?" and "How did you feel?" They were asked to write down their experiences quickly and fearlessly when answering the questions. The quick writing process without analytical thinking helps to extract their subjective experience effectively. The participants were instructed: "think back and describe your subjective experience of the artwork as much detail as possible." They were assured of the confidentiality of the information. They could write, note or draw their experiences in a hand written "journaling" form. This would give the participants the opportunity to take their time and to reflect on their experiences and to reconstruct the event in more detail on their own, without interference.

As soon as the writing session ended, participants were involved in an interview procedure. The participants were told that the interviews would be treated confidentially. The research instruments for the interview was an open-ended method. This protocol focuses on the researcher facilitating the participant in articulating a description of their experience, creating a phenomenological description. Each interview was digitally video-recorded. Video files were marked only with the session number and the participant number. Transcriptions of the interview were used for the analysis of the data. The participants experienced three sessions of the installation experience and wrote three times and interviewed three times.

Data Collection and Analysis

16 participants provided written descriptions of their experience by responding to three questions: "What did you experience?", "How did you experience?", "How did you feel?" (first-person data). Second-person data (of the participants experience) was collected using an interview technique adopted from Petitmengin [22] and Varela [23]. All the participants' bodily movements in the environment were video recorded and digitized (third-person data).

After the collected data were transcribed and coded, I focused on "themes" arising from the data. In the end, all the different themes were grouped for each participant and used to construct a model of qualities of the participant's immersive experience. This allowed the individual models and general model to be developed concurrently while being compared for validity. Based on the analysis, I constructed a combined model of immersive experience which can be used to develop a further understanding of the aesthetics of immersive experience.

Aesthetics of Immersive Experience

The focus of the research was to investigate the qualities of participants' immersive experience in physically immersive and interactive environments and explore to find meanings created by the experience. During the case study, it became apparent that the participants' experiences in *Light Strings* were immersive. Unlike other researchers' understanding of immersion, I focus on bodily experience engaged with culture, society, environment, and history. My analysis concentrates on building an experiential structure based on immersive consciousness considering temporal aspects.

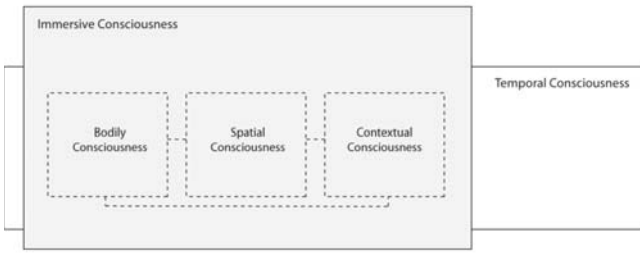

Figure 4. Experience structure of Immersive Experience

Immersive Consciousness

The notion of Immersive Consciousness that is built through my analysis is framed by Bodily Consciousness, Spatial Consciousness and Contextual Consciousness (Figure 4). I describe each of these elements in detail below. I have found that by using this model I am able to recognize similarities in sensorial and felt experience and processes across participants. In this paper, I define consciousness as embodied akin to the way it is defined by contemporary cognitive scientists [24-26]. Our consciousness can be affected by the existence of body or somatic or enactive processes. Therefore, Immersive Consciousness illustrates embodied consciousness as experienced through the body and explains how participants perceive an immersive space and make meanings out of it.

Bodily Consciousness

Body Consciousness focuses on the sensory experience of the participants in *Light Strings*. We learn and understand the world through our bodies. This is not just about a body rather a body in the space and in relationship to the installation. It is always connected to the world we live. Therefore investigating participants' sensory experiences allows me to examine the origin of immersive experience and frame immersive consciousness in terms of embodiment. Since *Light Strings* is a physically immersive installation, the participants experienced and described various sensory experiences including exteroceptive senses (sight, hearing, and touch) and interoceptive senses (proprioception, kinesthetics, and vestibular sense). The bodily consciousness includes mostly sensory experience focusing on what is seen, heard, touched, felt and some emotional valence from the sensory experience. Due to the aesthetic characteristics of *Light Strings*, multiple senses were stimulated and helped to create sense of immersion. Sensual richness helped create a deeper sense of immersion. It is also important to acknowledge that bodily consciousness is closely connected to spatial and contextual consciousness

New Sensations: Awe and Disrupted sensory habituation

Many participants described the experience in *Light Strings* as extremely new and said they never had a similar experience before. This was connected a feeling of being overwhelmed in the sense that their experience was sensorially very stimulating (awe).

> *"It was really hard to think of other things during that. I was sensorially overwhelmed by how cool that was."*

In *Light Strings*, the habituated perception of not being aware of any tactile feeling when we walk normally became disrupted. *Light Strings* is filled with fiber optic strings at a distance of three inches from each other. Therefore, any movement in the environment causes the fiber optic strands to touch the body. Descriptions from participants revealed feelings about new sensations that they did not experience in a daily life.

> *"It was like experiencing air"*

From this reawakened sensory experience, many sensory descriptions were collected. The descriptions focused on heightened individual senses. Sometimes senses were associated together and the participants experienced what might be described as a form of synesthesia, that is a recombination of their senses.

Associated Senses

Many of the participants said that they noticed two sensations at the same time. Senses worked together. In particular, the *Both* session showed a combination of sensory elements that really came together effectively. The associated sensations helped the participants to get engaged and immersed in the environment and created emotional and imaginative experiences. When the participants noticed two or more sensations at the same time, they often constructed associations and found meanings.

The tactile modality functioned primarily to integrate with the other senses. When other senses (visual or sonic) are prominent, the tactile sense intensifies those senses. In addition, the physicality and materiality of the fiber optics extended and enhanced the perceived quality of dynamicism.

> *"As I was moving through the fiber optics I just felt again that tactility but also the visual beauty of the lights combining together and moving away. And so that really had my focus for a really long time."*

Spatial Consciousness

Many participants described *Light Strings* as a space not an object. This is important that they perceived it not just by seeing with their eyes but via embodied seeing through the whole body. *Light Strings* provided an opportunity to expand their conscious experience through the space. Participants' spatial consciousness can be characterized by an emphasis on the sensation of a different world, metaphoric space, embodied space, and vast or proximal scales.

Different Space/World

In the installation, many participants experienced a different space/world, very different from outside. Moreover the participants' experiences in each session

were very different depending on the computer generated visuals and sound. At a basic level, the space was physically always the same, only the media changed. In general, where it was visual-centric, the space was perceived as warm, enclosed, meditative space. Many participants described these different worlds using metaphors from their memory, movies, and books.

> *"I feel like I'm in a different space; some kind of entering into another dimension or something – a space that you can explore, but at the same time, you feel like you're floating. You feel the curve and things like that."*

Metaphoric Spaces

After experiencing *Light Strings*, many participants reported that it is difficult to describe their experience in words. In the process of perceiving the space, the participants attempted to relate their bodily feeling to their previous knowledge or experience using metaphors (all 16 participants). Qualities of physical sensation evoked metaphors. The prevalence of metaphors means that as the participants were paying attention to their physical sensations, their imagination generated metaphors for the experience. The richness of poetic description really came from the interplay of their experience with the media of the system. This shows the success of the piece in terms of immersion.

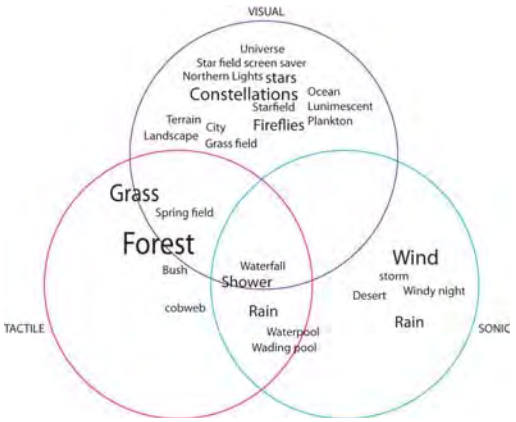

Figure 5. Metaphoric Spaces

Error! Reference source not found. is a visualization of word frequency in the descriptions of the participants' experience drawn from the written responses and interview data. All the metaphoric words for the space were collected and categorized by sensory modality. Some metaphors directly represent visual, sonic and tactile space such as fireflies and northern lights for visual space, wind and storm for sonic space, and bushes for tactile space. However, there were metaphors representing associated sensory spaces such as grass field for visual and tactile association. Different aspects of the sensory experience helped to build imaginative metaphoric spaces.

Embodied Space

Space is often defined by constituent and their behaviours: how inhabitants make a connection to environmental behaviors and how they frame it constitutes their space. If we look at *Light Strings* in terms of experiential qualities, it can be interpreted as a playful and meditative space. The most obvious qualities that the participants felt from the space were playfulness and meditativeness. These were characterized by the participants as extremely embodied. In the descriptions of the participants' experience, two different spaces (playful and meditative spaces) were being appeared depending on interaction with the environment.

> *"It felt very playful, kind of organic experience. It was very flexible and fluid and promoted my curiosity and sort of seemed to engage back because it was responsive and I really liked that. I just felt very open to it and sort of calm and curious at the same time."*

> *"Very small like um..at one point I just started collecting one string with another string and looking at it and then another string..it's like watching insects. As opposed to running around in a forest trying to climb trees. That's kind of the experience, it's more quiet, more gentle, more detail.*

Different Spatial Scale

The most interesting phenomenon of the immersive experience observed was that the participants perceived the space at widely different scales. *Light Strings* was perceived as two environments (vast and proximal) at the same time. The idea of multiple worlds means that the participants were able to connect to the physical sensation of vastness at the same time as noticing intimate poetic extrapolations. The specific amount of space in the installation was really contained. The participants were contained within the space but their subjective responses expanded beyond it. However, the space was often sensed and perceived as differently sized in a positive sense, evoking a feeling of wonder.

Discussion and Conclusion

Light Strings is a minimalistic but physically surrounded environment: it operates as part of a phenomenological case study. In the project, the physically immersive environment was created using fiber optic strings, with interactive components projected through the fiber optics and a surround-sound system. Due to the artistic use of fiber optics, kinesthetic tactility was found to be the main sense used in experiencing *Light Strings*, in association with other senses. The study reveals the primary qualities of *Light Strings*: connection, engagement, and attention. *Light Strings* became a medium for creating the participants' narratives by provoking metaphors. The participants brought various narratives and images related to nature and natural experience from the memories, books, and movies. Immersive environments like *Light Strings*

provoke the participants into being creators instead of passive receptors.

The whole experience in *Light Strings* can be interpreted as a meaning making experience with an immersive property that is co-constructed by the environment and participant. In the model I elucidate in this paper, immersion consists of bodily, spatial, and contextual consciousness. This model suggests how to explore immersion as a meaningful experience. My research journey through this model shows that immersion is not only present in virtual reality environments but also in physical but interactive realities that strengthen body, space, and contextual consciousness. This is very critical. I believe that awareness of our immersive experience will provide a highly promising path for transforming all fields of human experience, including the artistic, medical, pedagogical, and entertainment fields.

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The Ilinx Garment: Whole-body tactile experience in a multisensorial art installation

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Abstract

Utilizing the tactile sensory channel as a key sensory modality in a full body, cross media artistic installation presents unique challenges. In this paper we describe our experiences with the design and utilization of garments containing embedded sensors and vibrotactile actuators. We follow the garments from their conception through their use in a artistic installation experienced by over 300 visitors. In particular, we focus on the relationship between touch, hearing, and sight – both in the technological implementation as well as the artistic conception.

Keywords

Multimodal display, haptics, wearable electronics, responsive environment, first person data, sensory participation

Introduction

This paper presents the dual outcomes of a research-creation project whose focus was developing a system for generating tactile signals in an artistic experience. The first outcome we will describe is the design and construction of garments containing embedded sensors and vibrotactile actuators as well as a wireless connection to a central server which transmits performance instructions. The second outcome we will describe is the artistic work which utilized these garments, a performative environment incorporating visual, aural, and tactile elements.

Participants

The team involved in this project consisted of artists, clothing designers, electronics designers, and haptic researchers. As in any collaborative interdisciplinary project the outcome depended upon a careful balancing of the multiple interests and priorities of the participants as well as the practical constraints of the project structure. Throughout this paper we will touch upon the disciplines of the different collaborators and the ways in which their contribution affected the creation of the garments. While much of our discussion will be focused on the characteristics of the tactile actuators which are embedded in the garments, we will also touch upon general issues raised by the inclusion of a garment of this kind worn by the general public (rather than a trained model or performer) within the context of an artistic installation.

Figure 1: Promotional Image for Ilinx. ©Chris Salter

Ilinx

'Ilinx' is a performative environment for the general public provoking an intense bodily experience that blurs the senses of sight, sound and touch. A promotional image for the work appears in figure 1. In the environment, a group of four visitors at a time wear specially designed garments. These wearables are outfitted with various sensing and actuating devices that enable visitors to interface with the performance space. During the event, a ritualistic progression which lasts approximately twenty minutes, the natural continuum between sound and vibration, vision and feeling becomes increasingly blurred, extending and stretching the body boundaries beyond the realm of everyday experience.

The project is partially inspired by work in the area of what is called sensory substitution – the replacement of one sensory input (vision, hearing, touch, taste or smell) by another, while preserving some of the key functions of the original sense. The term "ilinx" (Greek for whirlpool), however, comes from the French sociologist Roger Caillois and describes play that creates a temporary but profound disruption of perception as is common in experiences of vertigo, dizziness, or disorienting changes of speed, direction or the body's sense in space – "an attempt to momentarily destroy the stability of perception and inflict a kind of voluptuous panic upon an otherwise lucid mind." [2]

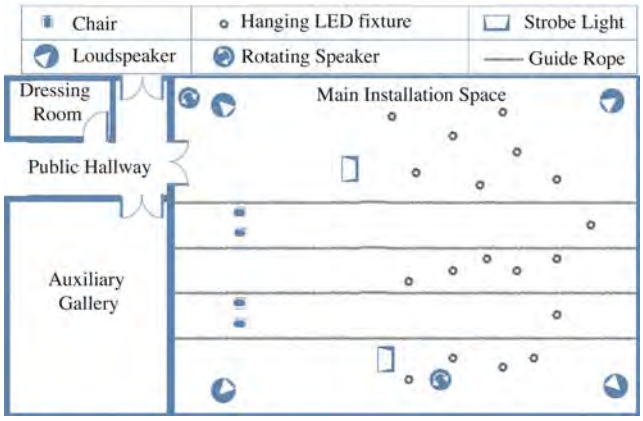

Figure 2: Diagram of the Ilinx installation space.

Figure 3: Participants in the Ilinx installation. ©Chris Salter

The garments worn by the visitors consist of a jacket, a pair of leggings, and a helmet with a semi-opaque full-face mask. The helmet serves to limit the visitors' vision to the perception of areas of light. Once garbed, participants are led into the main installation space and seated in chairs, as shown in figure 3.

The work is structured into two sections. The first section begins with a simple vibration pulse and corresponding sound. The sound is generated by a combination of a quadraphonic full-range speaker system as well as a pair of directional speakers each mounted on a rotating gimble. Throughout the first section new sonic material is introduced. A loud bell and the appearance of faint lights in the distance signal the beginning of the second section. In this section, visitors are able to stand and take hold of guide-ropes which allow them to safely explore the space. As they walk into the space they pass through a field of suspended LEDs as seen in figure 2. Towards the end of the second section bright flashes from a pair of strobe lights contrast with the faint illumination of the suspended LEDs, and build towards a gradual climax. After a final combination of a loud sound, flash of light, and set of vibrations the piece comes to an end. At that point the visitors wait where they are for a guide to come and lead them out of the space.

Background

Although there are numerous examples of multi-sensorial artworks which incorporate tactile stimuli (normally in the realm of "tactile audio"), the implementation and conceptualization of a system for generating these stimuli remains a challenge. [15, 6, 17] Conceptually the tactile sensory channel is very different from the aural and visual channels. Not only are tactile sensory receptors located throughout the human body but there are also multiple types of tactile receptors optimized for different kinds of stimuli.

The Haptic Channel

Haptics is an umbrella term which encompasses both tactile and kinesthetic perception. The former is issued from a complex network of mechanoreceptors which are located with varying densities all over our skin. In the most sensitive areas, such as the hands, we can count up to 10000 mechanoreceptors per limb, while in other areas (mainly hairy parts of our body) the density of tactile receptors is much lower. [23]

Four types of mechanoreceptors have been identified, each of which contributes to sensing specific features of a vibrating stimulus applied to the skin. Much research has been devoted in the last decades to identify what these features are, specifically in terms of frequency and amplitude range of perception. For glabrous skin, it is commonly stated that the skin is sensitive to stimuli from 40 to 1000 Hz (with a peak at around 200 Hz), and that amplitude perception can be as low as 1micrometer displacement. [4] These values have been mostly gathered from perceptual studies involving simple, sinusoid-like vibrating stimuli; more recent research though seem to indicate that for more complex signals (i.e. signals with richer spectral content) the upper limit might be higher than 1000 Hz. [3]

Tactile Perception in Art Installations

There are certain types of tactile stimuli which can be conceptualized as similar to visual and aural stimuli. Perhaps the most common experience of this are the vibrations created by high-amplitude low-frequency soundwaves. These sensations tend to be experienced as emanating from the environment, and not as being localized on a specific body part.

Previous projects developed by Salter, including *Just Noticeable Difference* and *Displace 2.0*, present a different approach to this kind of single-signal whole-body stimuli. [18, 19] In these project audio transducers designed for low-frequency signals are attached to platforms. When participants lie or sit on these platforms the vibrations are transferred to their body.

Conceptually, we can create an analog between the difficulty we have determining the directionality of low-frequency audio signals with the difficulty in determining the location of high-amplitude low-frequency vibrations. However, there are key differences. For example, in the platforms described above, the participant's ability to consciously change their seated position causes different parts of their body to come in

contact with the platform. The change of sensation generated by this kind of movement enable them to locate the vibration as coming from the platform rather than from the environment. This creates a different kind of immersion from that of an immersive sound- or colour-field. One consequence of this is a limitation to the creative possibilities presented to the artistic creators, in that any sequenced tactile stimuli will be filtered through the unpredictable coupling of the participant to the vibrating platform.

Another way in which tactile sensations can be viewed as analogous to visual and aural sensations is through the concept of sensory translation or sensory substitution. A classic example in this sense is the early work of neuroscientist Paul Bach-y-Rita, who theorized that it could be possible with sufficient training to re-map the visual cortex in the brain of a blind individual to another sensory organ such as the skin. [1] This led to the development in the late 1960s of a prototype of a tactile augmented chair: an array of solenoids attached to the back of the chair would be connected to a videocamera, and display on the back of the subject seated on the chair a *tactile translation* of the image. Scientists involved in the project reported that after some training participants would be capable of recognizing basic shapes through the display.

Of course many artworks incorporate tactile elements which are chosen for their own unique qualities. In Louis-Philippe Demer's "The Blind Robot," for example, a visitor sits in front of a (pseudo-)robotic arm. [5] The arm then reaches out and explores the face of the visitor. While exploring the sense of presence and engaging in a non-verbal dialogue, the main tactile elements of the piece remain the surfaces of the robotic arm as it touches the visitor's skin. Artworks such as this have the benefit of creating systems which can provide specific and highly-detailed tactile stimuli. However, they are limited to only creating the specific stimuli for which they are designed. Conceptually one can imagine them as similar to creating a bell carillon, or any robotic musical instrument whose material properties are fixed.

A different approach to creating a system for tactile stimuli is to have the system itself correspond to the primary characteristic of systems for visual and aural stimuli production. We have the expectation that a stereo speaker system, for example, will be able to create sounds that utilize the full-range of our hearing. This means not only reproducing the perceptible frequency spectrum but also reproducing appropriate amplitude levels as well as spatial location.

A tactile-stimuli system, therefore, should be also able to engage the full range of our tactile senses. In theory this would mean being able to recreate any form of tactile sensation which we might encounter in the real-world. This would require an equal engagement with all of the locations of tactile receptors on our body, with appropriate frequency and amplitude capabilities for each location on the body. In addition, the tactile stimuli created should be able to engage with the different kinds of mechanoreceptors described above.

It should be clear that the creation of such a full-range tactile stimuli generator presents a formidable challenge. The system we designed in no way comes close to fulfilling all of the requirements for such a system. Nonetheless, the design approach we describes one way to attempt to reconcile the requirements of such a full-range tactile stimuli reproduction system with the practical implementation necessary for artistic use.

Immersive Sensory Installations

Ilinx's focus on the combination of vision, sound and touch seeks to go beyond the A/V emphasis of most "immersive" media environments where "surround" is usually defined as an image encircling the visitors. [8] In this sense, with Ilinx's emphasis on exploring perceptual disorientation through cross-modal effects among different sensory modalities beyond vision, the installation participates in a larger critique of visuality that has been introduced by researchers in both new media and in the area of sensory anthropology. [10, 11] Simultaneously, Ilinx builds on and extends several previous projects from Salter and Martinucci that focus on cross-modal sensation, including the above mentioned *JND* (Just Noticeable Difference), and the multi-sensory environment *Displace*. The installation JND, for example, explored how the distinctive modalities of the acoustic and the haptic could be combined within a singular technological and perceptual framework, in particular leading to design choices that emphasized both the separation and combination of both modalities. For example, in designing sound structures that were interesting from both a sonic as well as tactile perspective, the creative team set out to work with material that was not easily representational (i.e., presenting a likeness or reference) and, at the same time, created a strong visual as well as aural sense of space. Tantamount to this was using sound to give the impression of different spaces that would shift from one moment to the next; something particularly important given that any common visual experience of space would essentially be thwarted due to the extreme darkness encountered in the installation environment. This "sense of space" carried over into the creation of specific tactile sensations, particularly the manner in which visitors could feel different tactile patterns on the body and how such spatial patterns could be modulated from clearly perceivable to essentially noise. The focus on immersion not as surround but as something which has tangible embodied presence, that operates on different bodies to produce potential affects is one of Ilinx's major points of departure from both "tangible audio" - based sound as well as immersive media installations emphasizing vision and audition over other sensory modalities.

Tactile Augmented Garments

In terms of the garments developed for Ilinx, several tactile-augmented garments have been produced in the past decades both for research and industrial purposes. We can identify two main categories of devices: performance/entertainment displays and navigational displays.

The first category covers tactile-augmented body suits conceived to be used in performances and art installations, or for enhancing user experience while consuming media such as cinema or tv. Gunther et al. developed a tactile suit intended to be used to compose music for the sense of touch. [9] This *tactile music* would be composed to accompany a regular musical piece and would take advantage of the suit designed for

the project. Eleven actuators of different size and power embedded in the suit would be attached to the body of the audience by means of velcro bands. Participants would experience vibration directly correlated to the musical piece composed for the installation. In another implementation, Lemmens et al. design a tactile augmented jacket featuring 64 vibrating actuators to be used for entertainment. [14] The actuators are arranged in 16 independent modules of 4 actuators each and are controlled by a custom software allowing an intuitive design of tactile effects.

In the second category, much industrial research in the field has been driven by potential military applications. Van Erp et al., for example, developed a tactile augmented belt designed to indicate waypoints to impaired users. [21] In this system, a vibrating signal would indicate the direction in which the user has to move.

Piateski and Jones developed a tactile display to be installed on the torso of the user and composed of a 3 by 3 matrix of vibrating actuators. [16] Several patterns of activation of the nine actuators have been tested to convey movement instructions to users. This type of device could be extremely beneficial to visually impaired users, and could take advantage of the haptic channel to receive information about the surrounding environment.

Development of the Ilinx garment

The primary objective at the beginning of the Ilinx project was to more fully engage the haptic channel in an immersive, multi-sensory artistic installation. From the earliest stages our goal was thus to create a garment which would allow for tactile stimuli over the whole of the participants' bodies. In order to create the most immersive and versatile system given the constraints of this project we leveraged contemporary research in haptic perception as well as a modular approach to electronics design.

Leveraging Contemporary Research in Haptic Perception

As previously stated, tactile receptors in the skin are not evenly distributed across the body. This, together with other perceptual effects, limits the number of both spatially and temporally close tactile stimuli that can be perceived as being individual events. For instance, after a prolongated exposure to a tactile stimulus at the same amplitude and frequency, mechanoreceptors eventually stop responding to the stimulation, producing an *adaptation* effect which makes subsequent stimuli go unnoticed. *Masking* effects can also happen when the second stimulus presented too temporally close to the preceding one is not perceived correctly.

The literature on tactile perception states that the average interval between two stimuli is 18ms in order for them to be perceived as separate events, and that the spatial resolution largely depends on the body part being stimulated. [3] Hands and feet remain the most sensitive parts, while torso and forearm for example are much less sensitive. [21]

Other important perceptual effects are so-called *tactile illusions*: for instance, by calibrating the delay between subsequent stimuli one can simulate a motion on the skin of the interested body part. This effect is generally known as *the cutaneous rabbit illusion*. [7]

All these considerations played an important role in our design of the tactile garment and control signals. The number of actuators was limited to 6 per limb, so not to overload the haptic sensory channel with too closely spaced stimuli. The distribution of the actuators was conceived to foster the emergence of tactile illusions such as the cutaneous rabbit: the actuators were disposed on straight lines on the limbs and across the torso to produce illusions of vertical and circular motion on the body of the participants. In our pilot user studies we demonstrated that by varying the temporal delay between actuations and the overlap between each motor actuation, we could progressively move from stimuli perceived as separate events to more continuous ones. This worked particularly well in the vertical direction, while the illusion of a circular motion across the torso could not be consistently produced.

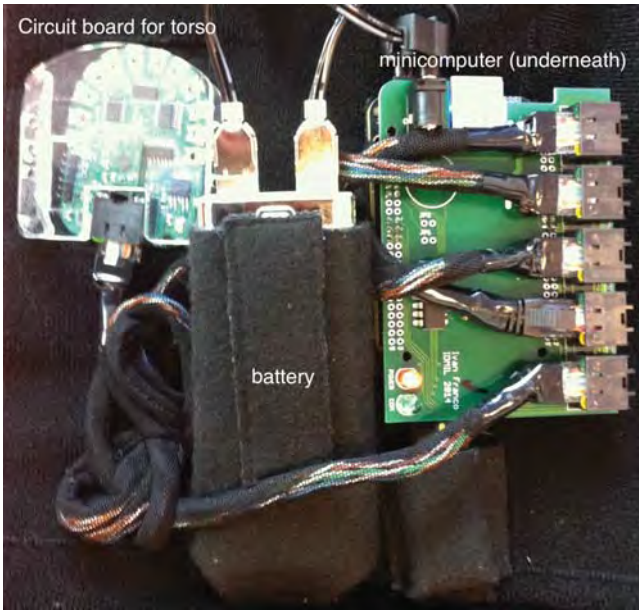

Figure 4: Electronics in the garment. ©Ian Hattwick

Visual Aesthetic

Visual aesthetics also played a strong role in the experience of the wearer and hence, the design of the Ilinx garments. An important consideration from the start was that the garments work as aesthetically pleasing and desirable objects, which could be read, understood, and accepted as a garment as opposed to a technological apparatus. Another consideration was that the garment be unisex so that it could appeal to and be worn by both men and women. The design was inspired by minimalist japanese fashion, such as the clothes of Comme des Garons and Yohji Yamamoto, and executed in muted tones of black grey and dark blue to adhere to the overall installation colour palette. The final design was a deconstructed suit jacket and two separate leg coverings that recall chaps.

Practical considerations

The use of the garment within a public artwork to be presented less than one year after the origination of the project, lead to a formidable set of practical considerations that needed to be taken into account by both designers and engineers within the project. Foremost among these considerations was the durability and stability of the system, concerns with battery life and maintenance, and manufacturing time. A detailed discussion of these issues is contained in forthcoming publications, which address issues including battery management, manufacturing scaling, and useability design.

Wearable Considerations

As demonstrated by previous works employing garments worn by audience members, numerous practical considerations come into play when designing for the body, performance, and multiple-users. [13] As the garments were to be worn by both women and men, sizing had to be adjustable to both sexes and accommodate a wide variability in form and size, including variations in the size of torso and the length and circumference of the arms and legs. As it was important that the garment rest comfortably on the body to maximize the contact points with the vibrotactile actuators, the final design was inspired by athletic and injury braces utilizing velcro or elastics to wrap around the body tightly. The garment parts were reduced to the smallest textile surface needed to house and contain the electronic circuits, which was combined with adjustable velcro straps. A second and equally important consideration was the efficiency and ease of putting on the garment over existing clothes, thus permitting the participants to remain in their clothing, as well as to minimize the need to launder the costumes after each performance or use. Furthermore, it was important that the guides would be able to, with a minimum of assistance from Ilinx staff, quickly put on and remove the garments without damage to the wearables.

Final Implementation

Here we provide a brief description of the construction of the Ilinx garments.

Technical Description

Each garment is embedded with a total of 30 motors divided into 5 groups, located on the four limbs and the torso. Each motor group has its own custom circuit board to generate the signals used to drive the motors. This board also includes a 9 DoF inertial measurement unit which can be used to derive orientation. The five driver boards are then connected via cat6 cable to a central processing-unit, implemented using the BeagleBone Black single-board computer. The BeagleBone Black, battery pack, and driver board for the torso are all contained in a pocket of the front of the garments jacket as seen in figure 4.

As depicted in figure 5, each garment communicates via Wi-Fi to a central computer. This central computer receives sensor data and sends control information for driving the motors.

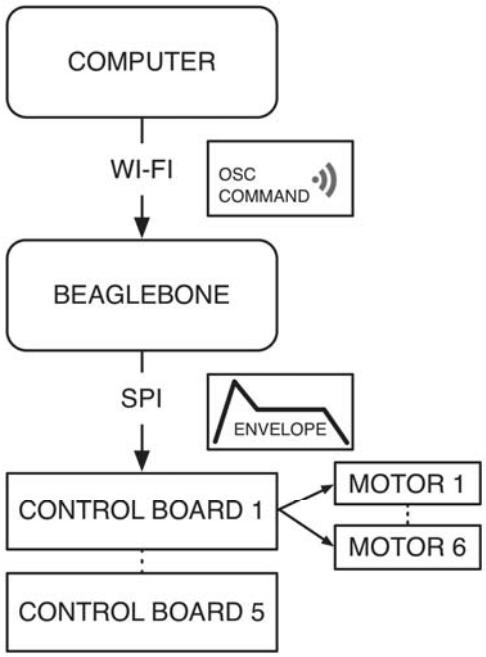

Figure 5: Signal flow showing the central computer communicating with a single garment.

Control Signals

Each motor is driven by a varying PWM signal whose parameters are determined by an amplitude envelope. The job of each motor driver board is simply to translate incoming amplitude envelopes into the appropriate control signals for the motors.

While it is possible for the sequencer on the central computer to generate individual amplitude envelopes it is more efficient as well as conceptually appropriate to produce tactile signals in groupings. These groupings might be intended to create a single perceptual effect, for example controlling sequentially controlling motors laid out along the length of a limb to create a sensation of a vibration moving linearly. When composing an effect in this way it is useful to think in terms of beginning point, end point, overall amplitude, and duration. A sub-algorithm can then be used to generate the individual motors amplitude envelope in real-time.

Wearable construction

In developing the circuitry for Ilinx a number of parameters shaped the final design outcome. The overall weight and flexibility of the garment dictated that we create soft e-textile circuits that could be sewn directly onto the garments, as opposed to relying on rigid and bulky wires. A very low resistance thread was chosen and sewn with a conventional machine to create the circuits. In general, the principal weak spot in e-textiles is often the junction between hard to soft circuit components. These connections can easily come undone and cause electrical or communication drops and breaks. With this weakness in mind a 3D printed casing was designed to

contain the actuators so that they could create a robust hub between the hard motors and soft conductive thread. The wires from the actuators were soldered to metal ring terminals which fit on top of circular cutouts in the housing. Conductive thread was then embroidered around the ring terminal which made the electrical connection as well as secured the housing to the garment. This proved to be a very efficient solution as we were able to sew the motors and e-textile circuits together onto the inside surface of the garments, providing a close touch contact between the motors and wearer without the bulk of wires or any issues of lost connection. Finally, after a series of tests, it was determined that a light lining fabric was needed to protect the e-textiles circuits and actuators from getting caught on and pulled by the wearers' garments or accessories while they were dressing.

Initial Presentation of Ilinx

The initial presentation of Ilinx was from September 25-28 at the TodaysArt 2014 festival in The Hague. Over four days more than 300 visitors experienced the installation while wearing the garments. To help meet the challenge of helping that many people don and remove the garments TodaysArt organized shifts of four volunteer guides. Not surprisingly, the interaction of visitor and guide played a key role in the participant's experience.

Figure 6: Visitors being dressed by the volunteer guides. ©Ian Hattwick

Visitor / Guide Interactions

Clearly, the visitors' experiences were highly mediated due to the use of the garments. The most obvious factor was the limited number of visitors able to experience the installation at one time. Six garments were constructed, with the intention that four visitors at a time would visit the installation. In order to create an orderly and planned dressing/undressing period, visitors were asked to make an appointment via on online appointment calendar.

On the first day few appointments were made, as many visitors had yet to find out about the installation and the online appointment system. On subsequent days, however, most of the appointments were quickly filled. Approximately 80% of appointments were kept which allowed for a limited number of stand-by visitors. By the last day the dressing room was a very social environment due to the number of people waiting for their appointment or hoping to fill-in for a missed slot.

The first experience visitors had once they arrived was usually a period of waiting for the previous round of visitors to return from the installation and be undressed. While the volunteer guides were asked not to volunteer information regarding the experience, the visitors still were curious to discuss the reactions of the previous group as well as see the garments being worn before they themselves were dressed.

This injunction for the guides to not volunteer information contrasted with the highly intimate acts of dressing the participants as seen in figure 6. Since the garments contained embedded electronics and consisted of three parts with associated wiring, visitors were asked to not dress or undress themselves. Typical guide/visitor interactions during the dressing phase consisted of visitors asking for information regarding the installation and not receiving any answer, while the guides were adjusting straps and fastening jackets and leggings while asking the visitors how they felt. The final step of the dressing process was the placement of a helmet with a semi-opaque full-face mask which served to limit the visitors vision to detecting areas of light. Once the helmet was in place the guide would take the visitor by the hand and guide them to a spot along a wall, where the visitor would wait until the installation was ready to begin. A picture of participants dressed, positioned along a wall, and ready to enter the installation is shown in figure 7.

When all four visitors were dressed the guides would take their hand and lead them out of the dressing room and a short way along a public hallway to reach the door to the installation space. The installation space itself was pitch-black at the beginning, so once entering the space the visitors were entirely blind. The guides would then lead the participants to chairs located on one end of the installation space, where the visitors would be seated. Each guides would then quietly issue a short set of instructions to the visitor they led in. The instructions indicated where the guide ropes were located and what signal to listen for in order to indicate that it was okay to stand and traverse the installation space.

At the conclusion of the 18 minute event, the visitors would wait for the guides to come and take them by the hand and lead them back to the dressing room. At this point the helmet would be removed and the undressing procedure began.

By requiring this intensive set of dressing/undressing rituals the use of the garments created a specific and highly social environment which bookended the visitors' experiences. In several key ways this augmented the nature of the time spent in the installation proper. The first is that, having seen the previous participants wearing the garments, a visitor would be able to identify themselves as wearing a kind of uniform or costume – a set of clothing which indicates they would

be either playing a particular role or would be stepping out of everyday life. The visual combination of the helmet and garment drew many associations from visitors, ranging from martial arts and riot police to science fiction references. This sensation was augmented by the facts that the suits were strapped tightly to their body (in order to facilitate transduction of the vibrations to their body) and that the garments had a certain weight and feel to them due to the embedded electronics and wiring.

A second key element to the visitor's preparations was the level of trust engendered by the guide/visitor relationship. Elements which contributed to this trust were the intimacy of the dressing procedure, the uneven flow of information between guide and visitor, the lack of vision of the participant, the guides leading the visitors by the hand, and the quiet instructions given once the visitors are seated.

Figure 7: Three of the volunteer guides suited up and ready to enter the installation ©Ian Hattwick

Participant Feedback

In order to evaluate the Ilinx experience from a user-centered design perspective, a series of over 100 collective "exit" interviews/conversations were conducted by one of the authors during the installation's premiere in September 2014 in the Hague. Seeking to reflect on how the visitors' sense perception might have been reconfigured during the installation, we utilized techniques arising from the domain of sensory anthropology and sensory ethnography; what anthropologist David Howes has termed "participant sensation." [12] The methodology of participant sensation involves a collective conversation comprised of discussions and recollections and even reflexive analysis of specific sensations and impressions as the visitors are guided through the process of making sense of the novel sensory interrelationships they have just undergone. In this way, many profoundly eloquent testimonies are elicited. Participant sensation (in contrast to the more distanced "participant observation" found in anthropological or sociological ethnographic work) also aligns with Varela and Shear's argument for the necessity of first person methods or what they label 'phenomenal data' to complement third person methods in understanding the workings of consciousness. We engaged in informal yet recorded conversations with the participants in order to capture in language the kinds of almost indescribable bodily affects that might have occurred during the installation experience. [22] As Varela and Shear have argued, "[b]y first person events we mean the lived experience associated with cognitive and mental events". While third-person accounts "concern the descriptive experiences associated with the study of other natural phenomena," first person methods deal with subjective experience that "refers to the level of the user of one's own cognitions, of intentions and doings, in everyday practices."

The interviews with Ilinx participants revealed a number of similar patterns in experience. More than half of the participants interviewed used the word "floating" to depict their experience during the period in which they walked through the space. Moreover, when describing the transition from sitting and experiencing the purely haptic-driven sensations to walking, the majority of the participants indicated a shift in modalities from touch to vision. Although Welch and Warren's notion of modality appropriateness (a hypothesis that claims that when confronted with an intersensory discrepancy, a conflict between different sense modalities, one sense may "bias" another based on the strength of its particular modality) has been recently challenged in the neuroscience literature on cross modal integration, the fact that many participants forgot they were experiencing haptic sensations when in locomotion and instead concentrated on the position and intensity of the light around them, suggests that there may indeed be something specific to the structure of the stimulus in the modality over the modality (vision or touch) itself. [20] More curiously, a number of participants described intense feelings of disorientation, confusion, and, in some cases, vertigo as the result of both having vision blurred and having to walk into the space itself with little sense of spatial visual or acoustic cues. While not statistically rigorous, these exit interviews reveal a strong set of cross modal correlations between modalities that are normally thought to be separate.

Future Work

It was always the intention that the garments designed for Ilinx would form the basis of further work. As always in projects involving the creation of custom technology it is impossible to fully explore their capabilities, subtleties, and implications within the context of a single project. We are therefore fortunate to have several new projects which will utilize the Ilinx garments or build upon them and which will allow us to explore these aspects more fully.

Haptic Fields A direct followup to the current project, "Haptic Fields" focuses on the creation of shared tactile experiences. How can the sense of touch be shared by participants within a space? Additionally, how can we draw upon cultural and anthropological understanding of touch to help develop technology and artwork to further haptics research? In order

to scale up from Ilinx's limited number of visitors, we are currently exploring game-based scenarios for both small and large groups which involve the social sharing of and transmission of touch-like sensations among different groups.

Sensory Entanglements The idea of the senses as being cultural constructs leads to the question of how members of different cultural groups can share their sensory experiences. "Sensory Entanglements" brings together First Nations/Indigenous and non-Indigenous artists, scholars, and researchers in a unique research-creation project which seeks to elicit, interpret and experimentally model Indigenous ways of sensing as expressed through art and analyzes the distinctive forms of sociality they support. Among the different sensory contexts to be explored, touch and vibration will feature prominently.

Conclusions

While the incorporation of tactile stimuli in artistic work is increasing, the design of a system able to provide a general-purpose set of tactile stimuli remains a challenge in terms of scalability, somatic considerations and cultural contexts which tend to lend focus to visual aesthetics. The work presented here demonstrates one approach to the design of such a system. We recognize that the garment described herein is capable of only a limited set of tactile signals, partly due to combination of the complexity of the haptic channel as well as the practical demands of the context of Ilinx itself. However, for use in the context of a multi-sensorial art installation we found that the capability of the suit is sufficient to allow for the creation of a wide variety of visual/audible/tactile correlations and hence, a powerful affective experience for the participants.

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Bio-Art

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Grene Epiphytes, an Immersive Bio Artwork

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Abstract

In the last two decades, emerging fields alternately termed Synthetic Biology, Artificial-Life Art, Bio-inspired Design and Smart Materials, to name a few, have acted as loci that spawned new methods for creating novel artworks based on phenomena that is generally described as *"natural"*. At the same time, there has been increasing interest and research in creating differing kinds of immersive environments, responsive architectures and inhabitable worlds. *Grene Epiphytes* is an artwork that grew from an exploration of bio-inspired theories and a rethinking of engaging and immersive inhabitable aesthetics. It offers a perspective grounded in the lineages of immersive artworks and aesthetics that engage participants (not with representations of other life-forms, but) with non-human life-forms, and question the distinctions of human and nature. In this paper, we articulate assumptions and theoretical constructs that inspire our approaches for creating and *"engineering"* this artwork, and address some of the challenges. Rather than creating nature-like experience where humans are assumed to be at a remove, rather than part of nature, the inhabitable environment presented here is focused on a context enlivened by human and non-human entities, their varied responses to each other and to aspects of their intertwined worlds, as well as a questioning of materials.

Keywords

Biomimetic- Performative Materials- Synthetic Aesthetic- Immersive Artwork- Algae- Bio Inspired- living and non-living

Introduction

As interests in interactive immersive environments re-emerge and grow, so too do the ways in which the aesthetic aspects of their design and conception are considered. This move toward interactive, immersive and affective aesthetics is partly generated by a desire to create more engaging and complex levels of nature-like beauty and conceptual interaction.

A set of approaches, each representing slightly different terminologies such as Synthetic Biology, Bio-inspired Design and Smart Materials carry with them certain assumptions about the role of the user, artists and ideas of interaction [20]. Broader processes of interaction that grants a participant's full-body interaction and sensory immersion with emphasis on design and style seem to be reappearing [13].

Nature -assumed to be somehow distinct from the human- has inspired artists and designers for centuries; but recent developments in technology and in our understanding of biological systems have expanded the range of possibilities for combining design and biology. At the same time, questioning the centrality of humans above all other life forms, and its purported distinction from *"nature"* is evident. The so called posthumanism, as well as an increased interest in materiality, sustainability of a planet threatened by humans and renewed interests in *"the nody"* embodiment and the plastic aspects of senses and capabilities that were thought to be static and separate. Taken together, this combination of new and renewed ideas and practices challenge the status quo on fundamental levels, which, in turn, also offer opportunities to reimagine what art and human-made inhabitation may mean and may be.

The postnatural [19] approach between humans, nature and technology becomes more and more apparent within art and design discourses surrounding so-called performative materials and Synthetic Biology. Postnaturalism and posthumanism argue not only new methods, but also fundamentally different ways of being where living and non–living, human and non-human boundaries are breached through cybernetic, biological substrates, systems and contexts. These become, in a sense, palettes, subjects and experiences for artists who are creating novel artworks [13].

The setting for creating such artworks has never been more auspicious. The revelations of systems theories and computation combined with biology (e.g. in the field of Synthetic-Life), has changed our understanding of life. Notions of life and computation has been deeply invested in art and has greatly inspired artists, addressing new approaches to creating art based on the synthesis of life-like phenomena.

Goals and Motivation

Experiences from our childhood persist, almost as specters that overlay our daily experiences: playing with the flow of water in the river, disturbing the marching path of ants, following the attractive and colorful butterflies – beauties to us, but horrific and monstrous bodies for our colleagues.

Some of us leapt off fences; convinced we could, if only we tried hard enough, to fly. These memories became our first motivations for an interdisciplinary research and development of an interactive and immersive art installations.

Our two key areas of interest are Biomimetic and Inhabitation. We draw from biology as a material and inspiration for designing artworks by exploring its unique properties and exploring processes of *"nature"* and radically different ways of being, such as imagining how bees see, how bats taste, how vines might sense the fence they wind around.

What motivate our artistic practice are interests in the synthesis of life-forms and materials that posses life-like properties and affordances. The challenge is how to create an aesthetic openness in which art, life, play, and computation momentarily cohere, akin to fascinating, sublime experiences of nature. In fact this is not a new goal, John Dewey in his book Art as Experience called for *"recovering the aesthetic experience with normal processes of living"* [4].

Background, Concept and Theory

What is Life?

In order to create evocations of nature-like experiences, and aesthetic experiences that involve human and non-human life-forms, ones needs to not only understand and study *"natural phenomena"*, in traditional ways, but one also needs to study in other ways; that is, *to be* and *to be with* non-human life-forms. This implies the expansion of the artists' task — from representing the way nature looks, to expressing and evoking in the manners of how nature works. "*Nature"* has been one of the most powerful sources of inspiration; however, our contemporary notions of nature reinforces our habits of assuming that we are outside of it, more distant from what humans paradoxically see as the original creative force. Therefore, in studying and observing non-human life-forms, we believe it is necessary to be with them in ways that may open our experiences from observing and "*interacting"* with them as still-separate, other beings, — and to nurture alternative ways of being with non-human life-forms.

The question of what life is has been a primary preoccupations for scientists and artists since ancient times, yet no single clear answer is agreed upon as satisfactory by all [9]. Contemporary accounts of life usually include such characteristic features as growth and development, reproduction, evolution and adaptation, responsiveness and autonomy, metabolism, self-organization and emergence [19].

For any explanation of life to be useful for the artists who engage in creating with inhabitable life-forms, that explanation must, in some way, be capable of coping with ways of thinking and being that are also required by an aspect of their medium; in this case, for example, that aspect is a model made by computer-generated prototyping. Computational language may indeed seem antithetical to our enterprise, but at the same time, it makes evident that even computational prototypes must allow levels of sensitivity, adaptation and responsiveness; accompanied by design methods where complex relationships can be analyzed and refined as part of exploratory processes [14].

Bio-Art

Bio-Art is art composed partly or entirely of living, non-human organisms, and/or art created in association with nonhuman organisms, remains in common use as stated by Capucci, Torrani and Gessert [10]. It crosses the line between the scientific domain and the domain of art and it may touch the border between the living and the nonliving therefore it has transcendence boundaries.

Bio-Art is a new direction in contemporary art that explores the processes of life. Thus, it is frequently deployed as one approach to generate and express Synthetic Life. Invariably, Bio-Art employs one or more of the following methods to address how life is brought into real world contexts and how to seek the meaning of life through such interactions with the world [5]: *"(1) the coaching of bio materials into specific inert shapes or behaviors; (2) the unusual or subversive use of biotech tools and process; (3) the invention or transformation of a living organism with or without social or environmental integration."* Bio-Art emphasizes the dialogical and relational (such as cell interaction, interspecies communication, and so on) as much as the material and formal qualities of art (such as shapes, colors and patterns,) [5]. Contrary to traditional art, which generates and produces objects, crafts, or environments, Bio-Art focuses more on its "core materials", which means the organism's development and species' evolution.

Boundaries of living and nonliving

Are there categories of life? Biologists would answer yes, presenting the whole discipline of taxonomy. However, as regards ethical issues such as the moral status of natural or artificial life, the boundaries must be drawn somewhere other than simply between species.

As Christian Martin [2] points out "life" is not a merely descriptive phenomenon but also includes a normative component. He suggests a differentiation of the term life [1] into three steps: (1) *"mere life"* (2) *"prereflexively self-conscious life"* and (3) *"reflexively self-conscious life."*

Even in biology, there is no satisfactory definition of life. Most attempts to describe what life is are limited to a list of functional features of life [17]. Therefore it is hard to define a boundary between the living and the nonliving, even from a scientific point of view.

Disciplinary Boundaries

Bio-Art is a new direction in contemporary art that explores the processes of life. Thus, it is frequently deployed as one approach to synthetic biology, which challenges

[1] The prototype for mere life is that of single-cell organisms, whereas self-conscious life encompasses the experience of a *"self "* in the form of pain. Reflexive self-conscious life entails understanding, judgment and the ability to conclude [2].

biotechnology by applying engineering principles in biology. Synthetic biologists intend not only to understand life better but also to utilize it in applications to minimize and optimize, to variegate and transcend life, to design and to standardize it.

A fundamental trait of synthetic biology is its interdisciplinary character. To be able to deal with the complexity of biological systems, synthetic biology crosses disciplinary boundaries. So does bio-art which, crosses not only disciplinary borders within science but also the line between science and art.

Related works

Invariably, Bio-Art employs one or more of the following methods to address how life is brought into real world contexts and how to seek the meaning of life through such interactions with the world [5]: *"(1) the coaching of bio materials into specific inert shapes or behaviors; (2) the unusual or subversive use of biotech tools and process; (3) the invention or transformation of a living organism with or without social or environmental integration."* Bio-Art emphasizes the dialogical and relational (such as cell interaction, interspecies communication, and so on) as much as the material and formal qualities of art (such as shapes, colors and patterns,) [5]. Contrary to traditional art, which generates and produces objects, crafts, or environments, Bio-Art focuses more on its *"core materials",* which means the organism's development and species' evolution.

In exploring the journey of life and synthesis of life, while certain artists experiment with plants (e.g *Streptocarpus hybrid* by Gessert, 2002), other groups look into *"tissue culture"* (e.g *Digital montage* by Catts and Zurr, 1998), some might also follow the coupling of the organic and inorganic, or the living and the machine (e.g *Victimless Leather* by Oron Catts and Ionat Zurr 2004). Some might look into biological systems of self-organization and collective decision-making, and the process of achieving dramatically varied results with very small alterations in an initial settings. (e.g *Objectivity* by Bar-Shai, 2007) and some might use the living organism as new material for design of inhabitable aesthetics (e.g Alive: New Design Frontiers by ecoLogicStudio) [5].

In our work, we adopted the third approach (*the invention or transformation of a living organism)* during the process of designing algae and its behaviors, precisely because it works in the living, from a single cell to a mammal. Such synthesis uses the properties of life and its materials, changes organisms within specific species, or invents life with new characteristics.

We believe that Bio-Art is not simply about creating metaphorical representations of scientific concepts — it is about using actual scientific techniques, creating hybrids and manipulating live organisms. As Eduardo Kac stated: *"After the age of robotics and digital technology, the new media is biotechnology"* [4].

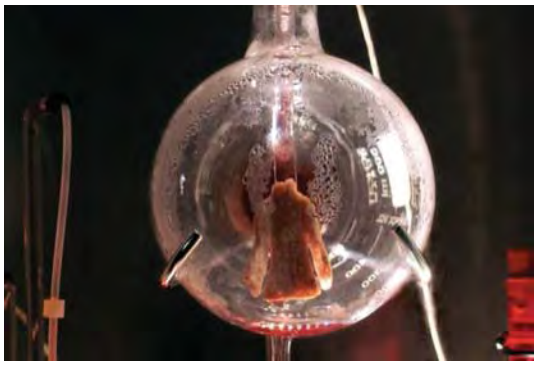

Figure 1. The Tissue Culture and Art project (Victimless Leather), led by Oron Catts and Ionat Zurr, have used tissue culturing in art. Their work features the semi-living: animal cells (which have included frog, human, pig, and mouse cells) that live and grow within bioreactors. The series is an ironic commentary on the positivist promises of growing leather and meat in a vat, without the ethical murkiness of having to kill an animal [5].

Figure 2. Nurit Bar-Shai's Objectivity [tentative]. The work explores the network and communication systems of Paenibacillus vortex bacteria. It explores the intersection of Art, Science and Technology. Using various settings to visualize the "chemical tweets" of microorganisms as beautiful and rare image patterns [5].

Figure 3. Alive: New Design Frontiers is an interactive / living environment installed at the EDF Foundation in Paris. Its morphology emerges from the reinvention of one of the archetypes of architecture, the column; imagined as a living and responsive organism, a photobioreactor of microalgae, ecoLogicStudio [24].

Creation of the artwork

Art as it could Be

To create the aesthetic relationship between living and nonliving, we gather interdisciplinary knowledge that supports the development of an analog computation to study biological behaviors within digital computational systems, including such processes as growth and evolution. This strategy of making possible complex phenomena by simulating simple components is known as a *"bottom-up"* approach [1].

A consequence of a *"bottom-up"* approach may be uncertainty regarding the outcome, but proponents of Artificial-Life are interested in the multiple phenomena that emerges from biologically-inspired artificial processes, even if the results have no direct counterparts in the natural world: an ecology of possible life made or orchestrated by humans rather than by nature. Langton characterized it as *"life as it could be",* in contrast to *"life as we know it"* [7].

The study of *"life as it could be"* has cultural importance; it implies a movement from an anthropocentric view toward regaining a balance with a cosmocentric point of view. This means that humans become one of many possible intelligent beings in the universe, rather than the only one [7]. The suffix *"as it could be,"* indicates a shift in thought and experience beyond the immediately apparent to the imaginable and possible: this lies at the heart of exploratory aspects of our artwork [8].

Our tendency is to find consummation in our experiences, to integrate or crystallize the loose ends of expectations and anticipations into an aesthetic experience. However, we believe that art capable of stirring our usual conceptions in ways that do not fully resolve into an easy experience and understanding has its own merits, ones that may persist beyond the initial experience with an artwork. One may be disturbed, delighted or struck with awe or disgust by participating with an artwork. Such an experience may reflect intensified emotions, and may be remembered as significant. An aesthetic experience is made of the same *"material"* as experience in general, but is intensified, without being arrested, diverted or distracted; *"Then and only then is it integrated within and demarcated in the general stream of experience from other experiences"* [4]. Life is not an uninterrupted flow, but has a distinct rhythm; Art also follows this principle (regardless of the medium), and those rhythms may be dissonant or sublime.

By deepening our knowledge of how nature works, and by questioning uneasiness by redefining ourselves *as* nature, we can integrate life and art in the creation of speculative new worlds capable of engendering more powerful aesthetic experiences.

The installation

Grene Epiphytes is an interactive-living installation emphasizing the sense of aliveness and implying continual changes in living things/organisms.

The morphology of *Grene Epiphytes* emerges from a lattice system housing arrays of clusters filled with algae; a living and dynamic network that arc above and around our attention and senses.

The system employs a series of transparent tubings, which are knotted into networks of a mesh-like structure; these in turn form the bio-matrix, connecting floor to ceiling in an arch-like shape. Living algae is pumped through the textile-like mesh, soaking up the daytime sun. Through photosynthesis, the algae forms a continuum of growth, change and interaction from processes of photosynthesis to harvesting by humans. The tubes, arranged in a textile-like mesh become an inhabitable form not only for the algae, but for human participants as well. The transparency of the tubes, help in directing participant's attention to the living forms and processes of the algae that temporarily *"house"* human participants. In this manner, the Spirulina algae are multiplied food for humans and other animals, co-producers of the very air we breathe, and in a way, keepers of time and transformers of light.

The overall shape of the installation offers an immersive experience for participants: an otherworldly space made of living biological substances and entities. Somewhat unexpected behaviors emerge in continuous motion and exchange in across differing time-scales.

Figure 4. Growing an algae culture and production of different colors with medium and nutrient changes in a lab setting (to test the changing color behavior in exhibition).

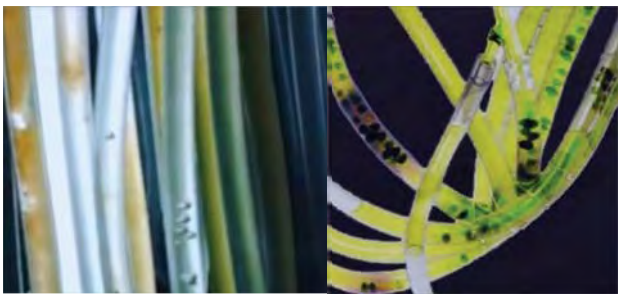

Figure 5. Fidelity prototype of the *Grene Epiphytes* concept using tubings filled with blue-green algae.

The Algae

Microalgae, like any other plant, when grown using sunlight, consumes (or absorbs) carbon dioxide (CO_2) and as they grow, releasing oxygen (O_2) and Biomass (lipids-natural oils).

The flows of energy and growth pattern in *Grene Epiphytes* responding and adjusting to weather patterns and participants movements during the exhibition. With more direct sun, for instance, the algae photosynthesize and grow more intensively; thus transparency, variant colors and the growth are some of the *"products"* of this complex set of relationships among climate, micro-algae, participants and the synthetic control system.

The bio-matrix hosts blue-green microalgae organisms (Spirulina) embedded with ambient light, sensors, actuators and a programmable virtual interface. Flows of energy (natural glowing light in dark), matter (biomass, carbon dioxide) and information (participants behaviors and movement) induce multiple mechanisms of self-regulation and evolution of novel forms of self-organizing algae during the exhibition.

The life of this hybrid organic system tries to marginalize Wilhelm Reich's idea that *"all plasmatic matter perceives, with or without sensory nerves. The amoeba has no sensory or motor nerves, and still it perceives... The terror of the total convulsion, of involuntary movement and spontaneous excitation is joined to the splitting up of organs and organ sensations. This terror is the real stumbling block..."* [18].

Why Algae?

It is now time to overcome the separation between technology and natural phenomena, to embrace its fuller potentials and genius across the multi-levels of design and everyday life. In this artwork, the boundaries between the materials, spatial and technological dimensions have been carefully articulated. The goal is to experiment the notion of hybrid space and the boundaries of living and non-living and to introduce and illustrate one of the natural sources of energy on earth and its efficiency, flexibility and beauty.

Algae are the fastest-growing organic material on the planet (ten times faster than trees). Some species double their volume every 6 hours. Compared to some of the plants that humans grow, microscopic Algae's yield per hectare is considerably higher than that of sunflower or rapeseed. Moreover, microscopic algae are a group of relatively simple organisms that capture the energy of light through photosynthesis, using it to convert inorganic substances into organic matter. Perhaps most surprising is that while humans in industrial mindsets see algae's potential as a form of energy which may replace petroleum (oil), it is also a food, but a food not commonly consumed as other animals do (whales, shrimps, flamingos). Rather, it is packaged and sold as tablets (e.g boosting the immune system, improving memory, increasing energy and metabolism). That algae, then, is not used as a form of common, widely available food, full of anti-cancer properties and so high in nutrients that it would outstrip the so-called *"superfoods"* is curious.

Conclusion

This artwork is intended to reveal the evolving beauty and complexities of a life-form we regularly take for granted and dismiss on the one hand, or to a much lesser extent, revered as a new raw *"superfood"* (in encapsulated form) on the other hand. *Grene Epiphytes* creates ways in which algae transform in our imagination from an annoyance that clouds our ponds and pools to an immersive environment that reveals its own responsiveness to our changing climate and movement of participants. Also the artwork enables complex understandings of its responsiveness and of mechanisms that transform light into the invisible ether we breathe. It emphasizes the many ways in which easy definitions of 'the virtual' and 'the physical' are problematic categories that cannot be maintained, and provokes speculation more on direct experience rather than on abstract concepts of creativity and beauty, and of nature and design. In these and other ways, *Grene Epiphytes* expands recognizable art-forms into more specular experiences of *"art as it could be" [8]*.

Contribution

This research contributes to emerging interests in Bio-Art, nurturing ways that humans and non-human life-forms may explore the inhabitable moments when their perspectives, needs and relations collide and collude. Implicitly, participants are asked to 'a-volve' their imagination and notions of life and evolution as they immerse themselves in physical, intellectual and emotional dialogues with the work. Artwork such as this may also facilitate diverse forms of interaction and alternative understandings among the art, computer science, life sciences and scientific communities. Ultimately, *Grene Epiphytes* may encourage artists and their public participants to further seek out informative resources and multiple engagements with this fascinating form of art.

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Living media: Transgressing bios, transgressing techne and paving the way to further transgressions

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Abstract

It was only a while ago that a clear opposition could be traced between *bios* and *techne*. However, together with the emergence of new branches of science, such as biotechnology, stemming from discovery of the code of life and an assumption, that there exists a certain relevancy, a pattern of relationships between genetic and computer codes were established and developed vastly at the intersection of the two, once distant domains. The silicone versus carbon division ceases to exist. Rather it's silicone and carbon, a come back of the material, of the carbon remediated by data, by codes and algorithms. An immense transgression this type of media elicited is that they are literally alive: living synthetic cells, living tissues, living organisms. Moreover, they transgress classical media theories, philosophical concepts and, when employed into artistic practice, common art theories. They may also pave way for further transgressions such as disruption of the boundaries of species as a consequence of deliberate scientific experiments or laboratory aberrations. In my presentation I would like to address these issues and make an attempt of tracing foundations and goals for the theory of living media

Keywords

Living media, transgression, bios, techne, media theories, art theories, bio art.

The rise of a unique type of media, comprising not only of silicone but also of carbon components mingled together, or to be precise, of organic, often living materials significantly transformed or empowered by the domain of technology, has been long predicted. Suffice to look back at a manifesto by Roy Ascott, first presented as an installation in 2000 in Graz. The piece is a prediction of a moist future, where a convergence of computational systems and wet biological processes will occur: ”Moist media comprises bits, atoms, neurons and genes.” [1] The consequence of the emergence of moist media would be the spread of intelligence to every part of technology as well as tremendous extension of our sensorium: “Between the dry world of virtuality and the wet world of biology lies a moist domain, a new interspace of potentiality and promise.” [2] Several years later, with the rise of molecular biology and biotechnology, this prediction becomes a fact. Biomedia, a seemingly congruent term coined by Eugene Thacker addresses the problem of “technological configurations in which biology can surpass itself.” [3] These processes are never destined to erase the body, the biological through digitization. On the contrary: in the concept of biomedia the bodies are informatic, the information corporeal and the technology disappears altogether. As Thacker explains, biomedia is a constant inquiry into a question of „what a body can do.” [4] It is a perpetual optimization of biology, allowing the body to be elaborated and reformulated. However, Thacker seems to understand the remediation, in which flesh is made data and subsequently data is made flesh in a rather Marxist manner, as a necessary translation of the body into products that serve the body: “The investment in bioinformatics is not purely digital or computational, but a dual investment in the ways in which the informatic essence of DNA affords new techniques for optimizing DNA through novel software, which in turn makes possible the development of techniques for enhancing the biological body via new compounds (pharmacogenomics), new therapies (stem cell therapy), or new diagnostics (patient-specific disease profiling).” [5]

Regardless of the name, when we look closely at physical examples of these media it turns out that often times they are alive: living synthetic cells, living tissues, living organisms. For this reason, I would like to propose a term living media. This designation is far from being easily defined; rather, it indicates an unsolved dispute surrounding the problem of life, and points to endless attempts of distinguishing dead matter from the living in scientifically rigorous definition. Almost every domain of human knowledge, from philosophy, humanities, to natural sciences has been preoccupied with the problem of life, however a consensus was never reached: a single coherent definition comprising all aspects has not yet been developed, the concepts proliferate forming thermodynamic, reductionist or cybernetic definition to name just a few. Edward Trifonov, a researcher at the Genome Diversity Center in Haifa has counted “123 uncertain definitions of this uncertain phenomenon,” [6] all of them equally vague and unsatisfying. This multiplicity at the same time suggests a disturbing potentiality, that life is a phenomenon of relative rather than absolute character. In The Magic Mountain by Thomas Mann we find an enigmatic statement: “What was life? No one knew. It was undoubtedly aware of itself, so soon as it was life; but it did not know what it was.” [7] We tend to say that we know life when we see it. But how is it possible that there is no absolute, universal definition for an apparently obvious problem? Today we are facing an even greater challenge. Not only we have to define what life is, but we are also compelled to reflect upon life cre-

ated by means of technology, upon life that often differs from one we have thus far known and that disrupts our notions of species. These definitions, which in the first place are based on the existing definitions of life, are multiple and leave us with even more uncertainties. Therefore the only way to comprehend living media is to understand them as technological mediations of a phenomenon that according to a chosen acknowledged definition could be described as life.

Before we move on to examining further features and qualities of living media and how they transgress *bios* and *techne* as suggested in the title of this paper, it is necessary to provide a definition of transgression in the first place. In natural language, transgression is understood as a "violation of a law or a principle and the exceeding of due bounds or limits." [8] According to this understanding, the transgression elicited by living media can be perceived as a violation of the agreed borders of knowledge domains; a disruption that destroys their assumptions. Transgression produced by living media results in cognitive doubts because it is a phenomenon so vague and liminal, that it cannot be fully described by designations and models elaborated by either of the domains

It is precisely the aspect of strange, peculiar liveliness that constitutes the greatest transgression to standards adopted by biology and media theory alike. The latter has been focused mainly on conceptualizing means of communication and their impact on various aspects of human life, yet a reflection concerning the medium itself was equally important. The so-called old media, such as radio, telephone or telegraph, by reason of their analogue signal, were still embedded in the material. Then, together with the emergence of the digital and the binary coding system, the media, despite the great mass of servers and storing hardware, became seemingly immaterial and ephemeral. Today, as the bio increasingly merges with the digital, we are experiencing a come back of the material, of the carbon remediated by data. The new media are real, material and factual and, moreover they are often times alive. This leaves media theories confused and limits their competence to speaking only about the process of remediation, which involves computational machines with their codes and algorithms, not of the very results of this process.

For majority of biological concepts, technologically mediated life is seemingly similar to the one that emerged in a 'natural' way, provided that it constitutes a sincere copy, which fits in an established category of species. However when the outcomes of laboratory experiences and aberrations greatly differ from these assumptions, and disrupt the boundaries of species, they are too much of a transgression to be accepted within the scope of this domain. Biological typology proves to be anachronistic and insufficient to grasp effects of artificial, rapidly occurring evolution and the new living entities are only referred to in terms of mythological and science fiction designations that migrated to popular jargon: the monster, the hybrid, the chimera.

An especially interesting case is the problem of organisms conceived via technological means in one of the trends of contemporary art. Bio art is, briefly speaking, the appropriation and exploitation of techniques of synthetic life creation developed within the field of molecular biology for artistic purposes. The answer to the question of why life could become both the subject and the object of art should be traced back to conceptual art, probably the greatest transgression that art has ever experienced. The main concern of artists associated with this trend was a perpetual revisioning and self-questioning of art. One of the most significant questions they posed was why something can become a piece of art, and how this affects our understanding of this phenomenon. They promoted art understood not as a domain devoted to producing objects of aesthetic value, but rather as a place for discussing, defining, evaluating and teaching art, whereas the role of the artist was supposed to comprise of both the craft and the theory. In the realm of bio art, contemporary artists continue this tradition by dealing with a fundamental problem of philosophical nature. The question of what is life and whether it can become an object of art is posed via various material realizations of this ambiguous phenomenon. William Burroughs expressed a conviction that "all artists are **trying** to literally create life." [9] An immense transgression elicited by bio art is that they **are** literally **creating** life. The creationist aspirations and simple curiosity are however infinite and apart from identical organisms, new, thus far unknown living creatures are being created. Admittedly, they remain in a certain relation with the prototypical organisms for they are created mainly with known genes and proteins. They therefore sustain a certain link with the 'natural'. However, they are at the same time unfamiliar and uncanny and constitute a transgression to the 'natural', as we know it. These beings urge us to reflect upon the problem of life again, and to rethink and expand our assumptions concerning its possible incarnations. If we are to trust Joseph Kosuth, who expressed a conviction that the essence of art should be the questioning and undermining of its nature and tradition, then not only conceptual art, but also bio art with its challenge of introducing increasingly strange cases of life as both subject and object of art is a pure transgression.

Let us briefly examine few artistic manifestations of these transgressions. A good example is provided by Eduardo Kac in his work Edunia. During a museum encounter Edunia appears to be an ordinary plant. However the artist's explication reveals that it is a hybrid object, a 'plantimal', which encompasses biological features of both a plant and a human. Kac had a gene isolated from his blood and introduced into the DNA of petunia plant. The resulting hybrid expresses his gene within red veins running across the petals. Edunia is a unique and individual organism, it is not an organism that can be found in nature.

Figure 1. Natural History of Enigma: Edunia, Eduardo Kac, 2008.

Being a hybrid it also disrupts biological taxonomies as well as species and kingdom boundaries. It cannot be classified neither as a plant nor as a human: it is a completely different, liminal, borderline form of life. Were it not for molecular biology and translations between human, plant and machine codes, the project would have been impossible. Yet media theories, when confronted with the end product of these operations also have very little to say. A completely new, interdisciplinary approach is needed in order to be able to conceptualize this new organism created through genetic manipulations. Another good example of *bios* and *techne* transgression is Spectrum by Robert B. Lisek. Lisek has prepared a new strand of luciferase-mediated *E.coli* bacterium, which self-replicates in the water at an extremely fast rate. He carefully analyzed the communication networks of Warsaw in order to check their ability for spreading the bacteria-induced disease. Thus, the project became a simulation of a bioterrorist attack on the capital of Poland. The strain of genetically engineered luciferase bacteria, which rapidly multiplies in the water is not originally found in nature. It mimics the mechanism of *E. coli* bacteria, but at the same time is a different, genetically engineered entity. It exceeds the abilities of biological agents and incorporates a feature of bioluminescence, which occurs mainly among marine vertebrates and terrestrial invertebrates. It provides a disquieting potentiality of alien life that could, according to the conceptual assumptions behind the project, literally enter into our reality. Just like Edunia, Spectrum leaves both biological and media theories concepts puzzled and confused.

With today's technological capacity growing exponentially, with the mutations and transformations that could be introduced on selected genes or whole fragments of genetic setup, it seems that we have infinitely many possibilities and combinations of creating new lives that will forever evade norms, definitions, classifications and theories. For now, the approach to living media should be interdisciplinary and methodologically open in order to draw upon numerous, apparently distant branches such as ontology, molecular biology and technology studies to name just a few.

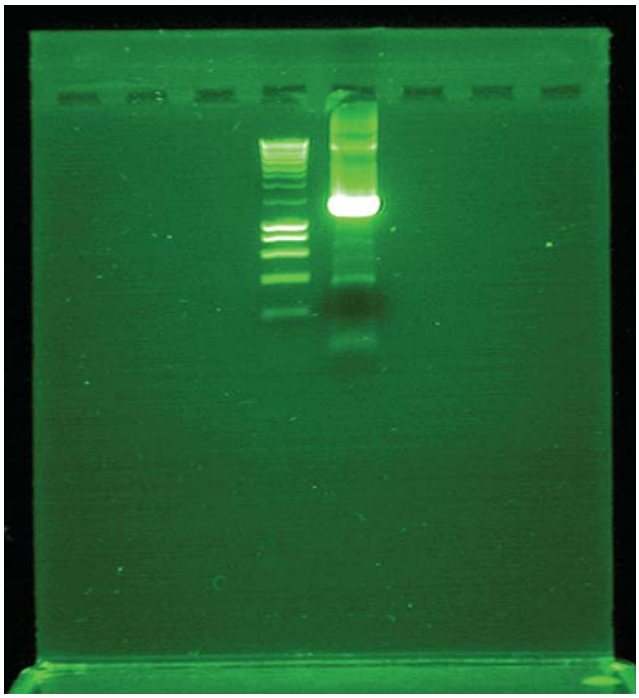

Figure 2. Spectrum, Robert B. Lisek, 2008.

An adequate approach to the problem of transgression is equally important. It should be thought of as an essential factor of change and infringement without which no progress would ever be possible. Hermeticism, conservatism and isolation cause domains and theories to become obsolete and dead, and eventually unable to speak of reality. The situation biology and media theory are experiencing with regard to living media deserves not empty conclusions about disciplinary crisis, but an effort of creating new approaches and methodologies, new useful transgressions. To recall the words of Ludwig Wittgenstein, used as a closing of his Tractatus Logico-Philosophicus that simultaneously call for its rejection, anyone who recognizes anachronism and inadequacy of a discipline "must transcend these propositions and then he will see the world aright" [10].

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Author Biography

Marta Heberle is a theorist and critic of culture. She specializes in issues related to bio art and bio media. Heberle is an author of numerous articles concerning contemporary art and aesthetics with a focus on transhumanist perspectives. Currently she is preparing her PhD at the University of Poznan. Her main focus is the problem of life, which, according to acknowledged definitions seems to be a phenomenon of relative rather than absolute character. She employs a non-humanistic approach to push the boundaries of biological systems. Heberle's work balances theoretical and applied research: she is also an artist concentrated on transgressive sensory experiments located at the intersection of sound and performance.

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Radical Reordering: *Bit*-size Chunks in the Al Grano Project

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Abstract

The paper unpacks my working methodology in the creation of large, multi-year projects based on the segmentation and grouping of ideas, materials, and objects into *chunks*. As case study I use my current project *Al GRANO: Framing Worlds*, a composite gallery installation with individually installable pieces that can be connected in various combinations. Exhibited together, the *chunks* compose a large project that addresses conflicting historical, cultural, technological, and political positions related to maize, a contested grain considered both food and cultural symbol in Mexico, and source of macro profits for multinational agribusiness. I discuss the process of recodification embedded in the artwork itself and the influence of a Latin American literary 'tour de force' in my practice of dismantling languages and codes. I furthermore examine how the structure of material, changed through bioengineering, can be used to stress that the hybridization between natural and biotechnological genes is a source of division that spawns - in countries such as Mexico - the need to establish geopolitical immunological structures for the protection of ecological and cultural infection from external forces. I conclude by articulating that an interdisciplinary approach in the use of art and technology tools and systems can serve to critically inspect temporally and spatially continuous permeation of infamous incidents throughout social and political worlds.

Keywords

Maize, biodiversity, contamination, Mesomaerica, histories, languages, chunking, composition, decomposition, recodification.

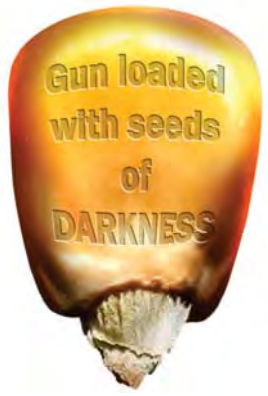

Figure 01. Digital image of transgenic corn seed, etched with a text from the novel *Men of Maize* (2013). ©Pat Badani, 2015.

Introduction

Al GRANO is a hybrid, multi-year project in which I use art tools and methodologies to inspect the debates between Mexico and the USA about maize and its genetic avatars; [1] controversies that involve monumental issues about cultural validation, language, identity, ecological balance and heterogeneity in Mexico, center of domestication and biodiversity of maize. [2] I view the defense of maize from a Latin American perspective influenced by my own cultural journey: I was born in Argentina, and I lived in Mexico and in the U.S.A. Corn Belt. The fundamental arguments involve a reaction to capitalist interests that instigate the protection of Mesoamerican cultural integrity, specifically by indigenous populations who defend native seeds, their lands and their livelihoods. With this in mind my work *Al GRANO: Framing Worlds* evaluates the idealized vision of scientific and technological progress and questions the rush by agribusiness to produce genetically modified corn to supply the needs of an expanding industry of processed foods and bio-products. This brings about a chain of imbalances in environmental and human ecologies affecting maize's biodiversity, causing impoverished soils and water depletion, and furthermore instigating the demise of small-scale farmers and the loss of ancestral agro-ecological knowledge systems (Fig. 1).

Approach

AL GRANO: Framing Worlds deploys a staging of fact and fiction where various registers of images, objects, texts and time-based pieces overlap; a strategy that I also applied in previous multi-year projects such as *Tower Tour* (1994-1997), *Home Transfer* (2000-2002), and *Where are you from?_Stories* (2002-2009). [3] As with these precedents the *AL GRANO* enterprise (begun in 2010) develops in *chunks* with the creation of aggregate projects that are hosted under the *Al GRANO* umbrella. Developing a project via *chunks* is part of my research and creation method, which consists of an inquiry on inhabitation, transculturality, human migration, and sustainable living. 'Chunking,' a term coined by one of the founders of cognitive psychology, George A. Miller, [4] is used to describe the splitting and grouping of concepts into small

meaningful units. It is considered an information measure for cognitive systems, from computer science to linguistics, with applications into broad cognitive skills (from pianists' finger tapping, to chess players' memory retrieval.) Studies claim that ideas are represented in the cerebral cortex by overlapping sets of neuronal assemblies and their synaptic interconnections. In chunking new ideas, a new neuronal assembly is recruited to represent a thought. The meaning of the new *chunk* idea is established via 'chunk-constituent overlap' and/or 'chunk-constituent association.' [5] Chunking, seen as both a triggering device and as a code building device, provides me with a useful theoretical framework to describe my operational model when researching and exhibiting layered, multi-year projects – a system that requires me to identify *chunks* from a sequence, and to then organize and classify these into categories that relate to the whole (Fig. 02), much in the same spirit of what Nelson Goodman referred to as "composition and decomposition" in the process of "worldmaking;" a practice that consists of:

> "…*taking apart and putting together, often conjointly: on the one hand, of dividing wholes into parts and partitioning kinds into sub-species, analyzing complexes into component features, drawing distinctions; on the other hand, of composing wholes and kinds out of parts and members and subclasses, combining features into complexes, and making connections. Such composition or decomposition is normally affected or assisted or consolidated by the application of labels: names, predicates, gestures, pictures, etc*." [6]

The method of chunking (taking apart, reordering, and putting together) helps me inspect a complex subject by focusing on a particular *chunk,* with all *chunks* allied to the project's nodal concept (such as sustainable living in Al GRANO). In combining *chunks* into *chunks* one can gain greater information, and by breaking them down one can examine their constituent parts. Any *chunk* is always connected to another and can potentially impact or reshape other *chunks*. The process is analogous to putting together Lego pieces in that interlocking *chunks* can conjoin in any direction to create a larger form. When I assemble *chunks* of research as a group in public exhibitions, different subjectivities are produced as viewers/participants experience spatio-temporal orderings of *chunks* that provide new experiences and sensations of known and fresh information, allowing the brain to create new connections – to 'rewire' itself and construct new insight and meaning. In my view, this process favors the emergence of new knowledge.

Languages / Histories / Codes / Glitches

Al GRANO: Framing Worlds is a gallery installation composed of three *chunks* having as common element the

Figure 2. *Al GRANO Project Mind Map* (2010). Sketch from Pat Badani's notebook. ©Pat Badani, 2015.

manipulation of languages, histories and codes – the latter pointing to the underlying structure of genetic systems. The individual yet connected *chunks* are titled: *Al GRANO: Hack*, *Al GRANO: Crop-Cropping* and *Al GRANO: Injection-Infection*.

Al GRANO: Hack is composed of 13 digital images printed on adhesive vinyl – silhouettes cut out in the shape of Maya glyphs adhered directly onto a gallery wall. *Al GRANO: Crop-Cropping* is an interactive work designed for portable, touch-sensitive devices. These two pieces illustrate how even when I focus on one particular *chunk*, this one is always part of another *chunk,* connected in a way that might change the content but not the concept of the *chunk*. As I discuss further on, the connection between these two is the notion of 'glitch.'

Additionally, both *chunks* integrate Mesoamerican Maya glyphs as well as texts from a seminal novel that I discovered over the course of my research: *Men of Maize,* written by Miguel Angel Asturias, Nobel Prize winner of Latin American Literature. Published in 1949, [7] it intermingles social commentary, myth and legend to address the sustained struggles by indigenous populations who defend their right to grow maize as daily sustenance and not as commodity to be commercialized for profit – a profanity in the eyes of Mayan people whose sacred belief

system sustains that men are made of maize. Although the novel *Men of Maize* was inspired by corporate exploitation of maize and the demise of Mayan peasants in Guatemala in the 1930s, the country is never named with the intent to represent Latin America as a whole, embracing the continent's whole history of conquest. *Men of Maize* is deeply influenced by early Mesoamerican Maya Quiché [8] narrative culture, and though it was misunderstood when it was first published due to its style and structure, it is now considered to be one of the "vertebral literary texts of twentieth-century Latin America." [9] It was the first great experiment in what critics now call "magical realism" and today it is also considered "a green conservationist document." [10]

After reading Asturias' novel in Spanish and in Gerald Martin's English translation, I became fascinated by its relevance in the present. What Asturias described as a phenomenon of exploitation occurring in the first half of the twentieth century, can be easily transposed and applied to what is happening in Mexico today in the twenty first century, namely, the exploitation of indigenous peoples, of the land, and of maize, by national and international corporations. The menace was – and still is – not only the potential erasure of domesticated maize seeds and of ecosystems, but also of indigenous Mesoamerican cultures and their ancestral knowledge systems.

Miguel Angel Asturias' biography was in itself revealing to me. I learnt that he had studied ethnography in Paris where he became involved in translating the famous Mayan bible the *Popol Vuh* or Book of Counsel, considered to be the Maya book of origin. Asturias was deeply influenced by the *Popol Vuh* when writing *Men of Maize*. Not only was he impressed by the narrative structure of the mythical text, most importantly, the very act of translation helped him discover the weight that words carry for indigenous peoples for whom naming is a sacred act with magical characteristics that furthermore empower what is named. [11]

Taking into account that I was a language translator myself in my youth, this biographical note revealed during my research on Asturias was of great interest to me. I was equally drawn by the complexities involved in the translation of culture through language. This accounts for my fascination with the three-step process involved in the translation of the *Popol Vuh*. The process entailed a conversion from the phonetic Mayan hieroglyphic system, to the Western alphabetic system, and then to the Spanish language; a translation detour that actually began in the 16th Century during the Spanish conquest with bishop Diego de Landa who imposed the Western alphabetic system onto the Maya writing system (Fig. 03) by teaching and forcing Maya scribes to write their language in Latin letters. [12]

The denaturing imposition of one writing system onto another has resulted in many transcription errors [13] – or what I'd like to call 'glitches.' Seen in this light, the processes of recodification begun by De Landa and sustained through time, adds up to compounded dislocations that Asturias takes on in his novel, and that I address in *AL GRANO*. They are disjunctions about empirical attitudes towards reality, notions of space and temporality, and the displacement of languages and writing systems – what Gerald Martin describes as the division of the eye and ear via the juxtaposition of the syllabic over the phonetic writing method. [14]

I found this account intriguing due to my works' focus on the social sphere and the means by which people have a voice in society. Additionally, my long-standing interest in language form, language in context, and the associated processes of social and cultural translation that convey and assign meaning, compelled me to delve deeper into Mayan hieroglyphs – an investigation that guided my decision to adopt certain glyphs as icons for two *chunks*; *Al GRANO: Hack* and *Al GRANO*: *Crop-Cropping*. I created new juxtapositions of languages and codes to generate purposeful glitches where hidden transcripts reside, hence representing the incessant efforts by elite groups to penetrate, disrupt and erase sites of knowledge and the corresponding efforts by subordinate groups to defend them. [15] To such a degree, these glitches embody a creative activity of resistance and the option to cultivate, and to even mobilize new modes of thinking and of doing.

I began work by researching and consulting existing Maya dictionaries – looking into basic glyph signs that have been deciphered – and I created a discrete inventory of glyphs that represent nouns, adjectives and verbs, or verbal phrases, all of them related to the area under discussion, for example: maize god, earth, tortilla; to scatter, to harvest, to demolish; in addition to representations of time, such as: it happened (past), it happens (present), it will happen (future). [16]

Once done with the lexical inventory, I probed into my archive of digital images of corn that I have photographed in the past four years, and opened them - not in an image editor - but rather in a 'hex' editor that revealed the images' coded hexadecimal and ASCII languages. [17] Then, with the intention of putting into practice my own recodification process, I proceeded to crop and erase sections of digital code, introducing citations from the novel *Men of Maize*; excerpts that speak of the devastating effects produced by capitalism and international companies on the lives of indigenous maize growers, having a profound effect on their customs, ancestral beliefs and cultural identity.

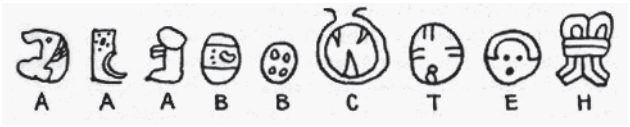

Figure 03. Detail of Diego de Landa's "alphabetic" interpretation of Maya hieroglyphs in *Relacion de las cosas de Yucatan*, 1566.

Figure 04. *Al GRANO: Hack* (2014). Two glitch images silhouetted as Maya glyphs included in the solo exhibition at the Centro de Museos, Universidad de Caldas, Festival de la Imagen 2014, Manizales, Colombia. ©Pat Badani, 2015.

My relentless process of code erasure and substitution – via the injection of content in a different language – created ineludible disruptions in the digital corn images resulting in digital glitches. These glitches play an idiosyncratic role in the *chunks*: *Al GRANO: Hack* and *Al GRANO: Crop-Cropping* and they draw attention to the notion of 'denaturing' [18] that animates the whole *Al GRANO* thesis. In a match of front and back, the glitches embody the tensions between surface appeal and the exposed background clamor. *Al GRANO: Hack* shows the front end of code that drives the artwork and *Al GRANO: Crop-Cropping* the back end.

The *chunk* titled *Al GRANO: Hack* (Fig. 04) is composed of 13 curvilinear silhouettes in the shape of Maya glyphs that bear individual language representations: maize god, earth, tortilla; to scatter, to harvest, to demolish, etc. They appear under the guise of deceptively bright graphic symbols that upon closer inspection reveal their 'denatured' character as corrupted digital images. Indeed, these silhouettes showcase the 'front end' of photos of corn whose 'back end' codes have been hacked, modified by a steady nervous tension infusion of disquieting texts from the novel *Men of Maize*. The resulting glitch images have an attractive and lush surface appearance dominated by striated bright colors such as pink, red, turquoise, and blue; colors quite unlike those of the objects photographed. In truth, the prints are as eye-catching in their surface appeal as packaging designs of processed foodstuffs sweetened with fructose corn syrup derived from genetically modified corn, and as deceptive as the shallow promise of a better world anticipated by bioproducts such as corn ethanol and corn plastics (PLA). (Fig. 5)

Figure 05. *Al GRANO: HFCS + PLA* (2011). Digital composites representing foodstuffs containing High Fructose Corn Syrup (top) and products made of PLA bioplastic (bottom). ©Pat Badani, 2015.

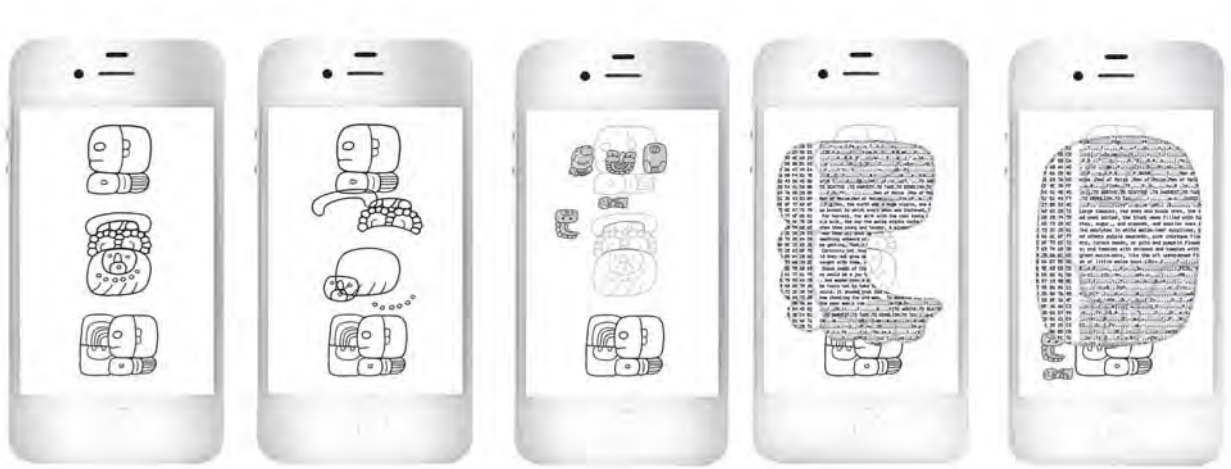

Figure 06. *Al GRANO: Crop-Cropping* (2013). Composite image with screenshots captured on an iPhone from the interactive App. ©Pat Badani, 2015.

The *chunk* titled *Al GRANO: Crop-Cropping* (Fig. 06) is a free App designed for mobile devices and it has a pictographic interface bearing the same 13 Maya glyphs used in the piece I just discussed – but devoid of all color in this instance. The work can be seen as the previous *chunk*'s shadow due to its austere black and white presentation showcasing the 'back end' hacked code that drives the 'front end' of the lip smacking GM corn glitch images. In addition, the piece's interactive design invites the user to engage with the past, the present and the future of maize by using their fingers in small gestures. By tapping, swiping, pinching and zooming, they engage in a game of deciphering meaning through ASCII and hexadecimal languages mixed with texts in the western syllabic language. These texts, extracted from the novel *Men of Maize*, highlight the plight of indigenous Mayan people in defense of maize culture (Fig. 07).

Yet another *chunk* titled *Al GRANO: Injection-Infection* (Fig. 08) is comprised of three sculptures. With the intention of exposing how the structure of material is changed through bioengineering, I used a 3D printer and PLA bioplastic to produce the sculptures. These three dimensional renderings show the structural formula of fructose, amylase, and polylactic acid; laboratory-processed components sourced mostly from transgenic corn, and used in the production of foodstuffs, biofuels and bioplastics. The work points to the effects of large-scale agro-industrial production of transgenic corn in order to optimize crop yield intended for the production of bioproducts. High fructose corn syrup (HFCS), corn plastics (PLA), and corn based ethanol – sourced from GM corn – cause a genetic and physiological imbalance in native maize varieties, disrupt local ecosystems, damage agricultural fields and also take away from local populations – specifically indigenous populations in Mexico – land that could be used for subsistence food crops. Indeed, the spread of USA-led agribusiness supported by the colossal NAFTA trade accords [19] required neither seed segregation nor labeling and in 2001 Mexican researchers discovered contamination of native maize landraces by GM corn genes that threatened maize's viability and the ancestral diversity developed there through traditional breeding. Truly, maize agriculture – whether native, hybrid or transgenic – does not only touch upon cultural and identity issues, it also touches on economic and civil realms. The contamination of

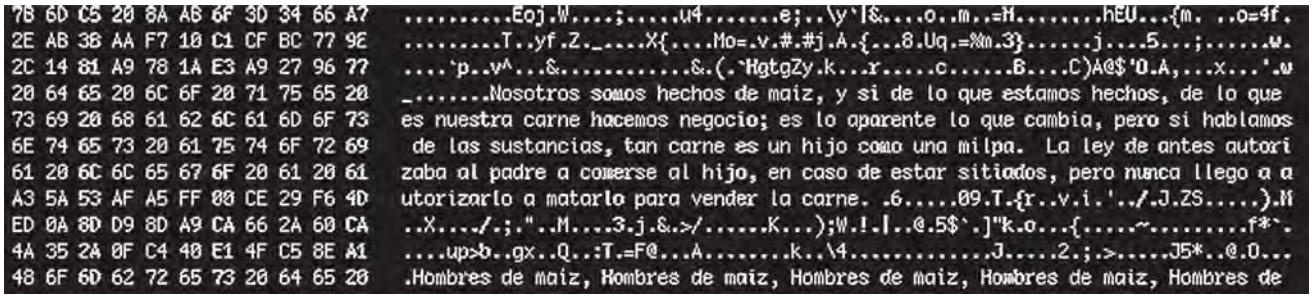

Figure 07. Recodification process. Detail captured from the hex editor in one of several digital prints on transparent acetate included in AL GRANO's solo exhibition. Centro de Museos, Universidad de Caldas, Festival de la Imagen 2014, Manizales, Colombia. ©Pat Badani, 2015.

Figure 08. *Al GRANO: Injection-Infection* (2014). Installation detail. 3D digital prints (designed in collaboration with Chris Wille) encased in glass domes. Centro de Museos, Universidad de Caldas, Festival de la Imagen 2014, Manizales, Colombia. ©Pat Badani, 2015.

landraces created the need to establish geopolitical immunological structures for the protection of cultural, ecological, and commercial infection from external forces [20] such as government-required moratoriums and requests that the USA undertake mandatory seed segregation so that it could guarantee Mexico the importation of only nonGM-corn. Further – to this day – citizen-led groups of resistance continue to lobby in defense of maize. Noted examples formed by indigenous, mestizo and rural communities are *Red de Defensa del Maiz* [21], and *Pro-Oax* [22] an organization in Oaxaca spearheaded by artist Francisco Toledo.

Conclusion

Al GRANO: Framing Worlds embodies internal disciplinary means that relate to its external relational context. Shaped by conflict situations instigated by a small grain with monumental impact and informed by interdisciplinary research in geopolitics, literature, science and technology related to maize and to GM corn, the *Al GRANO* enterprise exemplifies how creative practice in electronic arts can shape material complexes in a critique that is essential, incisive and also disruptive in its analysis of knowledge systems, processes and ideologies. The project's artistic means – tools, artifacts and systems – brings into play transnational communities and their practices over time, sites of memory and displacement, languages, codes and glitches.

With the intention of constructing a comprehensive image about a very complex topic, I use a "radical reordering" [23] research and creation method involving chunking and restructuring of temporally and spatially heterogeneous material and information. Gallery visitors encounter spatio-temporal orderings of installation pieces that articulate contrasting positions (Fig. 09). They engage in a process of "elaborative encoding," [24] associating and connecting new and known information, and encoding

Figure 09. Viewers encounter spatio-temporal orderings of installation pieces. Festival de la Imagen 2014, Manizales, Colombia. ©Pat Badani, 2015.

unfamiliar features or attributes to the representation of events. This process of reframing knowledge favors the emergence of fresh perspectives needed to challenge the idealized vision of scientific and technological progress, fomenting the possibility of cultivating alternative modes of being and making.

Aware of differing narratives that tenaciously emerge out of government officials; out of policy makers; out of research scientists and biotechnology experts; out of media and journalism; out of lobbying groups; out of farmers, artists, writers and the general public, my aim with this highly faceted multiyear project is to reveal a new pattern of value and enquiry in a troubling phenomenon that has persisted for decades. I speak to the gaps and glitches that exist in processes of codification, and recodification of national and continental narratives related to maize as food, and equally as cultural symbol. [25]

Endnotes

1. The term 'genetic avatars' refers to new genetic organisms created by scientists working for biotechnology corporations who are able to rewrite and alter the genetic codes of different species, and by so doing, create a new incarnation or manifestation. The term is used by Maryse Carretero in the title of her book *Histoires de maïs: d'une divinité amérindienne a ses avatars transgéniques* (Paris, Editions du CTHS, 2005).

2. Elisabeth Fitting in an interview with Pat Badani for her documentary film *AL GRANO: Corn-Regime* argues "Mexico is the center of domestication and biodiversity of maize." Fitting is the author of *The Struggle for Maize. Campesinos, Workers, and Transnational Corn in the Mexican Countryside,* (North Carolina: Duke University Press, 2011).

3. The projects: *Tower-Tour*, *Home Transfer* and *Where are you from?_Stories* can be viewed in Pat Badani's professional website, accessed May 17, 2015, http://www.patbadani.net

4. George A. Miller, "The Magical Number Seven, Plus or Minus Two" (1956 essay describing an experiment about the average limit for human short-term memory), *Psychological Review* 63: 81-97.

5. Wayne A. Wickelgren, "Webs, Cell Assemblies, and Chunking in Neural Nets," Psychology Dept., Columbia University, New York, NY, accessed May 17, 2015, http://www.columbia.edu/~nvg1/Wickelgren/papers/1992bWAW.html

6. Nelson Godman, "Words, Works, Worlds," in *Ways of Worldmaking*, (Hackett Publishing Company, 1978), 8.

7. Miguel Angel Asturias, *Hombres de maiz.* (Buenos Aires, Argentina, Editorial Losada, 1949). The English translation of the original Spanish language novel was published in 1993: Gerald Martin, trans, *Men of Maize*, Critical Edition, The Modernist Epic of the Guatemalan Indians. (Pittsburgh, University of Pittsburgh Press, 1993).

8. Quiché people are a Mayan ethnic group noted for mixing Catholic with ancestral Mayan practices, forming a contradictory religious system.

9. Gerald Martin, "Introduction" in *Men of Maize*, Critical Edition, The Modernist Epic of the Guatemalan Indians, page xi.

10. Ibid, page xviii.

11. Ronald Chirst, "The Text as Translation" in *Men of Maize*, Critical Edition, The Modernist Epic of the Guatemalan Indians, 440.

12. Franciscan bishop of Yucatan, Fray Diego de Landa was a Spaniard famous for his writings on Yucatan culture, namely for his book *Relacion de las cosas de Yucatan* in which he included an erroneous "summary" of Maya hieroglyphics. Assuming that the Mayas wrote with an alphabet, he asked his native informants to write "a" "b" "c" and so forth, in Maya. The Mayas, on the other hand, heard the syllables "ah" "beh" "seh" and naturally attributed glyphs using these phonetic values, accessed May 17, 2015, http://www.ancientscripts.com/maya.html

13. See the story behind the centuries-long decipherment of ancient Maya hieroglyphs in *Cracking the Maya Code*, PBS, NOVA, aired April 8, 2008.

14. Gerald Martin, *Men of Maize*, page xx.

15. Jmaes C. Scott, "Making Social Space for a Dissident Subculture" in *Domination and the Arts of Resistance – Hidden Transcripts*, (New Haven and London, Yale University Press, 1990), 108.

16. John Montgomery, *Dictionary of Maya Hieroglyphs*, Hippocrene Books, Inc., 2002.

17. OxED, an open source, native hex editor based on the Cocoa framework.

18. Catherine Bédard, "Culture transgénique et art global: le projet Al Grano de Pat Badani," in La Disparition de l'oeuvre, *Nouvelle revue d'esthétique* N. 08 (2011): 150. The term "dénaturation' is used by Bédard in reference to the AL GRANO project.

19. The North American Free Trade Agreement (NAFTA) signed by Canada, the United Sates and Mexico came into force in 1994 and was intended to eliminate barriers to trade and investments between the three countries.

20. Bédard, "Culture transgénique et art global: le projet Al Grano de Pat Badani," 149.

21. Red de Defensa del Maíz, accessed May 17, 2015, http://redendefensadelmaiz.net

22. Pro-Oax, accessed May 17, 2015, http://prooax.blogspot.com/

23. Nelson Godman, *Ways of Worldmaking*, 13.

24. Jeffrey D. Karpicke & Megan A. Smith, "Separate mnemonic effects of retrieval practice and elaborative encoding," *Journal of Memory and Language* 67 (2012): 18.

25. This ISEA conference proceedings paper is an expanded version based on an earlier essay by Pat Badani "Chunking and Recoding in the Al Grano Project," slated for publication (2016) in *Leonardo, Journal of the International Society of the Arts, Sciences and Technology,* published by The MIT Press.

Author Biography

Born in Argentina and having lived in Uruguay, Peru, Mexico, Canada and France, Pat Badani currently lives and works out of Chicago, U.S.A. She is an arts practitioner, critical thinker, educator, editor, and curator. Badani's praxis is concept and context driven and involves artistic research and creation around such topics as inhabitation, transculturality, human migration, and sustainable living. Her works have been shown extensively in international venues – museums, festivals, art centers and galleries. Essays examining her practice have been published in several languages in solo and group exhibition catalogues, in art-magazines, academic journals, and in thematic anthologies. Her own scholarly essays have been published in English and Spanish in symposium proceedings, journals, and in book chapters. As art educator in several institutions in Canada, France and the U.S.A., she has been instrumental in curriculum creation related to interdisciplinary practices. Since 2011, she is Editor in Chief of *Media*-N, Journal of the New Media Caucus, an international scholarly online and print journal.

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Owner of a Lonely Heart: Zebrafish Embryonic Heartbeats

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Abstract

The work presented here was developed in collaboration between the media artist Clarissa Ribeiro and the scientist Huanqi Zhu, by the time they worked together as researchers at James Gimzewki lab, UCLA. The 8 (eight) screenshots and the derived (sonified) environmental sound that integrate the piece "Owner of a Lonely Heart"(2014), were traces of an observation – a scientist measuring the heartbeat of a zebrafish (Danio rerio) embryo's lonely heart. After recording the data, using a microelectrode precisely prepared for the experiment, the scientist generated a series of graphs using the software OriginPro 8.1 and started zooming in different regions, looking for specific points where the patterns fit his expectations according to the main purposes of the research. Despite the procedures were initially part of a bigger project involving several labs and researchers, the actual collaboration was developed as a parallel experiment were the scientist joined the artist in a poetic reflection about the scientific procedures that became part of the artwork itself. Integrating the artist solo show at the Art Sci Gallery, UCLA (June/July 2014), the work invites the audience to reflect critically about the importance of observation in the creation of 'truth' in science, what plays a crucial role in the creation of 'reality', having radical influence in the ways we behave, in our survival strategies, in who we are.

Keywords

Art and Science, Data Sonification, Problem of Measurement in uantum Mechanics, Observer-observation relations in uantum Mechanics, Heart Beating Patterns of Zebrafish Embryo.

Introduction

In the work 'Owner of a Lonely Heart', the authors invite the audience to think about the role of observation in the creation of reality – a basilar concept related to problems of measurement in uantum Mechanics. Observation, from this perspective, is the active agent that collapses quantum possibilities into actualities. Bell 1 reflects on the consequences of a misuse of the word 'measurement', what can make it easy to forget that the results of quantum experiments "[…] have to be regarded as the joint product of 'system' and 'apparatus,' the complete experimental set-up." He emphasize that, as we learned from names like Bohr, the instruments don't play a purely passive role.

Taken as a poetic reflection about these considerations, beyond the realm of uantum Mechanics, the 8 (eight) screenshots and the environmental sound that integrate the installation are memories of an experiment where a scientist was measuring the heartbeat of a zebrafish embryo. The microelectrode where the heart extracted from the embryo's body was placed and accommodated the electronic microscope the web cameras computer hardware and software human's hands; the eyes the human heartbeat… – all intertwined in a quantum level as parts of a system (the apparatus included) that creates the observation itself.

Extended-Altered-Entangled

Our computer-mediated world amplifies our natural perceptional abilities and we can be non-locally engaged in observer-observation relations which nature and implications goes far beyond the use of our so called 5 (five) senses. In this scenario, engineered systems and sensors integrated in apparatuses of all kinds, help in approaching levels of reality from cross-scalar perspectives, bringing to the horizon the emergence and potentiality of exploring innovative aesthetics, procedures, technologies, discourses. This is the context from which the work 'Owner of a Lonely Heart' emerges. A context in which, if we consider ourselves as active elements of Complex Affective Systems (CAFFS), it could be easy to think about the ways we can non-locally affect and be affected by universal forces, by each other, by ourselves, creating realities from a multi-level perspective. A Complex Affective System (CAFFS) is a term the author coined to describe and discuss certain Complex Adaptive Systems (CAS) focusing on affectiveness as the main bond between the systems' elements, relating this aspect of system's interconnectedness, and the ability its elements have of non-locally communicating, to the phenomena of quantum entanglement.

In an objective observation in science, considering the procedures involved in laboratorial experiments in the most diverse areas of investigation, the ideal observer is the one who causes no perturbations to the system under observation. Nevertheless, the physics of the 20th century faced the challenge of questioning the role of the observer. From the uantum Mechanics' perspective, the observer and the system observed become somehow intertwined that the results of any observation seemed to be determined, partially, by the actual choices of the observer. This problem concerning observer-observation relations is represented by the wave function. The main intention in this collaboration was 'to observe/integrate the scientific observation', building a 'meta-point of view' to poetically reflect on how, by means of observing having an hypotheses in mind, the scientist radically influences the results of the experiment. According to Edgar Morin,

> "The meta-point of view is only possible if the observer-conceiver integrates himself or herself into the observation and the conception. This is why complex thought requires the integration of the observer and the conceiver in its observation and conception." 2

In 'Owner of a Lonely Heart', together, collaborating, the scientist and the artist become part of the observation itself and the system (CAFFS) 'scientist-artist-apparatuses-observation' become the 'reality' encapsulated in an art piece. As part of the procedures, the heart of the zebrafish embryo was extracted from the fish's body in search for more precise measurements. The interval from life to death of the 'extracted heart' accommodated on the top of the microelectrode, varies – it can last around one minute or so.

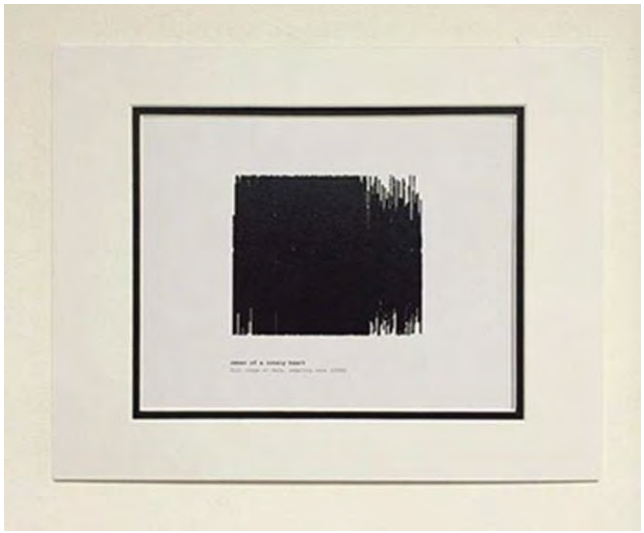

Figure 1. The entire dataset in OriginPro 8.1: the zebrafish embryo heartbeat caption's resultant graph from where the 'zooming procedures' start.

After collecting/recording the data, the scientist generated a main graph (figure 1) using the software OriginPro 8.1 and started zooming in different regions of the graph, looking for specific points where the patterns fit his expectations, according to the main research hypotheses. In this specific case, the purpose of the experiment was to study the beating pattern of zebrafish at different developing stages. The beating patterns can serve as markers to help identifying healthy and mutant hearts, being, in turn, used to test drugs that can improve specific functions of the organ. A control sample with healthy heart was studied. The detected electrical pulses were strong, regular and consistent. An experimental sample with a mutant heart showed the electrical pulses were very irregular and weak. After the administration of a specific drug, the heart function from the mutant sample was restored, and the detected electrical pulses became periodic and normal – an indication of the validity of the initial hypotheses referent to the functional reparatory qualities of the drug.

The Owner of a Lonely Heart

'Observing poetically an observation that could be decisive in a near future by making precise assertions about specific drugs that can effectively fix a damaged human heart' – this was the position of the collaborators in the conception and production of 'Owner of a Lonely Heart'. Together with the scientist, the artist was following and observing the procedures – from the measurements to the search for patterns in the resultant graphics and never-ending datasets.

Figure 2. Beating pattern selected from the entire dataset by the scientist, looking for equivalence with healthy human heart beating patterns.

Eight different screenshots from the entire dataset analyzed were selected to integrate the installation. Each screenshot represents a decisive selection made by the scientist in the search for patterns that matches his expectations – a regu-

lar pattern that is similar to a human's healthy heartbeat an irregular pattern that indicates a malfunction. These specific patterns can only be found in extremely short segments of the dataset, considering that the heart of the zebrafish was extracted from the embryo's body, placed on the top of a microelectrode, and was beating for no much more than one minute. From life to death – from the first screenshot to the last one, the audience could observe in the gallery the lifespan of the embryo's heart from the scientist-artist-apparatus meta-point of view.

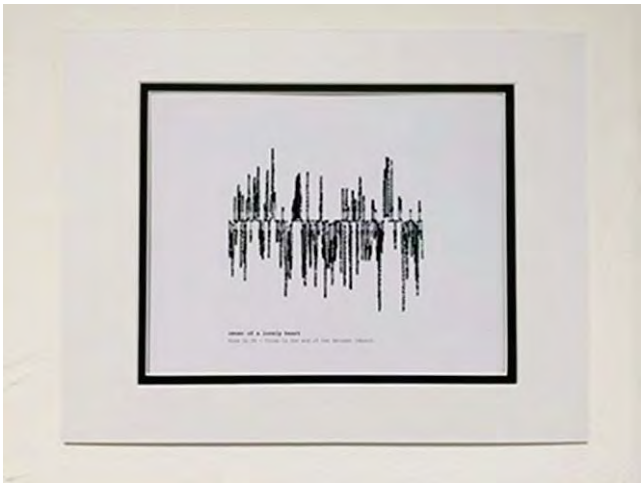

Figure 3. Graph showing the zebrafish's heart near death.

Gentler and deeper: mindful awareness

The sound was derived via data sonification from the entire dataset – full range of data, sampling rate 1000Hz. The artist manipulated the data using the software *Audacity* and *Adobe Audition*, altering the speed and adding effects to give it spatial qualities and explore specific nuances in the perception of the raw data patterns. Similar strategies for data sonification have becoming common during the last two decades, in works that emerge from collaborations involving artists and scientists. One work that was very influential to the artist in the development of the present project is the 'Blue Morph', collaboration between media artist Victoria Vesna and nanoscientist James Gimzewki – an interactive installation that uses nanoscale images and sounds derived from the metamorphosis of a caterpillar into a butterfly. According to Vesna and Gimzewski 3 , the sounds used in this piece were acquired and recorded by detecting nanoscale motions of the pupa surface using atomic force microscopy (AFM) and optical beam deflection during the developmental stages of metamorphosis.

According to Walker and Nees, from Georgia Tech 4 in sonification it matters which specific sound dimension is chosen to represent a given data dimension. Reducing the speed from the original (corresponding to 0,000) to -98,000, was a strategy to enable the audience to perceive subtle variations in the raw data (22,400 lines/ values Figure 1) directly sonified in Audacity 2.0.5. In a subsequent editionof the exported *.wav* file in Adobe Audition CS6, effects as echo were applied to give the sound qualities that could stimulate mindful awareness and relaxation.

The intention was to produce a sound that could allow for a perception of the data recorded via microelectrode array (MEA) from a poetic perspective that brings all the fragility and subtleness of a life in its early stages. In addition, another intention was to emphasize all the ephemeral qualities a heart extracted from a fish embryo could awake when the audience gets immersed in a rhythmic travel from the moment it was recently extracted and is pulsating in all its strength (Figure 2) to the very last moments when it is dying (Figure 3).

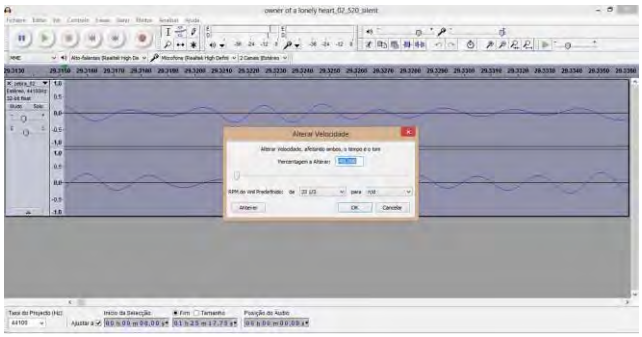

Figure 4. Direct Sonification using Audacity 2.0.5

Subtle Apparatuses for Extrasensory Affectiveness

The installation is a result of the artist's most recent project that is focused on the conception of a series she named 'Subtle Apparatuses for Extrasensory Affectiveness', some of those were in her solo exhibition at the Art Sci Gallery, CNSI – California NanoSystems Institute, UCLA, in Los Angeles, form June 5th to July 5th , 2014. The 'subtle-apparatuses' could be understood as semi-material systems conceived as exercises on experimental metaphysics – performing ventures in realms beyond the physical domain, bearing questions about the nature of reality and our bodies, our affective dimension, consciousness and the self. According to Professor Michael Punt,

> "The fact that technologies rapidly become associated with a class of objects that are fundamentally material should not deflect our attention from the semi-material: another class of objects that emanate in our fullest relationship with the world as necessary mnemonics to our affective dimension." 5

By means of the artist approach in the work 'Owner of a Lonely Heart', apparatuses are not taken as external forces that operate on bodies from the outside. Following the considerations of aren Barad, apparatuses could be considered as "[...] material-discursive practices that are inextricable from the bodies that are produced and through which power works its productive effects." 6 According to Roy Ascott, apparatuses as the "scanning tunneling microscope (STM), as an example, calls for touch rather than vision to navigate the nanofield and to manipulate individual atoms." 7 Professor Ascott emphasizes that "[...] the nanofield mediates between pure matter and pure consciousness and that its significance as an interface between two levels of reality can hardly be overestimated." 8 Travelling through touchable and untouchable, 'Owner of a Lonely Heart' is a call to explore the very power of observation in the creation of the realities we inhabit.

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Authors Biography

Clarissa Ribeiro, Ph.D., is a media artist and researcher. She is currently the main Associate Professor of Roy Ascott Studio in Shanghai, China. Recently, she was awarded a Fulbright grant in Arts, and was living in Los Angeles, California, as a Postdoctoral Research Scholar, connected to the UCLA Art Sci Center and Lab, collaborating with artists and scientists that are running cutting edge projects in their areas. During her Ph.D. in Visual Arts by the University of Sao Paulo, Brazil, by the time she was together with the Gilbertto Prado's group, she was a visiting research member of the CAiiA-Hub of the Planetary Collegium, U . As an independent artist, she has been producing and exhibiting a series of experimental interactive installations exploring complex affectiveness through macroscale metaphorical translations of the non-local phenomenon of quantum entanglement. At present, regardless of living in Shanghai, she is still 'non-locally' collaborating with the Art Sci Collective.

Huanqi Zhu, Ph.D., is a researcher at Nano and Pico Characterization Research Lab, UCLA, specialized in quantitative analyses and predictions in physical systems. He has hands-on experience and working knowledge in physical sciences, with extensive experience in noise isolation and noise cancelation with comprehensive training and skills in data processing.

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Toxicity and the Equidistance of Biotechnology and Biopolitics

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Abstract

The paper looks into how "Toxicity" entrenches itself into what Phenomenology sees as the co-constitution of society and technology. The cultural deciphering of the toxic societal terrain resonates with current socio-economic global transformations. The topic of toxicity reconstructs the current environmental situation and socio-political contexts by looking into modes of contemporary cultural and technological production. Biopolitics maintains an extended role today by shaping life and attaining central role in society. It adds a complexity of layers that allows radical reconstruction of relations between politics and nature, allowing for a reassessment of how we look at life today. The trajectory of development of Biopolitics is altered, for life appears not to be what we have originally assumed that it was, and therefore its regulation cannot continue under previously granted premises. The dualities of power and right, sovereignty and law, do not leave the contemporary Biopolitical discourses for a minute. The Bio-political characteristics of Toxicity are seen by some in line with eugenics, as the toxins will most certainly lead to sterility of the indigenous population, and are to be seen in correlation with the degenerative pathology of the prevailing illnesses such as alcoholism, STDs, obesity, diabetes, cancer, etc.

Keywords

Toxicity; biotechnology; biopolitics; Foucault; Heidegger; bio art; phenomenology; Enframing; bio-society; apparatus

The idea of *Toxicity*, in its theoretical and practical results, entrenches itself into the standard phenomenological understanding of the co-constitution of society and technology. The cultural deciphering of the toxic social terrain resonates with current socio-economic global transformations. The topic of toxicity reconstructs not only the current environmental situation, but also sociopolitical contexts by looking into modes of contemporary cultural and technological production, the extraction of minerals, toxic waste, local and international policies, community-based responses and processes of production, consumption and disposal.

We are continually subjected to processes whose full impact is hard to comprehend; the phenomenological approach allows us to reveal these processes. The Heideggerian *Dinge* (Thing) contains within itself the possibility of gathering together the contents of the universe, *toxins* included. Relations between Things become crucial, acquiring different features depending on the contexts of where and how they are situated. The discourses of biotechnology are evolving, showing us that their latest theoretical and practical developments have a potential to cause a tectonic shift in our society and culture, wherein we experience the world at the intersection of the engineered and the biological. *Toxicity* appears precisely at this intersection, and its biopolitical modes must be understood. Marshall McLuhan noted that the creation of the technological world has created a neural exoskeleton. I maintain that this skeleton has become tainted by Toxicity in numerous ways, from the bioenvironmental to the info-financial.

The extended role of biopolitics today focuses on the crucial question of how biotechnology shapes life and comes to assume a central role in society. Biotechnology, through its complexity, radically reconstructs the relations between politics and nature, allowing for a reassessment of how we look at life today. Under biotechnological pressures, the regulation of life cannot continue under the premises of what had been previously taken for granted. The dualities of power and right, sovereignty and law, do not leave biopolitics for a minute. Additionally, biotechnology generates its own internal conflicts (e.g., Monstanto vs. Dupont in regard to GMO seed patenting.) We become witnesses of a process in which the state control of the biological is increasingly being ceded to biotech companies. In Michel Foucault's words: *For capitalist society it is the biological that is important before everything else; the biological, the somatic, the corporeal. The body is a biopolitical reality, medicine is a biopolitical strategy.*

Life, politics and economics intersect at such speeds in the globally-connected society that a novel biopolitical model is emerging which alters this society's operational functions. I refer here to the social and political functions of the Biotech Revolution. The technological and psychosomatic constitute the two poles in this emerging biopolitical discourse. At the centre of this discourse is the notion that *life* can now be moulded as we see fit, enabled by biotechnology. Biopolitics is therefore able to control life by taking it out of the *natural domain*, reshuffling it at will and subsequently using it in a functional or structural form, thereby *freeing life* from nature. This intertwining of nature and technology makes the schematic of biopolitics increasingly complex. The question of articulating sovereignty no longer depends on the suppression of life; our understanding of life and death has altered. Biopower, embedded in biopolitics, now concerns itself with the mere reshuffling of biological units of data. We have moved a step closer to

the fulfillment of Foucault's prophesy about the extension of biopower: *the excess of biopower appears when it becomes technologically and politically possible for man not only to manage life but also to make it proliferate, to create living matter, to build the monster, and ultimately to build viruses that cannot be controlled and that are universally destructive. This formidable extension of biopower, unlike what I was saying about atomic power, will put it beyond human sovereignty*. Thus, we have effectively banned experiments with plutonium, but we continue to be quite liberal with the experimentation, research and use of biotechnology.

In order to contemplate fully the notions of life, flesh and the body, we must now surpass the Heideggerian dichotomy between existence and life. We are witnesses and participants in the creation of the Biopolitical Apparatus in all of its paraphernalia. And when we speak about this Apparatus, we should remind ourselves of Vilém Flusser's remark that apparatuses are based on technical and political programs which are highly ideological and always biased. There is no value-free technology. And indeed, we can see that biopolitical conflicts are accelerating in both the real and virtual worlds among governments, NGOs and corporations over genetic-technological practices, stem cell research, bioethics and bio-patenting. Public engagement in biotechnology can be seen in the increasing interest in DNA profiling, personal genomics, biodata gathering and, most recently, genetic social networking. One of the possible outcomes of this arrangement is the creation of a genetically based value system. Another outcome may be the development of appealing forms of neo-eugenics and the creation of new utopian communities. Biology has a long history of being politicized, but we must admit that the biotechnological changes in the past two decades are indeed profound. *Historically, all technological revolutions have resulted in an alteration of the political, social and economic spectrums of society. We find ourselves as a society facing radical changes in power relationships in the local and international domains*. This biopolitical shift registers at the economic (bio-capitalism) and cultural (bioculture, bioart) levels. This shift, generated by the Biotech Revolution, configures the biological as political and economic. *The biological as political* includes notions of human rights, the changing and increasingly toxified environment and bioterrorism. *The biological as economic* sees bio-capitalism as the latest stage of capital's development, but also discloses a certain negation of profit-oriented values and the necessity of growth, thereby holding an ambivalent ethical position regarding capitalist production values.

As contemporary biopolitical discourses intersect in the re-contextualization of the relations between state apparatuses, scientific protocols and cultural systems, the consequences of the Biotech Revolution become apparent in the political and economic spectrum. These relations coalesce in the construction of a global Biopolitical Apparatus, encompassing new vectors of power with regard to social, political, economic and administrative mechanisms, as well as knowledge structures which have the capacity to create, maintain or destroy contemporary society. Biotechnology thus enables a certain neo-politicization by putting into motion control mechanisms based on a coding system, altering the dynamics between state and individual and resulting in an increasingly programmable and disciplined society. This up and coming Biotech era has the potential of inaugurating a very different constellation of political visions and social visions just as the Industrial era did. The current debate over cloning human embryos and stem cell research marks the beginning of the new biopolitics.

Félix Guattari taxonomizes the apparatuses of subjectification in three ways: as *pathways of power, pathways of knowledge and pathways of self-transformation*. The relations between these three pathways determines how society is established and whether the Biotech Revolution will create the conditions for new *existential territories* for humanity, rather than replicate and continue present alienation systems. I am of the opinion that in order for the pathways of self-transformation to influence the pathways of knowledge and power, we will have to embrace collectively the idea of *biopolitical and biotechnological responsibility*, which will assist us in further developing the governmentality of *bio-society* according to the theoretical and practical pathways of self-transformation.

The overall implications of technology are exemplified in the everyday relations that technology establishes. The disclosure of the world through technology also is a disguise of these relations, relations that can, however, be unconcealed. In "The Question Concerning Technology," Heidegger noted that the essential unfolding of technology harbours within itself what is least expected, the possible rise of a saving power. Where does this saving power of technology reside? Will salvation be found in art and activism, that is, strategies of resistance? Perhaps the Biotech Age will allow us to witness what Heidegger called the second beginning of thinking, the meeting of the world in historical time-space, and perhaps this space can be built only in art.

At the same time, artistic and cultural research into biotechnology has questioned established philosophical systems, ethical beliefs and cultural practices by proposing new ways of looking at life and society, as artists, critics and theorists navigate the maze of the global Biopolitical Apparatus. How art and technology interrelate, how this interrelation changes in the cultural, sociopolitical and ecological landscape and how biotechnology infiltrates into everyday life are important research areas. Artistic responses have included examining biopolitical conflicts in the real and virtual worlds; pollution; corporeality and somatic biopolitics; energy control, fuel material and alternative energy sources; the inheritance and programmability of life; the causes and consequences of environmental changes; environmental sustainability; micro and macroecologies; life, empathy and questions of ownership; GM products; death and appearance; and the ethical implications of working with biological media in an art context.

Practical strategies of resistance such as these need to

address structures of knowledge in order to achieve broader ethical and philosophical concerns concerning biotechnology; they must also look into what Heidegger would have called the Biotechnological *Gestell* (Enframing) of everyday life and address the changes that Toxicity causes in the cultural, sociopolitical and ecological landscape. Of course, those concerned with Toxicity must be aware that this Enframing has infiltrated deeply into the system, aided by lobby groups mediating between the biotech cartels and various governments. Any potential resistance must engage in a robust imposition into mass media channels and make periodic feedback analysis to assess its progress. Phenomenology's meta-social function is necessary for this. In particular, an analysis of the *natural attitude* must be implemented. The phenomenological investigation of the biopolitical must look into element of reflexive interplay between biotech programmers' standards (content development) and the lifeworlds of actual people – the interplay in which new identities are forged. After all, Heidegger tells us that Enframing is *destining* from which the *essence of all history is determined*. Enframing is the essence of modern technology because, for Heidegger, technology is rooted in *tēchne*: it is a means for sourcing true forms and ideas that exist prior to their phenomenal appearance. Heidegger's concept of Enframing can be deciphered today using Eugene Thacker's triumverate of *encoding, recoding and decoding*, as today the dissemination of biological data through information networks either on demand or out of necessity creates a new situation in which the biological is seen as a digitally packaged commodity.

In conclusion, in order to track the changes brought about by the Biotech Revolution, we must utilize both phenomenology and biopolitics. Phenomenologically speaking, the social order and reality of interactions between institutions and individuals are constructions. Society is a fragile construction. It is consciousness that determines the actions of all entities. There is no alternative but creativity in this process, and therefore human beings must act as creative agents in the construction of their social worlds. It is necessary to assert meaning in a process which would otherwise seem chaotic.

As far as biopolitics is concerned, the biotechnological changes that our civilization is witnessing are profound, and as all technological revolutions throughout history have resulted in significant changes in the political, social and economic levels of society, so we find ourselves collectively facing radical alterations in local and international power relations. Thus, we are in a different situation than the one predicted by Foucault, as biopolitics today begins to realize that biotechnology potentially allows for a further emancipation of the human being in terms of its self-understanding, its own genetic make-up, all of its flaws and virtues. The constant advances in biotechnology, and we can note the Human Genome Project as a sign of this advancement, signify a shift in the balance of power in favour of a society that can select and design desirable life-forms in advance.

Thacker reminds us that biotechnology takes place on a global level, be it in terms of exchanging biological information, controlling epidemics, deterring biological attacks or standardizing intellectual property laws. Importantly, the Biopolitical Apparatus suggests novel blueprints of power allocation in the domain of the governance over life. Thus, any interpretation of biopolitics, in light of these new developments, must take into account how biopolitical discourses have changed in terms of *the biological as political* and *the biological as economic*. This necessitates the articulation of *Biotechnological Responsibility* and the development of *Modes of Governmentality for Bio-Society*. This future bio-society could take upon itself a variety of roles including the role of *hegemon*, and might develop new modes for *governance*, *economic domination* and the *repositioning of our relationship towards nature*. However, alongside the potentially negative consequences of the Biopolitical Apparatus, we must also consider a more humane role, indicated by Giorgio Agamben in his *What is an Apparatus?*, wherein we learn that at the heart of friendship, philosophy and politics lies the same experience: the shared sensation of being.

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When Ideas Migrate: Postcolonial Perspectives on *Biomodd [LBA^2]*

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Abstract

Biomodd is a global series of art installations in which computer technology and ecology converge. Computer networks built from upcycled computer components are provided with living internal ecosystems. In a symbiotic exchange, plants and algae live alongside electronics and use the latter's waste heat to thrive. Sensors and robotics provide additional interaction possibilities with the organisms. The first version of the project was completed in the US, while the second version was built in the Philippines. Using a postcolonial stance, we reflect on the challenges involved in translating the project from one context to another. We focus on issues related to heat recycling in the tropics; authenticity and hybridity; obsolescence and the convertibility of capital; cultural sampling, remixing, and appropriation; and structures for social organization. We advance Biomodd as a significant contribution to art-science collaborative initiatives in the global South.

Keywords

Postcolonial computing, installation art, collaboration, ICT4D, HCI4D, digital games, e-waste, recycling, gaming, ecology, biological art

Introduction

Many practices of contemporary art have wandered into and set up shop in territories traditionally held by science, and vice versa. [1] This crossover between art and science seems particularly noticeable to those of us who live in what media theorist Rolando Tolentino has termed "advanced capitalist countries", in which intellectual practices and concerns in scientific and artistic disciplines have experienced particular shifts and turns. [2, p. 101] However, a review of the literature on why science matters in so-called 'global South' countries (like the Philippines, from where we are currently writing this paper) reveals that questions of existential philosophy or aesthetics hardly figure. Instead, issues that do appear to matter – and for which the study of pure and applied sciences is encouraged – include improving food security, achieving better maternal health outcomes, preventing the spread of communicable diseases, and addressing other challenges articulated in texts such as the United Nations Millennium Development Goals. [3] In response to these socio-economic challenges, perspectives on information and communication technologies for development (ICT4D) and human-computer interaction for development (HCI4D) have been advanced within computing science. [4] While such perspectives are interdisciplinary and do draw from the arts, much work could be done to advance the intersectionality of the arts and the sciences and their role in addressing the diverse range of issues particularly in the "imperialized formations" of the global South. [2, p. 101]

For instance, art-science collaborations matter in addressing the global challenge of fostering what might be thought of as a *critical awareness of connectedness*. By this we mean a shared understanding of how the flourishing of human societies relies on our interaction with the natural ecosystems on which we depend, and on a critical engagement with the artificial systems that we create. This includes an acknowledgement and understanding of the fact that social, natural and artificial systems are continuously impacting on and reshaping each other. These dependencies and interactions have underpinned a diverse and burgeoning corpus of artistic and design work that has emerged over the years, marked by an interest in imagining a new "ecology of relations" through interfaces and systems that link humans, organic materials, and machines. [5] For instance, *The Telegarden* features a robot arm that tends to a garden and which human participants can remotely control. [6] Mussels control lights and sounds in Natalie Jeremijenko's *MUSSELxCHOIR*. [7] *Biolesce* uses electric motors to agitate algae that luminesce in response to the heart rate of audience members. [8] *Legend of the Sea Lord* uses mobile technologies to deliver a "mythological spectacle" and parable on the impact of human activity on marine ecosystems. [9] In each of these cases, the artists have responded to the invitation to address critical awareness of connectedness through poetic and technology-led forms of interventions.

Figure 1. Biomodd installations. From left to right: Biomodd [ATH[1]] (Ohio, USA, 2008); Biomodd [LBA[2]] (Los Baños and Manila, Philippines, 2009); Biomodd Maribor (Maribor, Slovenia, 2010); Biomodd [NYC[4]] (New York, USA, 2012). Images used with permission.

In this paper, we present our attempt to find a shared space for inquiry and practice between contemporary arts and sciences in a postcolonial, global South context. In particular, we reflect on how we navigated problematic engagements during a process of reimagining and reinterpreting an interactive, new media art work that was originally designed in US and led by a Belgian artist/scientist – titled *Biomodd [ATH[1]]* – in the context of the particular social, cultural, and economic conditions of the Philippines. The result of this translation we titled *Biomodd [LBA[2]]*. (For brevity, we abbreviate these two projects as *ATH[1]* and *LBA[2]*, respectively.)

ATH[1] and *LBA[2]* are both part of *Biomodd* (www.biomodd.net), a global, collaborative, cross-cultural platform that brings together these various threads of artistic praxis into an integrated artistic work through interdisciplinary collaborations between artists, scientists, and other social change-makers. While *Biomodd* has been discussed in relation to climate change adaption and to education, we have as yet not teased out what we feel are the most salient cultural themes that have figured in the process of carrying out the project. [10], [11] This paper aims to address that gap.

Postcolonial critique and new media art

To frame our reflections, we refer in part to Irani et al's discussion of "postcolonial computing", which they define not as a new way of doing things, but "an alternative sensibility to the process of design and analysis" of digital products. [12] The term was advanced in the context of the application of HCI and human-centred design to a growing range of complex global problems, including "technological cultures, digital divides, multiple stakeholders, [and] economic disparities":

> *We take as our starting point a move from "development" discourse to postcolonial discourse – that is, a discourse centered on the questions of power, authority, legitimacy, participation, and intelligibility in the contexts of cultural encounter, particularly in the context of contemporary globalization.* [12]

Postcolonial critique of digital media and the electronic arts first surfaced in the late 1990s but then disappeared from the technology and computing design discourse until its resurgence a decade later. [13] We aim to contribute to the thickening of *postcolonial discourse in interactive art and technology design* by using the lens of postcolonial computing to retrospect on *LBA[2]*.

Biomodd Themes and Approaches

Biomodd reimagines and integrates relationships between social, natural, and artificial systems. The project was initiated by the second author of this paper in 2007 and has been undertaken in collaboration with various groups and individuals in the USA, Philippines, Slovenia, Belgium, the Netherlands, New Zealand, Chile, and the UK. [14] Figure 1 shows some of the different *Biomodd* versions. While the project does not solely aim to create a singular art object, like many other process-oriented projects, *Biomodd* projects nevertheless coalesce into physical structures that have been shown in exhibition contexts, whereupon the installation stands as a material testament to the dialogues, negotiations, and other exchanges underpinning the work.

Biomodd is predicated on a range of concerns that, taken together, form a conceptual framework.

Case modding and hardware hacking: *Biomodd*'s name is derived from the practice of *case modding*, the practice of transforming computer cases into imaginative structures. [15] *Biomodd* is inspired by the codes and techniques in the case modding subculture.

E-waste and its creative reuse: Obsolete hardware is reused in *Biomodd* functionally and visually. As we discuss in the next section, the difference between obsolescence in the industrialized West and in the global South presented a number of challenges in *LBA[2]*.

Symbiosis between electronic and biological systems: *Biomodd* installations bring biological life in proximity with electronic hardware, and provide mechanisms for the two systems to communicate with each other through meaningful symbiotic relationships.

Open sourcing: *Biomodd* encourages the use of open source operating systems and software applications in order to extend the modification potential for the artwork as far as possible. In return, online guides have been produced that allow anyone interested to build their own version of the *Biomodd* installation.

Digital games and gaming culture: *Biomodd* installations can function as multi-player gaming environments. Games are either modified open source games or, as in the case of *LBA*^{2}, developed from the ground up by team members.

Recycling: After showcasing the project, the team that built the piece dismantles it and adopts the various components, or else recycles them in thrift stores, recycling centres, and institutions that might find use for the materials.

Juxtaposing the local and the global: Selected parts of previous versions are integrated into subsequent versions, which are built with different collaborators and new materials, but with the original concept reinterpreted according to local cultural and social conditions. In this way, *Biomodd* echoes Irani et al's observation that "technology travels … around the world in projects of design and development". [12] However, as we discuss in this paper, this goal of juxtaposition creates tensions due to conflicting histories, value systems, and narratives.

From Ohio to Los Baños: The Biomodd migration

As mentioned, the first *Biomodd* version, *Biomodd [ATH*^{1}*]*, was designed in Athens, Ohio in the US in 2007-2008. The second version, *Biomodd [LBA*^{2}*]*, was completed in Los Baños, Laguna in the Philippines in 2009. *LBA*^{2} was largely patterned after *ATH*^{1}. The social, cultural, and economic contexts of these two sites are widely different and resulted in outcomes that we feel reflect these differences. To discuss *LBA*^{2} sufficiently, we first describe *ATH*^{1}.

Figure 2. The *Biomodd [ATH*^{1}*]* installation

Led by this paper's second author, *ATH*^{1} was designed by a group of artists, scientists, and social change makers, and developed in the USA as part of an artist residency at The Aesthetic Technologies Lab at Ohio University in Athens, Ohio between September 2007 and January 2008. Around nineteen collaborators contributed to the project, which initially began without "a specific detailed design in mind"; and was instead left open as a an open-ended concept of translating "social heat" into "computer heat" and then finally into "life-sustaining heat":

> *Biomodd [ATH*^{1}*] reflects our attitude towards technology: never satisfied with the status quo, machines are endlessly evolved, systems are boosted and performance gets violently pushed. Overclocking of computer processors becomes a metaphor of contemporary society; a society fascinated by growth and productivity but at the same time generating massive amounts of excess heat.* [16]

The material outcome of the process was a living sculpture that functions as a social gaming station. Figure 2 shows the completed *ATH*^{1} installation, which featured the following components and subsystems:

- A metal frame covered with acrylic panels that contains exposed computer components and various plants;
- A networked system of five upcycled computers running a Linux distribution; the different computer parts are visible and mounted throughout the case;
- A multiplayer computer game that runs on the networked computers;
- A liquid cooling system that used a green algae culture as coolant liquid and stored in a large glass aquarium;
- A second aquarium – inhabited by goldfish – that was used to cool the algae coolant liquid; and
- Living plants housed within the case and whose growth was enhanced by the heat produced by the computer

Like *ATH*^{1}, *LBA*^{2} emerged out of a formal engagement between this paper's second author and with a university, namely the UP Open University in Los Baños. We co-led *LBA*^{2}, with the first author acting as the second author's local counterpart in the project. *LBA*^{2} heavily built further upon the design that was established during *ATH*^{1}. We initially aimed to use the same approach as in *ATH*^{1}, starting with a standardized conceptual framework without strict guidelines on how to formally interpret that framework. To facilitate the process, we offered the team the idea of interpreting the *ATH*^{1} system using local materials and aesthetic vernaculars, but only as a point of departure. However, a variety of contingencies forced the team to transform what was originally an exploratory design exercise into a blueprint for the final installation. These contin-

Figure 3. The Biomodd [LBA^2] installation

gencies relate to real complexities around funding, space, temporality, collaboration, collegiality, authority, and power. For reasons of space, we postpone further discussion on these contingencies, though we have previously covered some of the relevant issues in an examination of *LBA*^{2} as a platform for teaching and learning new media art. [11], [17] For now, we note that the team felt that they augmented the initial design to such an extent that they preferred to keep it in the final presentation. These augmentations cantered on the multiplayer game, an embedded aquaponic system, environmental sensing, and the use of traditional woodcarvings.

In this section we focus on five aspects of the *LBA*^{2} project that deserve analysis in the context of the postcolonial. We begin the discussion of each aspect with a discussion of material aspects of the installations. We believe that the political is embedded in the material. [18] Reflecting on the material differences between the two versions provides us a platform to unpack five issues: appropriate metaphors for heat in the tropics; colonization, authenticity, and hybridity; defining e-waste and leveraging the convertibility of capital; sampling, appropriating, and remixing; and the rhizome and the tree as metaphors for social organization.

Appropriate metaphors for heat in the tropics

One of the significant challenges we faced was reinterpreting in fact the central idea from *ATH*^{1} of the creative transforming and upcycling of waste heat. In temperate climates where excess heat generated by machines can be effectively used to keep spaces more liveable or productive (as with greenhouses), similarly generated excess heat in already hot tropical climates is extraneous and near useless. That technological solutions cannot simply be ported over from one context to another is well established, at least in other fields of science and technology such as agriculture and architecture. [19] Irani et al's observations on *appropriate technology* strikes close to the problem: "Many such well-intentioned efforts to 'migrate' technologies from industrialized contexts to other parts of the world have foundered … on social, cultural, political, or economic assumptions that do not hold." [12] In the case of the migration of Biomodd to Los Banos, the assumption was an environmental one.

The solution we settled on was brought forward by one of the team members who happened to specialize in aquaponics – the practice of recirculating water from aquaculture tanks to a hydroponic system. [20] The warm fertilized fish tank water in *LBA*^{2} was used to irrigate a vertical system of hydroponically grown plants inside the case. This elegantly closed the conceptual and thermodynamic loop: if people were using the game more intensively the computers would heat up more. As a consequence the algae culture would also heat up and dissipate more heat to the fish tank. The increased temperature of the fish tank consequently increased the fish's metabolism creating more nutrients for the plants in the vertical hydroponics system. Playing boosted growth.

Colonization, authenticity, and hybridity

In *ATH*^{1}, the processor of the server of the network was cooled using a water-cooling setup. But instead of commercial coolant liquid, we used a living culture of single-cell *Chlorella* algae. The warm algae culture was subsequently cooled using a simple heat exchanger. The warm algae were pumped through a submerged spiral in a fish tank. In this way the heat dissipated in the fish tank.

The algae's provenance is relevant. Originally sourced from Belgium, the algae was dried and revived in the US during *ATH*^{1}. *Chlorella* is known to exhibit a high tolerance to desiccation through the formation of spores. [21] Moreover, *Chlorella* algae are so-called bioaerosols and can be carried along through the air. [22] As a consequence, "American" algae "contaminated" the "Belgian" algae, which were cultured in a non-sterile, open environment during *ATH*^{1}. We repeated the process in *LBA*^{2} and cultured the *ATH*^{1} algae – an American/Belgian hybrid – with the expectation that the local Philippine variant would infect the *ATH*^{1} algae mix.

During a talk that we gave in the Philippines, the concept of mixing algae spurred some discussion with the audience. "Why not use a purely local species?" we were asked. There was a criticality to the question. It carried weight. After all, as a poetic act, the notion of one algae strain "infecting" or "contaminating" another is a powerful. But as a political act, it raises question about cultural integration. Was the audience member's question a veiled expression of xenophobia? Perhaps, but it is well worth stressing that the Philippines is a postcolonial state that has only relatively recently emerged out of over a combined

425 years of Spanish, then American, rule. It has been well documented, in fact, that the United States "sought to make over the Filipinos into little brown Americans". [23] Around the time *LBA*[2] was initiated in the Philippines, the nation was (and to this day still continues to be) engaged across multiple scales in dynamic processes of cultural and personal *identification* characterized by an inclination towards an "imagined community" that could be seen to transcend precolonial identities. [24], [25] As historian Fernando Zialcita has observed, "many Filipinos question the 'authenticity' of their identity… [They] are uneasy about the heavy Spanish influence that came in with colonialism… [and] wonder if their culture is a mixture of conflicting traditions." [25] Little wonder, then, that the provenance and metaphoric signification of the algae provoked questions.

But if there is uneasiness about hybridity and absence of authenticity in some quarters, an opposite sensibility – one that celebrates the mutability of identity and the possibility of a global cosmopolitanism – characterizes other areas of the Philippine experience. [26] Seen in this light, Biomodd's deliberate hybridization of *Chlorella* could be seen as desirable. It resonates with Irani et al's reminder of the instability of geographical or physical distinctions when demarcating the boundaries of culture. [12]

Defining e-waste and leveraging the convertibility of capital

Biomodd attempts to engage with the problems posed by electronic waste (e-waste). *ATH*[1] featured a networked system made of computer components – motherboards, hard drives, optical drives, CRT monitors – that had previously been discarded and regarded as obsolete. Team members assembled these components into fully functional computers by identifying usable or repairable components and maximizing their functionalities – for instance, by maximizing random access memory (RAM) use – and by installing lightweight operating systems. In addition to reusing computer components functionally, the team also used e-waste as architectural elements in the installation based on what Kim and Paulos have identified as the *material, shape,* and *operation* properties of e-waste. [27]

Functionally and visually, e-waste was used in similar ways in *LBA*[2] as in *ATH*[1]. However, the process by which we acquired the e-waste differed drastically between the two contexts. Technological obsolescence is different in the US than in the Philippines. This was highlighted in an extended search we conducted for discarded Pentium 4 motherboards – a difficult task since at the time we were working on *LBA*[2], most offices and homes in the Philippines were not willing to part even with Pentium 2 computers. (Our request for such powerful computers was met with visible amusement by the manager of a local recycling plant!) A discussion arose within the team about whether we should work with and hack what was readily available. In the end, we decided to stick with the original minimum specifications, as we believed that hacking older computers required technical skill, which would be harder to find than Pentium 4s.

Decisions such as these highlight the types of trade-offs and *conversions* that we had to make in sourcing material, labour, and other forms of capital. (Our use of the term 'capital' is based on Bourdieu's notion of forms and convertibility of capital and Talisayon's typologies of intangible assets. [28], [29]) Since we had little by way of *structural* capital (sufficiently powerful but somehow also obsolete computers) or *human* capital (skilled programmers who could hack the old computers that were readily available), we turned to our *social* capital. The team held a public event where we invited friends and family and colleagues (and their friends and family) to come and donate their old computers to the *Biomodd* team.

Indeed, our reliance on converting one form of capital into another extended to a bewildering array of activities, from barbecuing donated hotdogs, and selling cocktails created with cases of donated vodka at parties; to convincing people at social events to drop the equivalent of 50 US cents in a "*Biomodd* bowl" for the opportunity to have their photography posted on the *Biomodd* website. We crowdfunded in real crowds. After two failed grant applications (a failure to secure *financial* capital) and an initial level of disinterest from major art spaces in providing *infrastructural* support, we realized that building our social capital was the most viable way to keep the project growing. Over the course of about six months, we grew the *Biomodd* team to the point where we had about 10 core team members, about 40 occasional team members, and over 70 people on the team mailing list. The final roster of *Biomodd* was immense and featured supporters from academia, the nonprofit sector, industry, private individuals, the arts, and the sciences. The convertibility of tangible and intangible forms of capital is crucial to all projects that seek growth and is particularly powerful in the context of the global South. [29]

Sampling, appropriating, and remixing

A strategy for responding to the postcolonial condition can be retrieving, reinscribing, and (to an extent) reimagining what precolonial narratives, value systems, and histories have persisted. While *ATH*[1] featured a modified version of an existing open source game, in *LBA*[2], our team of game designers designed a persistent game based on the folk mythology of *Maria Makiling*. *LBA*[2] was built near the base of Mount Makiling, a forest reserve. Maria Makiling is the deity believed to protect the mountain. [30] During the initial conceptualization stage of the computer game, the *LBA*[2] team decided to use Maria Makiling's mythology as core inspiration specifically because its overtly ecological undertones. The entire team was invited to contribute concepts and narratives, both through on site discussions and through the mailing list.

It quickly became clear there were roughly two groups in the team: people that had little or no experience with computer games, and people that considered themselves literate in games with at least basic knowledge about game

mechanics and genres. The first group tended to focus on creating detailed narratives, more akin to scriptwriting in film. The second group was more concerned about creating a technically feasible gameplay that would emanate some of the mythology's core ideas. One particular discussion stood out during game development: how much of the mythology could be reinvented and rehashed? When someone suggested mixing characters (in the form of different mountains from the Philippines), this caused a backlash with some of the team members. One of the core team members gave a compelling argument: "Putting [the mountain] Banahaw as a character [in a game about the story of Mount Makiling] would be like placing a Marvel character into a DC comic. If this were all a parody, why not? But it's not."

Our colleague's concerns runs along a similar vein in the world of commercial video games where (up till recently at least) stories and perspectives of indigenous peoples around the world have been under- or misrepresented. [31] Here we find it relevant to highlight categories on the use of traditional themes that others – such as game company Upper One Games – have articulated. Upper One Games specializes in designing games on indigenous themes and narratives, and distinguishes between games that *appropriate*, *sample*, *depict,* and are *infused by* indigenous culture. [32] While our goal in *Biomodd* was to infuse, perhaps we ended up at best sampling. However, we strove to avoid unauthorized appropriation. We did not find any cultural proscriptions about how the narrative of Maria Makiling (or, for that matter, of Banahaw) could be shared – unlike, for example, a case that Irani et al have described concerning an Australian Aboriginal people and one of their sacred narratives whose telling was strictly regulated. [12] Still, the issue raised many questions around the extent to which we were at liberty to remix ideas, symbols, and mythologies.

In the end, we decided that the Maria Makiling mythology would be the overarching theme of the entire *LBA*[2] project, including the game. Two players on one keyboard can play the resulting multiplayer game. The game world is a single screen in which the character of Maria Makiling takes centre stage. The goal of the game is to help protect her forest ecosystem and assist with reforestation. Destructive projectiles from outside are attacking the forest. Players can either choose to be a protector, or a grower. Protectors can set up temporary barriers while growers can plant trees. In order for the forest to fully develop, players have to collaborate. When the game is left alone, the forest will disappear. The character of Maria Makiling also tweeted about the state of her forest and thanked players for helping out. In this way the *Biomodd* also continued beyond the walls of the spaces where it was exhibited. Figure 4 shows a screenshot from the game.

Figure 4. The *Biomodd [LBA*[2]*]* game. Video of a gameplay sample is available on http://youtu.be/7TtlKs4gq4Q.

The rhizome and the tree

One of *ATH*[1]'s main features is the metal frame that encases the electronics and the living ecosystems that have been brought into close contact with each other. It is a singular structure, erect and imposing. In subsequent versions of *Biomodd*, this central structure has grown increasingly monumental. In addition to commenting on the potentially phallocentric imagery that this evokes, there was discussion in the team about reimagining the structure instead as a redistributed system of smaller structures. It was suggested by at least one member of the Philippine team that this perhaps might be a more 'truthful' or 'progressive' vernacular aesthetic that resonates in the Philippine context because of many reasons, including the archipelagic geography of the country; the importance and pervasiveness of many small-scale economic structures (such as the pervasive *sari-sari* stores and countless sidewalk vendors); and the continued failure of large-scale governance. [33] There was even a material and practical basis for such a distributed structure: one of the workshops we had undertaken involved creating tiny *Biomodd* structures using inexpensive shower racks as scaffolding. It would not have been too much of a stretch to build on these tiny structures and link them together to form a dense network of small *Biomodd* structures.

We believe that this debate within was in fact rooted in the team's (perhaps implicit) understanding of two basic structures that Deleuze and Guattari have described: the tree and the rhizome. [34] The rhizome "resists structures of domination" and "ceaselessly establishes connections between semiotic chains, organizations of power, and circumstances relative to the arts, sciences, and social struggles". [34, p. 7], [35] Deleuze and Guattari contrast the rhizome against the tree, which is linear, and has "dominated Western reality and all of Western thought, from botany to biology and anatomy, but also gnosiology, theology, ontology, all of philosophy". [34, p. 18] Thus, the rhizome could be seen as a possible structure of postcolonial grassroots movements: decentralized, distributed, and resilient to rupture.

But the monolith prevailed, for reasons related to why *LBA*[2] as a whole emerged as a functional, rather than a conceptual, translation of *ATH*[1], as already mentioned. Perhaps the single, monumental case persisted also because of what Deleuze and Guattari have called the "arborescent schema" that pervades contemporary imperialized, postcolonial cultures. [34, p. 328] The debate, however, was

not forgotten. A later *Biomodd* workshop in St-Niklaas, Belgium, expanded on the shower rack prototyping exercise. Using found objects of all sorts, participants produced a diverse array of 'miniature' *Biomodd* systems whose sensibilities ranged from the grotesque to the delightful, recalling the heterotopia of the rhizome. All were networked and displayed in a horizontal layout. A recent Biomodd workshop in Santiago, Chile generated similar small systems distributed throughout the trees and scrubs of an art gallery garden.

Towards a heterotopia of design fictions

We deliberately concluded the previous discussion on postcolonial themes in *LBA*^{2} with the theme of the rhizome, as well as with a mention of subsequent *Biomodd* versions. Since *LBA*^{2}, we have facilitated other *Biomodd* projects in other countries. But several other versions of *Biomodd* were also built independently by other groups in the Philippines in response to *LBA*^{2}. [17] To what extent can the independent *Biomodd* projects be called *Biomodd* versions? Perhaps the most appropriate answer is a question: does it matter what the answer is? The heterotopia of the rhizome rests on the belief that diversity matters, that diversity is good. It is one we subscribe to, at least for now.

We had mentioned that one of the contingencies that the *LBA*^{2} team were forced to reckon with was temporality. Reflecting on our experiences in *LBA*^{2}, we wonder what would have happened if we had more time than the eight months that we had to work on the project. Would it have looked very different? Probably. Perhaps we could have better taken to heart Irani et al's abstracted framework for a postcolonial computing design collaboration, involving *engagement*, *articulation*, and *translation*. [12] This abstraction, it seems, allows people room to breathe, and think, and act, and then breathe again. We have found that creating ground-up movements of art-science collaboration in the Philippines requires time. An open call for scientists and artists to collaborate with us on *LBA*^{2} went unheeded for months. It was only after we had spent several months building networks, holding social events and fundraisers, did we finally manage to attract the kind of expertise that significantly contributed to the growth of the project.

Nevertheless, we take the fact that independent groups in the Philippines initiated their own *Biomodd* initiatives as a sign that there is indeed a space for projects that straddle the boundaries of art and science. We submit that like Irani et al's notion of postcolonial computing, *Biomodd* is a sensibility, not a methodology. It is an approach that seeks to nurture that awareness of critical connectedness, and affiliates itself with the countless of other projects around the world that hopes to do the same thing (or, rather, something similar enough). For instance, we also see *Biomodd* as an example of design fiction or speculative design. [36] Biomodd does not meet directly solve an immediate problem, but it does aim to suggest to the viewer a parallel reality that in which alternative ecological relations exist.

Conclusion

In this paper, we used a postcolonial lens to re-examine our experience of working on *Biomodd [LBA*^{2}*],* a large-scale, collaborative, art-science project in the Philippines that was based off a prior project completed in the USA. We used a comparative discussion of the components of the physical installations that were built in both contexts to examine how the different social, political, and economic contexts influenced the final outcomes. We revisited the appropriateness of the metaphor of heat recycling in the tropics; unpacked issues regarding authenticity, hybridity and colonization in the poetic use of multiple varieties of *Chlorella* algae; examined how conflicting definitions of obsolescence in e-waste led to the conversion of different forms of capital; reflected on whether our use of folk narratives constituted sampling, remixing, and appropriating; and elaborated on the rhizome and the tree as metaphors for collaboration and social organization. We hope to report in future publications on the outcomes of other *Biomodd* projects that have been initiated since *LBA*^{2}, and on our continuing effort to build alliances with individuals, organizations, and initiatives that seek to articulate the sensibilities that the *Biomodd* platform embodies.

Acknowledgements

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[Session 22]

Liquid Transformations

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At sea with the past: reflections on an artwork

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Abstract

This paper offers reflections on an artwork entitled, *At Sea*, (2012). *At Sea* is a picture derived from a 3d laser scan of a wave, presented as a two dimensional digital image, and printed at variable scales. My conceptual interests in this artwork were concerned with disrupting perceptions of the 'first world' as being perceived as 'the centre' and the 'third world' as being perceived as marginal.

I have written this paper from the position of both the artist and commentator. I discuss my background research, working process, innovative use of technology, thoughts about ways of looking, methodology and results. Particularly noteworthy is my use of 3d laser scanning within a fine art context.

Keywords

Colonisation, 3d laser scanning, mapping.

Introduction

I made the artwork *At Sea* in 2012. It depicts a wave, rendered in small, light dots on a black, panoramic format background. This two dimensional image was made from source information collected by a 3d laser scanner. The artwork has been exhibited in a variety of ways: as an image on a billboard (Figure 1.), as a print on vinyl adhered to a gallery wall and as a conventional inkjet print.

At Sea was commissioned by Radar, a contemporary arts programme that develops new work linked to academic research, located at Loughborough University. The commission was associated with a conference, *Home/Land: Women, citizenship and Photographies* (2012) which in turn was generated by an international research project led by Marion Arnold and Marsha Meskimmon, academics from the Visual Art Department at Loughborough University, in the United Kingdom.

The margins and the centre

The commission's brief was closely aligned to the concerns of the aforementioned research project but also

Figure 1. *At Sea* exhibited as a publically sited artwork in Loughborough, U.K. 12 – 25 November 2012

highlighted the following areas for consideration: land and identity, gendered, virtual and imagined landscapes, contested lands/spaces, national identity and nationalism, (post)colonial lands, the globalisation of land, borders, cartography and the politics of land.

With this in mind I began to consider current global socio-economic and political structures in relation to the 'west' being viewed as 'the centre' and my home, South Africa, as on the periphery. I also wanted to establish some kind of connection between Loughborough and Cape Town. I have lived in Cape Town for most of my life but prior to going there I knew little about Loughborough. During a two week residency in Loughborough, as part of the commission, I researched, followed up thoughts, photographed and worked towards a proposal for an artwork.

I looked to the past as a way forward. Loughborough is a medium sized market town, dominated by its university. It is situated in the east midlands of England, and surrounded by more well known towns such as Derby, Leicester and Nottingham. In 1780 the navigable waterway system was expanded to include Loughborough in its vast web of canals that linked towns, transporting coal thereby facilitating growth in industry and the town's role in the industrial revolution [1].

The principal form of global travel at this time was via water. Shipping and naval prowess were important channels of colonisation, with inland waterways and the sea linking Britain to the colonies, Loughborough to Cape Town. I had found a connection: Loughborough, with its industry and location on the canal system, was linked to Cape Town through colonisation, the industrial revolution and water transport. Coal-driven steam engines played a major role in shipping, effectively bringing the colonies closer in travel time.

An imaginative connection can be mapped through water: a drop of water could travel through the Grand Union Canal from Loughborough to London, out to sea with the River Thames, and there get caught up by the great ocean conveyor belt and find itself off Cape Town at the southern end of Africa.

My concept began to take shape around thinking about the Cape as a British colony and the connections between the sea, power and control. The final piece of supporting information for my artwork was making a link to mapping. During the creation and expansion of the British Empire land was 'discovered', named, surveyed and mapped, then 'claimed' and 'owned'. Using surveyor's tools the image I have made is a futile attempt to map the unmapable.

Disruption and resistance

Using a specialised land-surveying instrument, a 3d laser scanner, I surveyed and scanned the waves. To survey is an act of authority, control, ownership and order. To survey waves, from a mapping point of view, is a pointless exercise. At the time I made *At Sea* I wrote:

> I was particularly interested in the futility of this activity, of mapping moving water, a thing that cannot truly be owned, that will not be ordered, even if it can be measured. This artwork is a representation of chaos using measured, contained, scientific visual language. [2].

It is a disruption of the original purpose of surveying and of the concept of a map that demarcates place and by association, ownership. It is a non-map, it cannot be used to locate position and it cannot define areas of ownership in a conventional or meaningful way. In this it is a celebration of chaos, an act of defiance. It is my way of talking back to the centre from the periphery.

My intention here shares much with post-colonial texts that talk back to the centre to re-interpret and destabilize supposedly immutable positions and 'truths'. By 'talking back' I am referring to theorists Ashcroft, Griffiths and Tiffin's seminal book, *The empire writes back: theory and practice in post-colonial literatures,* that explores the complexities of post-colonial writings. Their book title quotes from the title of an article written by Salman Rushdie, *The Empire Writes Back with a Vengeance,* published in the London Times, 3 July 1982.

Scanning waves

I undertook a voyage in a small boat twenty-five nautical miles south of Cape Point. This expedition, while only a few hours and in moderate weather conditions, was long enough to make some observations about deep sea waves as they welled up and bulged, retracted and opened into cavities. Although there were generally defined swells and troughs these seemed to be an underlying form onto which endless surface variations occurred. Water collected, patterning the surface one moment, then falling away, insubstantial the next - a dynamic, heaving mass.

This far out to sea no land is visible. The seascape is all one can see and this contracts and expands as the boat rises and falls, changing one's point of view. As the boat descends to the bottom of a trough, the world contracts. The next instant a vast seascape opens up around one, as the boat rises to the crest of a wave. This constantly shifting view point is reminiscent of moving about in the 3d laser generated, virtual scanned sphere, but in the real world I have less agency and am bound by physical forces. The physicality of ocean waves and the structure of the sea surface inspired the formal qualities depicted in *At Sea*.

A detailed illustration (Figure 2.) shows some of the topography and variations in the scanned waves' surface - there are peaks, ridges, a cliff - like area in the top left hand corner, and along the upper edge the image fractures into blackness. In the final artwork the panoramic frame acts as a window, selecting part of a larger scene that extends into vastness beyond the picture. This is a sea to loose oneself in.

The coastline around Cape Town is sometimes referred to as the Cape of Storms and as its name suggests, it is notorious for heavy weather and a dangerous, unruly sea. The waves I chose to scan meet the coastline in front of Green Point Lighthouse in Cape Town, the oldest lighthouse in South Africa. I specifically selected this site as the lighthouse was first operational in 1824, when the Cape was a British colony. The lighthouse is situated on the eastern headland adjacent to Table Bay, assisting with navigation into the bay for those wishing to land.

While researching this site I learnt about the *SA Seafarer* that stranded directly in front of the lighthouse during the winter of 1966. This disaster was well documented and aerial photographs show the ship on the rocks with the Green Point Lighthouse clearly visible in the background. The wreck was so close that the lighthouse's rotating light was stopped and the beam pointed towards the ship so that the rescue operation could continue after dark. Other dramatic photographs document huge waves breaking over and engulfing the ship, eventually splitting the hull apart. Accounts of this event reinforced thoughts of the precariousness of coastal activity and the sea's ferocity,

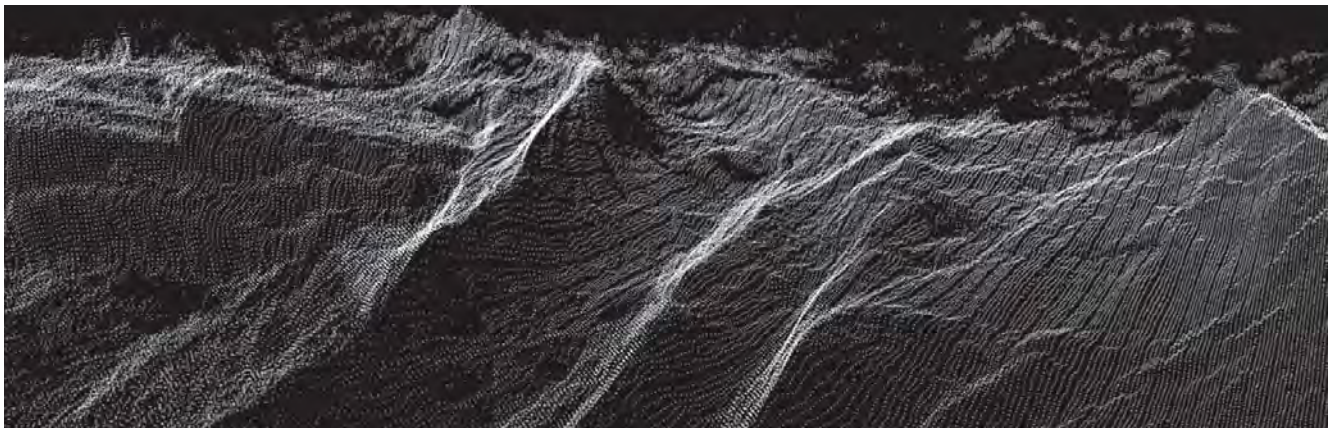

Figure 2. A detail from the digital source file for *At Sea*

and stressed the futility of any attempt to exert authority or control over it. This accentuated the pointlessness of scanning and mapping the waves.

I generally make art using a camera and this was the first time I had worked with a 3d laser scanner and its associated technology. The scanner is mounted on a leveled tripod. The scanner head rotates horizontally as the laser spins on a vertical axis while firing beams to record information in its spherical range. Each laser pulse records a point, a return distance reflected from an object's surface. Its application in surveying is to measure the distance between any of the recorded points, allowing complex environments to be surveyed in a short period of time. Depending on the model of scanner the distance that the laser travels varies. A scanner has a fixed reach, for instance eighty meters. Figure 3. shows an overview of the scan site with the elevated promenade above the sea wall providing a protected location for the scanner. Although this view looks from the edge of the scanned sphere back towards the land, the lighthouse was not recorded as it was beyond the scanner's range.

One of the limitations of laser scanning is that water diffracts the laser beam, so it does not record a return point distance and no image is captured. This was brought to my attention by Cape Town based land surveyors, Gavin Lloyd and Justin Hill, when I approached them to assist with this project. In discussion we decided to experiment, to see if a scan of a breaking wave with foam, a reflective surface, would record an image. This was successful.

My image making using the scanner, consisted of two activities. The first entailed gathering information on site with the scanner, the second interpreting that information on computer. With each scan a sphere or point cloud of information is recorded, a spherical mini sample of the world.

Using software this mini sphere can be interpreted in a 'photographic' way. By this I mean the same formal decision making processes that I go through when I take a photograph can be applied here, except I am not bound by gravity and the physical world. In the virtual information sphere I can float about and choose any position to 'photograph' from. I can 'photograph' from the position of the scanner, or position myself at the edge of the sphere and look towards anything that interests me, in any position I imagine. Like conventional photographic image making I can decide to take a wide shot, or zoom in close to my subject. I can include many formal elements in my composition or compose an image with a large negative space. In this way I can interpret and select information in the mini sphere to compose and 'take' my final image.

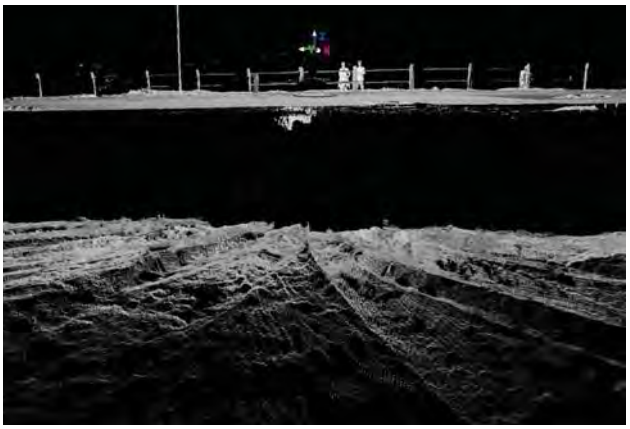

Figure 3. A laser scan detail showing the position of the scanner on the elevated walkway (below the XYZ), in relation to the waves scanned. On the immediate right of the scanner are two figures, inadvertently scanned, myself and land surveyor, Justin Hill.

Shifting perceptions

Unlike human visual perception, the 3d laser scanner has no discernment, no 'filters' and all information, in the on site scan, is gathered with equal attention and with the same 'neutrality'. This echoes sentiments about photography's supposed objectivity expressed in the 19th century, for example -

> But in its early years photography was celebrated for its putative ability to produce accurate images of what was

> in front of the lens; images which were seen as being mechanically produced and thus free of the selective discriminations of the human eye and hand. [3]

Today few people still believe in the 'neutrality' of the photograph. And any 'accuracy' is undermined when motion is present, either with the recording device or in the subject. In making *At Sea* both scanner and subject were moving.

A scan takes approximately a minute. This technology and its way of looking and recording, is disrupted when the subject moves while being scanned. 3d laser technology is also referred to as 'real scene copying'. This implies a facsimile of the original and this is possible only when the original subject remains static during scanning. Here however, the subject, the waves, are moving so the result recorded is not a facsimile of a wave, but an impression of a wave, a trace of movement.

The speed and direction of the wave relative to the scanner's position and rotation influence what is recorded. In this instance the wave moved and scanner rotated in the same general direction. As a wave meets the shore it speed varies, it slows as it builds up prior to breaking, then accelerates with gravity, slowing once again as it dissipates. The scanner moves at a constant speed. If the wave moves at the scanners rotational speed the points recorded will be recorded without distortion. However if the wave over takes the scanner the points will be spaced further apart, conversely if the wave is slower than the scanner, the points will be condensed. This made it difficult to predict results. Until we had done it I had no idea what was actually going to be recorded.

Here the recording device (the scanner) and subject relationship has shifted from a mimetic relationship (real scene copying) towards an interpretive relationship. This 'mechanical' interpretation coupled with my post scan, 'photographic' interpretation and selection of the final composition made *At Sea* an imaginative translation of a sea experience, rather than a naturalistic visual representation.

Conclusion

My initial interest was sparked by the historical and contemporary socio-political distribution of territories on the globe, and perceptions that map some areas as the 'centre' and mark others as the 'margins'. The title of the work, *At Sea* alludes to the subject of the artwork and to the idiomatic expression, *to be at sea*, meaning to be confused or at a loss. Through the process of making I have interrogated global power dynamics and in this regard I am less at sea. However I have been captivated by the sea as a rich area of investigation, and a project that began in a town in the English midlands has led me to discover the shifting quality of the ocean in relation to my own history and geography.

Acknowledgements

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Author Biography

Jean Brundrit is a visual artist who works with photographic media. She has exhibited extensively in South Africa and contributed to a number of international exhibitions. She is a Senior Lecturer at the Michaelis School of Fine Art, University of Cape Town where she teaches photography. She is a NRF rated researcher. Her research interests are primarily concerned with exploring the environment and identity, specifically lesbian identity and strategies of representation within a South African context. Her work pertaining to the environment is focused on the impact of rapid climate change and how this is represented in art; as well as the interconnectedness of humans and their relationship to the natural world.

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Fluid Control – Media Evolution In Water

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Abstract

We have developed water based electronic elements which we built into electric circuits to control different parameters of electronic sound and video tools. As a result of our research we have constructed a complex controller whose main component is water. This tool makes it possible to control analog and software synthesizers as well as video software and other electronic devices, especially microcontroller based platforms like Arduino or Raspberry.

Keywords

controller, computer interface, water, electronic music, video, mass inertia, fluid, potentiometer, switch, fader

Introduction

Many traditional music instruments such as violins, guitars, timpani, pianos, and trumpets can give the musicians an immediate tactile response to their play. A strike on the timpani makes the mallets bounce back in a very specific manner, depending on the velocity, intensity, point, and angle of the beat. Plucking a guitar string, bowing a violin, sounding a trumpet or pushing a key on the piano not only requires overcoming a resistance but it also produces a kickback. On a piano for example, this kickback consists of the hammer falling back, an effect which the musician, upon touching the keys, can feel directly in his fingers. The nature and strength of this kickback response depend on both, the type of the action (plugging, beating, blowing, striking), and the strength, the sound quality, the pitch.

In electronic music the tactile feeling of the generated sound is absent. We cannot grab into the electric power and influence the sound quality with our hands in a direct manner. We cannot feel the swinging of an oscillating electric circuit consisting of transistors, resistors, and capacitors. Musicians have to play electronic instruments always in an indirect manner via interfaces.

These days the development of many industrially produced interfaces tends to avoid mechanical components as much as possible or to use only a minimum of mechanical parts. This leads to the fact that the input devices themselves do not create any music adequate resistance against the musician´s acting. Moving a fader or potentiometer from point zero up to half (50%) requires the same force as moving it from half to the top (100%). If this tool is used to influence the volume or the amount of distortion of a sound, one would wish for a fader whose sanding resistance increases according to the distance. Certain attempts have been made at finding a solution but the results have not yet gone beyond the status of a dummy, i.e. they are not actually included in the work circle of the sound production.

The best known example of such a development are the weighted keys of a keyboard. They are supposed to imitate the feel of a traditional piano but are not actually linked to the sound production. However, these particularities of the electronic sound generation do not imply a lack because the listener is rewarded with an immense amount of sound possibilities, a wealth that hardly exists in music produced with traditional instruments. On the other hand we have to admit that these particularities clearly influence the aesthetic perception of the work. Especially in the beginning of electronic music people used to describe the sound as very mechanical.

Fluid Control

The artist group „wechselstrom“ has made an attempt to develop the potential: A first approach consisted of producing the movement of sounds in space with an interface that gives the musician a physically tangible reference to his actions. These movements are normally regulated with a pan knob or a joystick. We equipped the interior of a closable plastic box with metal wires that took over the function of inputs and outputs of a mixer. These wires were isolated from each other, i.e. they hung free-floating inside the plastic box (Fig. 1).

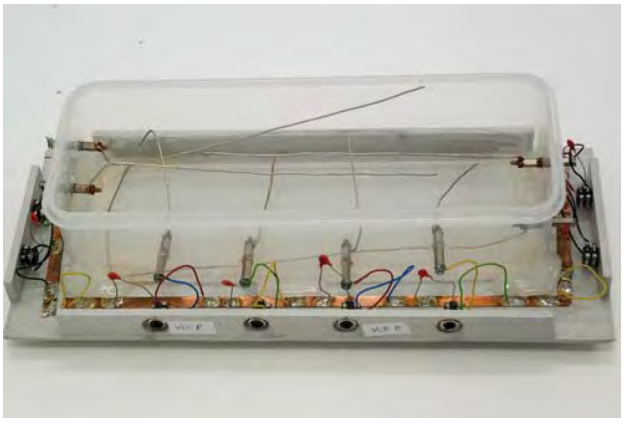

Fig. 1

The moment when the box was filled with (tap) water a complex structure of potentiometers was created mutually influencing each other. The wires took over the function of electrodes and the water served as a variable resistor. Measurements showed that the electrical resistance between two electrodes was between 15 - 50 kohms, depending on the immersion depth and the degree of wetting. These values are also used in normal potentiometers in electric circuits.

We have called this new instrument the „Fluid Control" box. It has been our goal to use Fluid Control as a matrix mixer which combines the functions of controllers, switches, faders, panning regulators, and joysticks in one hand. The movement of the water inside the box, the sloshing of the liquid reveals not just an audible image of the movement of sounds in space. Furthermore, the player / musician can bring his own body into a tactile relationship with the shifting weight of the water. The body and the instrument can now get into a resonant interaction. This process is similar to the rhythms of a sand- or rice-filled egg shaker which sound most lively when one succeeds to synchronize the movement of the grains with the swinging movements of the hand and arm.

In summer 2012 (during the festival Sound Barrier) we set up two Fluid Control boxes, two CD players, which resulted in a total of four mono tracks, and a 4-channel sound system. The four mono tracks coming from two CD players were launched into the input side of the first Fluid Control box mixed together with the appropriate proportion of water and sound levels on two tracks. This mixture was fed into the second Fluid Control box and distributed dynamically to the four channels of the sound system (Fig. 2).

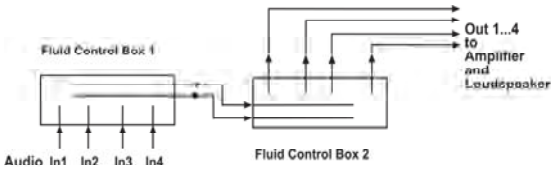

Fig. 2

Following the golden rule "current is current is current" the next step was to modulate not only audio signals but also to modulate control voltages generated in analog synthesizers. These electronic devices have the advantage of providing multiple physical inputs and outputs that can be plugged in directly. We showed this second setting for the first time on Sept 15th 2012 in the Jazzschmiede in Düsseldorf. We used the possibilities offered by Fluid Control for influencing the control current that was produced by an analog sequencer in order to drive an analog synthesizer (Fig. 3).

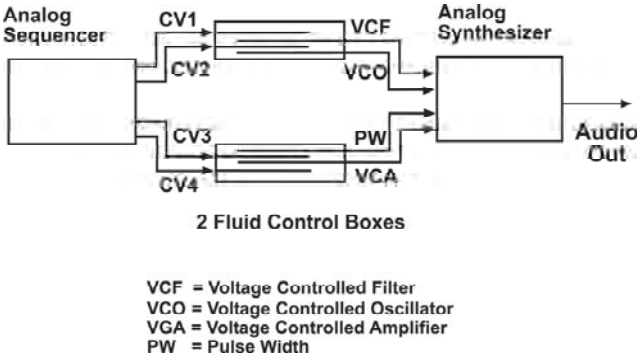

Fig. 3

As a result of our research we have created a tool which makes it possible to control electronic sounds within the dispositive of preselected sequencer and synthesizer setups in a very fast, dizzy, sophisticated, and sometimes chaotic way. Developing this tool we intended to make the change of the sound parameters in electronic music physically tangible. We also wanted to give the player a resistor / a weight into his hand which enables him to react in a more immediate and body conscious way to changes in sound beyond the scope of what controllers and interfaces like buttons, faders, rotary potentiometers, and touch screens can do.

As a the third we wanted to bring Fluid Control into the sphere of the digital world of computers, software synthesizers and, as a follow up, of video or any other multimedia software. All well-known software synthesizers like MAX, pd, Reaktor etc. and most video/graphic software (MAX/jitter, Resolume) use and understand MIDI specification to control various parameters. We used a MIDI box which provided MIDI inputs and outputs and was connected via USB or FireWire to the computer on the other side at the same time. For the creation of a reliable MIDI data stream we took the +5 volt CV (Control Voltage) specification as an equivalent for the midi data value 0…127. We generated the corresponding data stream via a CV-to-MIDI converter. We modified the control voltage, which is often constructed with a single potentiometer, by adding the Fluid Control Box and by building it pre-, and/or post-fader or as a side channel into the electric circuit
(Fig. 4).

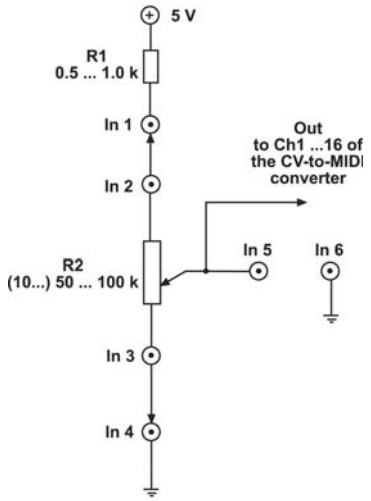

Fig. 4

"In1" and "In4" (socket symbol with arrow) are sockets with switching contacts, all other sockets are without switch. R1 is a resistor preventing a short circuit when sockets are connected in a wrong way (e.g. if you connect In1 to In6). The out goes to the input of one of the 16 channels provided by the CV-to-MIDI converter, which means that this circuit diagram was built 16 times (Fig. 5).

Fig. 5

Connections can be made between all sockets, even between sockets of different channels. However, only the following connections produce an effect: In1-In2, In1-In5, In2-In5, In3-In4, In3-In5, In4-In5 and In5-In6.

Fig.6, 7, and 8 show the basic connections. In Fig.6 two Fluid Control boxes are looped in. Together with R2 they build a voltage devider. When the slider of R2 is in the upper position the first Fluid Control box has more influence than box nr.2 and vice versa. When for instance the second box is plugged out the remaining box achieves the highest effect with the slider of R2 being in the upper position. When the slider is in the down position the box is inactive because the slider is connected to ground, therefore the output voltage is zero. In Fig.7 and Fig.8 the box achieves its highest efficiency when the slider is in the center position.

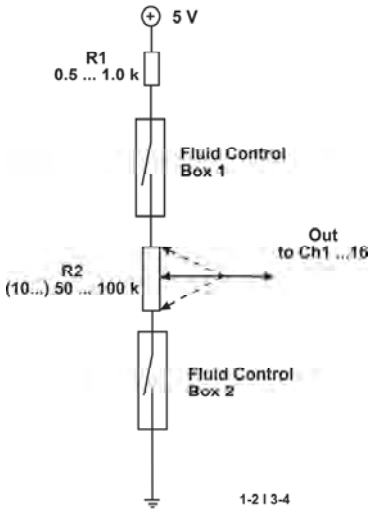

Fig. 6

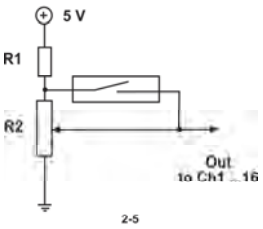

Fig. 7

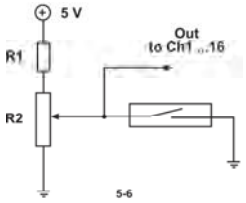

Fig. 8

Obviously, Fluid Control can be connected to any microcontroller or computer. In this case a MIDI-translation is not necessary, the circuits shown in Fig.4 - Fig.8 can be directly plugged into the analog inputs of the Arduino or Raspberry.

Film clips illustrating the operation of this instrument are available under the following Internet links:

How it works: (search for "Fluid Control Essenz")
https://www.youtube.com/watch?v=ed4JlMMNnyg

and "Fluid Control – The Installation"
https://www.youtube.com/watch?v=41uZi7bEdeI

wechselstrom

Christoph Theiler & Renate Pittroff

"wechselstrom" is a label owned by Renate Pittroff and Christoph Theiler. Based in Vienna, "wechselstrom" runs a so-called "offspace", which offers room for exhibitions, media activism and all art forms on the fringe of culture.

Selected works:

Piefkedenkmal – the construction of a monument for the musician Gottfried Piefke, who is also the namesake of the well-known Austrian derogatory name for Germans (2009 Gänserndorf)

Samenschleuder – a tool for environmentally conscious car driving (2009 Weinviertel, Lower Austria)

bm:dna – the government department for dna-analysis (2005 Vienna)

Tracker Dog - follow a (your) dog and track the route with a GPS, then print and distribute new walking maps (2008 Mostviertel, Lower Austria)

Community Game – a tool for distributing government grants using a mixed system of democratic vote and randomized control (2006 Vienna - distributing 125.000 Euro)

whispering bones – a theatre play asking for the whereabouts of A. Hitler´s bones (2004 Vienna, rta-wind-channel)

Reply - mailing action: resending Mozart´s begging letters under our own name to 270 people: to the 100 richest Germans and Austrians, to managers and artists of the classical music business, and all members of the Austrian government (2005/06 Vienna)

Re-Entry: Life in the Petri Dish - Opera for Oldenburg 2010

www.wechsel-strom.net, www.piefkedenkmal.at
www.samenschleuder.net, www.trackerdog.at

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From meaning to liquid matters

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Abstract

Artists like Sachiko Kodama have demonstrated the aesthetic potential of ferrofluids in unique, visually spectacular installations like the *Morpho Towers* and *Breathing Chao* [2]. This paper presents a more systematic approach to ferrofluid manipulation: a vertical display, build under project-name: "Liquid Choreography", later released as "Ferrolic". [1]

This Digital FerroFluid Display's (DFFD) potential rests in visual references to movement of fluids but also living creatures. Specific dynamic and graphical properties that generate a narrative in the form of an animation are displayed in a video [1] that is central to this paper. In order to understand the written descriptions in this paper, it is strongly advised to review this video before reading this paper. Also see figure 1 and figure 2.

In the first part of the paper, the principles of operation of the DFFD are described. Creation of images, transitions between images and fundamental aspects of FF manipulation are presented.

In the second part of the paper, a first attempt to come to a vocabulary for the use of the DFFD as an expressive platform is presented. For this purpose seven different animations were generated and presented to in total five experts in the field of art and design. These experts were interviewed about their personal constructs for the animations. Based on a systematic (thematic) analysis of these interviews, the vocabulary was derived.

Keywords

FerroFluid, display, tangible, content, choreography, liquid, narrative, dynamics, nature, electromagnets, Ferrolic.

Introduction

Motivation

Intrigued by the aesthetics of Sachiko Kodama's work on ferrofluids [2], people who practice both art and science such as Louis-Philippe Demers [3] and Neri Oxman and work of many students, artists and designers like Marcin Ignac [4] who visualised data in very creative ways, motivated me to turn a long shelved idea on *how to shape and move a liquid body* into a physical reality.

The value of new and inconceivable embedded in a natural looking appearance - regardless it's true level of artificiality - is likely to have a natural attractiveness to people. Well known examples are Neri Oxman's life-size tangible sculptures that are based on microscopic biological physical structures [5] and Harvard's technology that grows flowers on a nano scale [6]. I believe these new unique technologies are not only carried widely because of their technological uniqueness, but also because their natural appeal; Meaning, their close visual relation to nature itself.

Purpose and Goals

There is a well established body of art-work on FerroFluid. Sachiko Kodama made it well known in the form of *liquid sculptures* [2]. The opportunities for manipulation of FerroFluid in these sculptures are however limited. In this work we aimed to create a technological platform that allowed for more freedom in manipulating FerroFluid and to develop a vocabulary for the creation of content.

Figure 1. Example of *bodies* merging into *written figurative matter*. ©Zelf Koelman

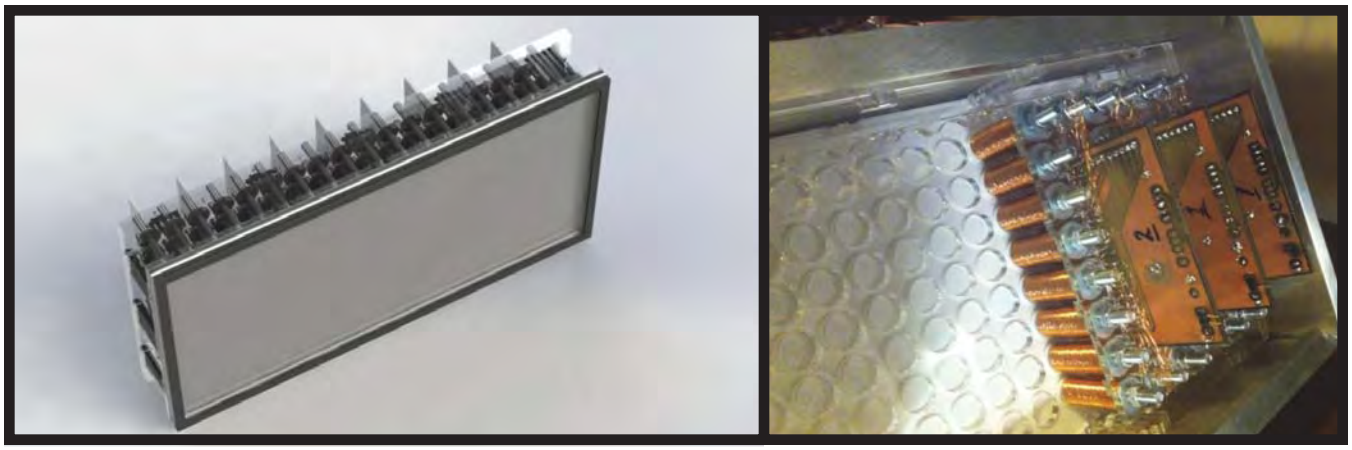

Figure 2. The DFFD: A quantity of FF is contained between two glass plates, sealed at the edges. Behind the FF container, a rectangular array of electromagnets is used to manipulate the fluid. At the right a detail showing the configuration of magnets. ©Zelf Koelman

An open research model was applied to get grip on the design process, yet, leave room for innovation. [7]

Background

We conceive the majority of digital information through two-dimensional arrays of light-sources, better known as LCD displays; A large number of small light-sources packed densely together because just a few, so called, *pixels* would have no meaning. Perceived information is generated by multiple formations of many pixels, each with different colours that can produce a (from a humans perspective) *infinite* amount of combinations.

To make matter understandable, the *infinite* is reduced to a useful set combinations that we recognise as visuals with meaning. Among clearly observable text, photo and video, this new unreal mini-world on a screen seems to be always in conflict with its own size. Software interfaces try to help us bridge the unnatural gap of *it all happening on this small screen* using functional methods like scaling, tabs, windows, scrolling, etc.. Eventually, displayed content that refers to *real world matter* will never be observed as natural as its tangible counterparts.

Tangible means perceptible by touch. It is one property an LCD display can not forward when it is displaying content. For displays, tangibility is a property that does not per se mean that the matter has to be touched to be observed. Examples of displays that use tangible matter are the flip-

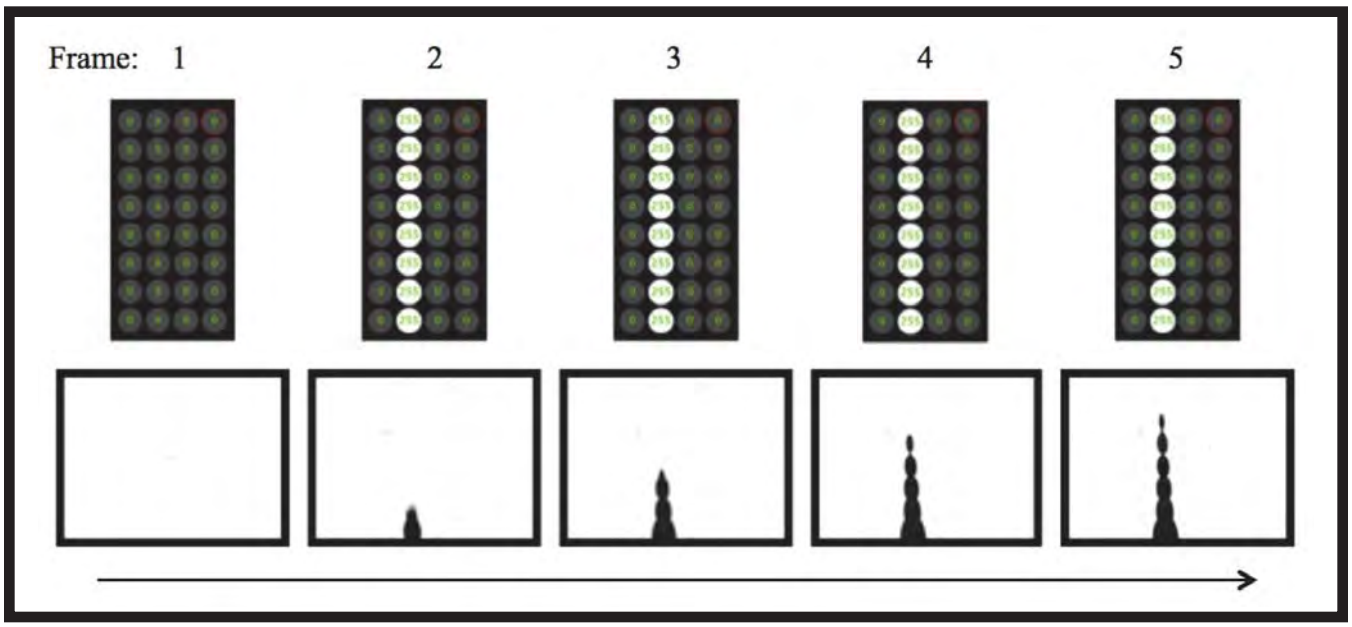

Figure 3. How a straight vertical line builds up in FF. Frame one is the initial state, in frame 2 a vertical line of magnets is switched on, frames 3, 4 and 5 depict how the FF moves up from the reservoir at the bottom of the display. ©Zelf Koelman

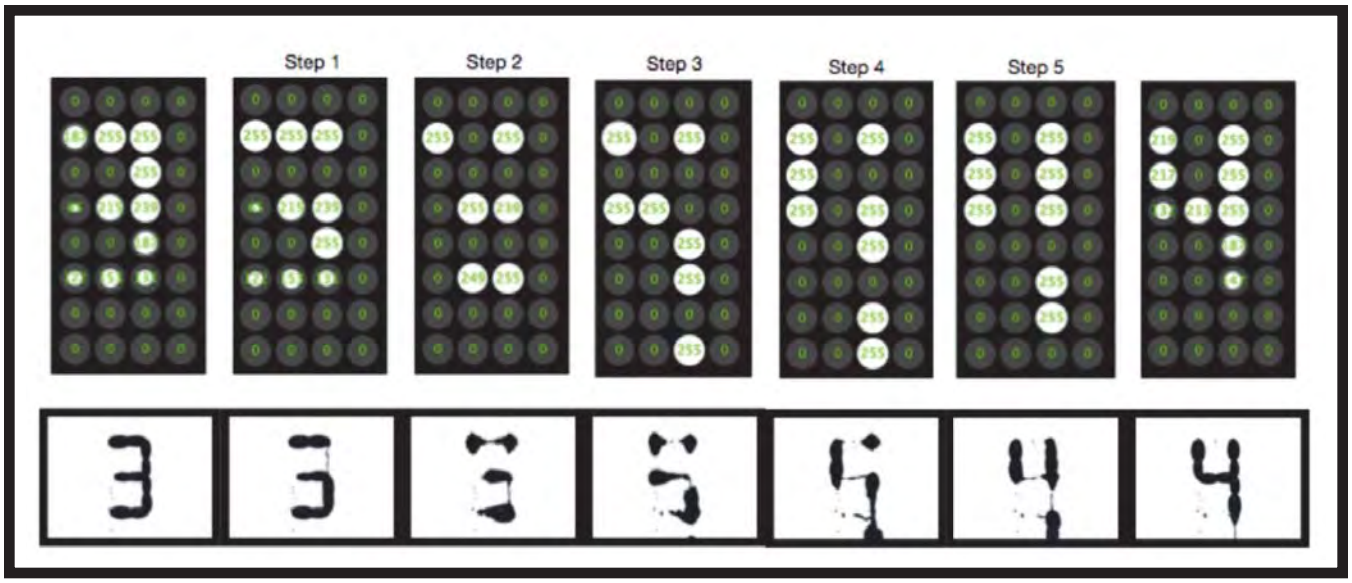

Figure 4. Making a transition from a number “3” to a number “4”. Note how first the “3” is broken down into separate dots of FF, extra FF is attracted from the reservoir, before the “4” is formed.

disk display [8] that we often see installed on city-busses and The Water logo by Hara Design Institute [9] that systematically displays text in the form of water-droplets floating on hydrophilic fabric. These tangible displays all have a specific characteristic because of their own physical properties. Properties that are visually been observed as true matter. This paper covers specific characteristics that belong to the digital FerroFluid display.

The Digital FerroFluid Display

The DFFD in essence consists of an array of electromagnets behind a container of FF. Every electromagnet can be controlled individually by setting the current through the coil.

With this array of magnets, images can be created and manipulated dynamically. Figure 3 shows how a straight vertical line builds up. In total 5 time frames are shown, one every 500 milliseconds. At the top half of the figure, the black/green screens represents the applied magnetic forces for every pixel. In this example only “on” and “off” is used. A white dot is “on”, at the bottom half of the figure, the actual observed FF (ferrofluid) distribution is shown.

The straight line builds up from the FF reservoir at the bottom of the DFDD. If the same force is applied to all pixels, the line will be thickest at the bottom and get narrower towards the top. The actual density distribution between two adjacent pixels is influenced by several factors: gravity, adjacent magnetic fields, locally available amount of FF and cohesive forces in the FF fluid. The combination of cohesion and gravity cause the broadening towards the bottom of the line.

For a controlled manipulation of FF it is necessary to incorporate these factors. Figure 4 shows an example of a transition between two shapes, the number “3” and the number “4”. In this case, the used algorithm calculates the needed quantity of FF, breaks up the “3” into 3 separate dots on strategic positions and creates an additional FF dot from the reservoir. From these dots the number “4” is created. Notice how the strengths of the magnetic field is not the same for all pixels. It is lower near the bottom and at the pixel at the lower left corner of the “4”. The latter is because this pixel is effectively helped by the neighbouring pixels. Though many ways are possible to achieve this shape transition, this one illustrates the considerations to be made in such a transition.

Towards a vocabulary for FF manipulation

After having the first animations reviewed in a set of exploratory user-tests, it became clear there was an evident difference in *appeal* for the different animations. It was also hard to communicate the specific values for viewers and maker alike. To further develop this medium it was (and is) necessary to be able to clearly communicate about its specific characteristics.

Expert evaluations

In order to map the specific characteristics, seven animations were made that all contained a mix of specific visual characteristics. The seven animations of the first test-set have been described and labeled in table 2.

These animations were evaluated by in total 5 professionals from the field of arts and design, all with a different background. Table 1 outlines the procedure for the inter-

view. Next we describe the parts in turn. The participants were individually interviewed. The experimental setup was as following: participants were invited into a closed room and sat next to the interviewer in front of the Digital FerroFluid Display. The interviewees were given a short introduction on the following steps.

Part	Average Duration	Summary
I	3 minutes	introduction to the study
II	21 minutes	reviewing 7 animations and answering the primary question
III	4 minutes	answering secondary question
IV	2 minutes	debriefing

Table 1. Procedure for interviews series 1.x

Participants were asked to review a sequence of 7 animations that were displayed on the DFFD in random order. In Table 2 these animations are described. The first question to the interviewee was *what do you see*? which had to be answered for every single animation. This question, as well as the physical setting, was borrowed from the *Rorschach test* [10]. Descriptions were vocally explained by the participants during their reviewing. There was no particular time constraint for every animation. The participants reaction was recorded during the interviews as written notes.

In the interviews series 1.x, two out of five participants mainly judged the animations on its specific visual characteristics (i.e. *leaking*, or *morphing*), two participants mainly judged the animations on its narrative (i.e. *A chase of two creatures* or *9 am*) and one participant judged the animation on both.

After all 7 animations where reviewed by the participant, the second question was to judge the animations again. This time, participants that focused on the visual characteristics were asked to focus on the narrative and vice versa. All participants were able to take both perspectives. Table 3 shows frequently used properties (at least more that twice by different participants) over the two methods of observing and explaining the content.

Name	Description
Pattern	A repeating cycle of: An array (horizontal line) of separate bodies arising from the bottom, moving up and dropping at the top.
Chase	One body following another, variations in speed and distance
Clock	Four digits displaying the actual time
Fountain	FF spraying upwards from a point in the reservoir
Pong	A game of Pong animated in FF
Smiley	Different Smileys morphing into each other
Rain	A continuous cycle of bodies moving upwards from the left and right of the reservoir into a large body at the top of the display and raining down again into the reservoir

Table 2. Seven different animations. The first test-set.

Observations on narratives

In the interviews, different type of narratives about the animations came forward:

- *body language*: A direct reference to animalistic or humanistic behaviour. Also called *anthropomorphism* which is closely related to *empathy* [11].
- *written figurative matter*: Translation of meaning through letters that form words and/or trough numbers that form values.
- *non-written figurative matter*: Direct translation from visual representations to meaning.

Combination of narratives also occurred.

Participants mainly had difficulties to translate animation 5 (pong) and 7 (rain) into its narrative. Further questions revealed that they did not recognise the narrative be-

Category / Level	Specific visual characteristics		The narrative
	Dynamics	**Graphics**	**Information**
Description	Actions	Figurative and abstract physical references	The narrative and/or emotional reference
Average physical scale	1 to 4 square actuation points	1 to ∞ square actuation points	1 to ∞ square actuation points
Vocabulary	Morphing, Leaking, Speeding, Accelerating, Dropping, Moving, Disintegrating	Pattern, Mass, Systematic, Repetitive, Randomness	Agression, Playfulness, Exchange, Cagey, Cyclus, Raincloud, Chase

Table 3. Mapping a vocabulary

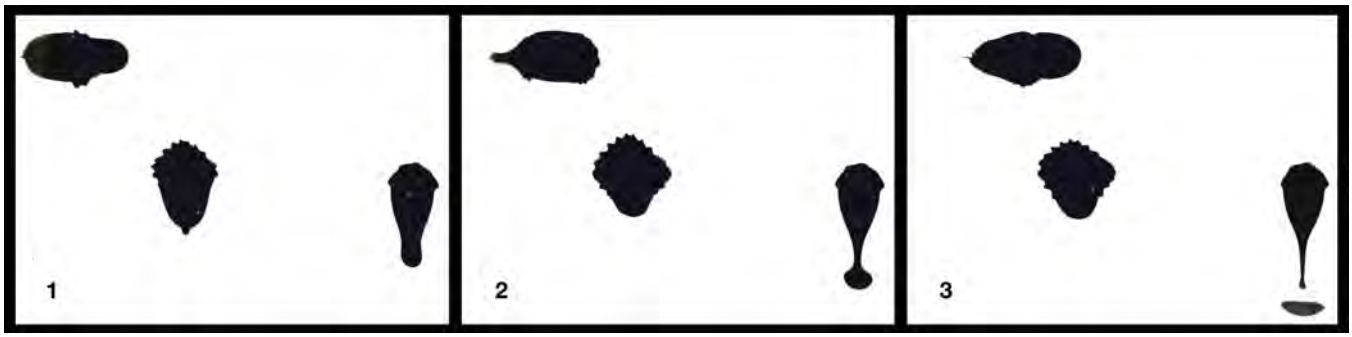

Figure 5. Example of moving, morphing and leaking bodies. ©Zelf Koelman

cause of *lack of detail*. The tests showed that, due to the low resolutions of actuation points, a simple combination of very basic distinguishable figurative matter - like *dots* and *lines* forming text and numbers - is likely to be successfully translated into meaning. If a *dot* itself shows specific dynamics, it is judged upon references to animalistic behaviour. A side-conclusion could be that the more physical detail the figurative matter is expected to have, the less likely it is that the narrative is readable.

A living entity Testing the first prototype (one vertical array of magnetic actuators) a thing reveal itself when a sinus wave was applied to the actuators. A FerroFluid drop that got separated from a mass that floated on the bottom, was perceived as a *body*. Not only a *body* in physical terms, but like interviews 1.x also turned out: *body* with a strong relation to a living organism. The current DFFD prototype allows this *body* to freely move vertical and horizontal over the full width and height of the display.

Participants associated the visual effect of this phenomena to the movement of biological organisms that move through water. They regularly recognised tadpoles, little fish and undefined little *creatures*. The participants explained to be intrigued by the unknown playful movements. The *creatures* seemed harmless and evoked the participants to discover them and it was mentioned to be perceived as a pleasant experience.

This visual reference might be the same reason why the artificial FerroFluid bodies, moving through water and forming a tail, are perceived as *living creatures*. Similarities put forward in several discussions are that the *creatures* perform a degree of random behaviour, have a third dimension (in contrast to LCD displays), are made of true matter, are explorable into fine detail and share different visual dynamic relations like *speeding stretched bodies*. Here is an interesting similarity to *Disney's Twelve Basic Principles of Animation*; A set of principles of animation introduced by the Disney animators Ollie Johnston and Frank Thomas in their 1981 book *The Illusion of Life: Disney Animation*.[12] Where it is their goal to produce more realistic animations adhering to the basic laws of physics. The most discussed principle *squash and stretch* [12], which gives a better sense of weight and flexibility to a virtual object, happens to be a core property of the digital FerroFluid display since this visual effect is caused by true natural physics itself. The success of theses principles and the relation to what is perceived on the DFFD may illuminate an important value of using true (liquid) matter in animating a narrative.

Positioning the DFFD

Though practically everybody that was invited to experience the DFFD was deeply intrigued by it, it is hard to pinpoint a potential natural habitat for it. To shed some light on this matter, at the 2014 International Robotics, Art and Science forum *Bal Robotov 2014* in Moscow, Russia, a second round of interviews was done with five experts from five different institutes. They represented the realms of indeed art and science. All had in common that their personal projects, like this one, somehow bridges science, art and technology. These interviews 2.x - inter alia, with Alexander Reben from MIT Media Lab and Louis Philippe Demers from NTU, Singapore - added perspective to these uncertainties. Below some relevant quotes from the interviews.

The experts visions Its basic function is *generating a very specific kind of aesthetics*. What it is and where it lives highly depends on the kind of content.

"You want to create an aesthetic threat for people. You want to give someone an experience. Show them something interesting and beautiful. And your medium is technology, your medium is digital but the actual piece is definitely an artwork..... It could also be practical; It could be a clock. But it will probably be expensive, heavy and consume a lot of power so... that's why it's still art." (Interview 2.4 - Jonathan Tippett)

In its current state, it's unique value lies in the specific dynamics that occur during the transition from one state to another, which is also its main function and reason why it is build, regardless the kind of content. This makes it a worthy to be considered "art".

"The less you make it scripted (it being the animations), the more it is coming to be a thing on it's own.
The more you make an animation that is recognisable, the more it is going to be like a... you name it..." (Interview 2.1 - Louis-Philippe Demers)

Summarising, in it's current state the DFFD can not (yet) be positioned as a functional medium but rather as a platform for art installations.

Conclusions, Discussion and Future Work

Conclusion

The DFFD, in its current state of development, can be seen as an expressive platform mostly for use in the field of art. Though it is up to the artist to decide about the suitability of the platform for her or his ambitions there are some considerations that can be made to assess this suitability.

The key question is: *Does the animation has a narrative?* If the answer to this question is NO, the aesthetic qualities of the DFFD is in the same league as for example a lava lamp. If the answer is YES, we propose to distinguish three types of narrative, each opening a different aesthetic perspective. If the narrative has an (1) *anthropomorphic* character, the lifelike associations people have with the FF animations is expressed very well. It is also possible to have more (2) figurative use, like in the animation of the fountain or the rain. Also in these cases the appreciation for the aesthetic qualities is expected to be high. Finally (3) a simple textual animation like the time flowing in the 4 digit clock animation is generally found intriguing too. The DFFD usually fails when we tried to express more detailed graphical information. The quality is in the dynamic behaviour and certainly not in the high information density of the visualisations.

Discussion

The intersection of science and technology in our opinion is an exciting place to be. With the DFFD we have found a fascinating area with unique aesthetics. Initially the ambition was to find ways to display useful information using FF. The display presented in this work does not offer that practical usability yet. People engaged in art and interactive installations receive it with enthusiasm. As such it offers a new expressive platform.

Quoting Janet Murray's three principles from her Inventing the Media framework:

"*All things made with electronic bits and computer code belong to a single new medium, the digital medium, with its own unique affordances, designing any single artifact within this new medium is part of the broader collective effort of making meaning through the invention and refinement of digital media conventions, and When we expand the meaning-making conventions that make up human culture, we expand our ability to understand the world and to connect with one another." (Murray 2011)* [13] We hope and believe that the work presented in this paper does contribute to future developments of interactive media.

Especially in the fast growing field of shape changing materials we see potential relevance of this work: The aesthetic qualities found in this work do offer a richer, possibly more humane, perspective on that field, beyond functionality and usability. As Janet Murray states: "*we need every possible medium to express our humanity.*" *(Murray 2003)* [14]

The Inventing the Media framework has also been considered for the evaluation of the DFFD. However we feel that the main strength of the display lies in the narrative, whereas Murray's' framework leans more towards higher information densities, which is not a particular strength of the DFFD. That is why we feel it is justified to introduce our own key question about the narrative as the key value of the display.

On a more technical level, we believe that a certain degree of randomness in the flow behaviour of the FF is an essential element of the aesthetics. To a certain degree this randomness is implicit in the material properties of the display. Yet it might be relevant to include this aspect in the development of algorithms for the manipulation of the FF too.

Future Work

Technology To enable the content to be generated and reviewed by a large audience, this platform could open its gates to an endless realm of algorithms, narratives and creative expressions by making it interactive through an online portal.

A third dimension The current design consists of a grid of magnetic actuators. The third dimension is generated by the magnetic arcs that form over the grit. Further research in shaping these arcs could add new visual characteristics.

More efficient magnets The magnetic actuator's current design is stretched to its physical boundaries. New technologies could reduce energy-consumption and provide smaller actuators.

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Mother, Body, and Weather: An Artistic Exploration of Transcending the Physical Experience of Motherhood

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Abstract

Echoes of Balance and Push is an immersive video art installation that explores how a new mother's daily life relates to tumultuous and unpredictable experiences of weather. This paper describes an interdisciplinary collaboration between the authors, who are artists and researchers. The researchers in tandem with the artist explored the creative process and experience of viewing Echoes of Balance and Push. Through the lens of an iPhone, an improvisatory experience of maneuvering a large weather balloon in the open elements creates the environment for exploring struggle in relationships to motherhood. We describe the design process and results of the work through concepts of Experience Prototyping: using methods of Rasaboxes, RSVP Cycles, ritual interaction, improvisation, and Bodyweather performances. *Echoes of Balance and Push* presents an exploration of improvisatory performance art through a perspective of design prototyping in order to highlight the creative process of a sensorial-based art practice.

Keywords

Video; art installation; Experience Prototyping; Rasaboxes; RSVP Cycles; ritual; improvisation; Bodyweather; dreams; embodiment; performativity

Introduction

Echoes of Balance and Push is an immersive art installation that questions how one transcends the physical experience of motherhood through the lens of weather patterns and environmental changes. Using Butoh Bodyweather movement, a practice that acknowledges and compares the internal processes of the body with the movement of weather around the earth, a link is made between mother earth and human motherhood including issues of care, control, and prediction. As with any complex system, weather is tracked, monitored, quantified and predicted yet remains outside of our control and even long range forecast. Mother earth provides a ground for these sometimes violent dynamic processes -- containing, absorbing, and being subject to them. Similarly motherhood at once envelops and engages with the chaotic entry of a new agentic life. Using a weather balloon as a metaphor, the interaction between the artist and the balloon illustrates this juggling act of agency. Conceptually, the *Echoes of Balance and Push* merges imagery and ideas of life changing processes such as bringing life into this world, decreased control, and the overwhelming powerlessness that can result..

Figure 1. *Echoes of Balance and Push* Installation View at Emily Carr University Art + Design, 2014. Digital Photograph courtesy of Amanda Arcuri

Echoes of Balance and Push was presented at *It's Not You, It's Me* at Emily Carr University's Concourse Gallery from March 27th to April 9th. The artwork consists of three 22-inch video monitors with built in speakers placed along a wall and showing looping video clips. Videos are of the performer dancing with a weather balloon on three separate days: one windy, one snowy, and one rainy. The audience witnesses the constant shifting of elements in changing weather patterns. A 12-foot white weather balloon centered in the middle of the concrete floor accompanies the viewing experience. From afar, the balloon looms over the monitors, changing and shaping the viewer's experience of the videos by the sheer physical size and presence of the balloon. The soft video sounds entice the audience to move closer. As the audience becomes attentive to the videos, what emerges is a performative dance with a weather balloon around a dilapidated barn. Three videos show similar movement sequences from different vantage points and varied weather patterns.

Figure 2. *Echoes of Balance and Push* Installation Video Stills, 2014. ©prOphecy Sun

The sound experience of the work includes ambient textures of wind, rain, birds, and of a woman breathing from a struggle outdoors. The composition enhances the performance by connecting the audience with the trials the woman is encountering in the natural landscape. The soundtrack is constant, ebbing and flowing in subtle sequences throughout the gallery space. The unique soundscape projects and weaves around the space and is individualized for each video. As the audience comes into a closer proximity to the screens, they will notice that each video has a different soundscape of the woman breathing with subtle changes of timbre and vocal expression depending on the level of difficulty of her movements. The story in the videos depicts a woman's movements around an old barn, relaying daily struggles under shifting conditions. As a new mother, the artist filmed herself struggling to keep a giant weather balloon afloat as she moved continuously around a barn in these five to ten minute looping video clips.

This artwork was created through a self-reflexive performative and improvisational process in which the experience of new motherhood with its vulnerability, lack of control, and loss and reconstruction of identity are subsumed within the metaphor of weather patterns, with their larger than life unpredictability and difficult if not impossible-to-control nature. Weather patterns are analyzed by 'big data' technologies and algorithms that attempt to codify, explain, control and predict weather activity. This can be likened to medical and social interventions defining motherhood. Weather balloons chart and explore the skies in our stead. They can also be artistic objects that traverse the surface of the earth, a floating technology that caught in the delicate grip of human hands allows for the negotiation between realms, a dance between layers of conscious and unconscious movements. They have been used by others to carry tools, bodies, objects, chairs, and people. The weather balloon is a translucent and luminous instrument that has agency, buoyancy and liveliness. The weather balloon creates a performative framework that is able to ironically invoke the vulnerable relationship between motherhood, identity and the daily interplay and perception of a scale that is beyond the body's ability to control, yet beautifully poignant and even humorous in its interplay.

Artistic Inspiration For the Work

Echoes of Balance and Push was inspired by considering the experience of being pregnant as a temporary shelter for another life. In her investigations with the weather balloon, the artist used her body as a safety blanket, or a restrictive device that protected and carefully guided the balloon through obstructions. This experience was realized by using a weather balloon to depict emotions and narratives based on the work of Anna Rewakowicz and Kelly Nipper. Rewakowicz and Nipper are two contemporary artists that also use weather balloons and inflatables in their practice. Rewakowicz relies heavily on the relationship between objects (which she describes as portable architecture), the body and the environment. She creates public experiences that can be very intimate. For example in the *SleepBagDress prototype 1-2*, she created a multipurpose kimono dress that when inflated changes into a cylindrical contained inhabitable by one or two people [1]. Rewakowicz creates look at the portability and self-sustainability of a wearable cell, comfortable as both a dress and a temporary shelter. Nipper and Rewakowicz connect to the work by creating objects that come alive and have their own agency which depict emotions and narrative to ultimately tell a story.

Design Process

Echoes of Balance and Push began as a study to understand how movement can be improvised through tumultuous indoor and outdoor spaces with an unusual object, representing a relationship between self and other. The artist began experimenting with weather balloons after seeing a white orb tethered to her arm in a dream. She then translated that dream into a video installation using the technique 'Experience Prototyping'.

Experience prototyping "is any kind of representation, in any medium, that is designed to understand, explore or communicate what it might be like to engage with the product, space or system we are designing" [2]. Experience

prototyping uses a combination of imagination, role-playing and material tinkering to explore the potential experience of a design concept. This work refers back to the experience of participating in a design process, creating a design product or imagining a design scenario based on the physical, conceptual and emotional experiences that could be illustrated. This work can be directly related to the Art and Design world through Frayling's 'Practice as Research', focusing on embodied practice and materiality to guide the development of a work [3]. Using experience prototyping as a guide we leveraged multiple methods from artistic practice for guiding and prototyping creative exploration.

Material Qualities of the Weather Balloon

One element of the artist's experience prototyping process was the unique material qualities of the selected medium: a weather balloon. The weather balloon is a very fragile object made out of latex or synthetic rubber (neoprene) and filled with helium or hydrogen. Not only a technology for scientific mapping and exploration, the weather balloon can transport other tools, bodies, objects, chairs, and people, allowing it to become an artistic device that traverses the surface of the earth. The weather balloon is very large (8ft) and light, with a shifting exterior in relationship to contact. In the research the artist draw upon Atlas' image of holding up the Earth, portraying a woman holding a weather balloon off the ground so that it is not destroyed. The wielding of the weather balloon in conditions, such as rainfall or wind, was also used as a metaphor for disruptive change in unusual conditions.

Over time, she was able to use increasingly large weather balloons. As she became more comfortable with a 4ft. diameter balloon, she continued her prototyping using an 8ft. balloon. The more experienced and practiced she became, the more confidant her movements became and the more she could push the boundaries of the experience and her physical experiments. Because of the experience prototyping process, she was able to portray the physical struggles without destroying the balloon.

Interplay Between Dreams and Reality

Experimentation began with physical explorations of a weather balloon, using environmental forces and self-reflexivity as a guide to let the movement patterns follow the lead of the balloon travels. The artist found herself in concrete stairwells and small elevators, investigating the sounds of the balloon in confined spaces. The weight and malleability of the balloon were important. She felt that it was important to first experience the balloon indoors within a controlled environment. There she was able to experience the boundless nature of the shape in a confined space. Through experience prototyping, she was able to learn about the movement qualities of the balloon and how to carry the weight. The shape was more controllable because there is no weather inside – it felt like a sanctuary.

In experimenting with the balloon in an indoor studio, the artist explored concepts of time, flight and alternate realities. The concept of time was explored by doing repetitive tasks such as lifting the balloon over her head again and again. When the task had the appropriate outline to answer her artistic question, she subtly modified it to create unique interesting movement patterns. Time felt different in alternate spaces and experiences changed due to the constraints of the architecture often shared with others. For example she had to work around people using an elevator next to the studio. She became very aware of the time it took people to exit the elevator. When there was no one else present she was able to experience timelessness and stillness. When she was alone, she created exaggerated and boundless movements with a mental freedom to get lost in time, to successfully "fly" and transcend reality. It was too difficult to create these spaces of play and experimentation when other people were sharing the space.

The interplay between reality and dreams also became important to the work as the representation of the largest 12ft weather balloon felt like another body when carried and moved around spaces, shifting and reacting alongside her. There was interplay between reality and dreams. The experience itself felt like a long lucid dream. The artist investigated how rational objects move in irrational spaces that are natural, organic, non-Cartesian, and curvilinear, such as orchards and fields. Things she sees and hears in the intangible world of dreams are of interest and a recurring source of inspiration for practice.

Figure 3. *Time is Precious* Installation Video Stills at Emily Carr Graduate Studio and Elevator 2013. ©prOphecy sun

Coupled with observations from lived, waking experience, dreams offer another layer and resource for making art. The weather balloon is used as a metaphor for the entanglement between waking life and the dream, between multifarious vantage points within the reality of everyday experience.

Artistic Methods Leveraging Experience Prototyping

Buchenau and Suri's work in experience prototyping [2] was a seminal concept that has been explored and extended by many, including Lowgren's 'Thoughful Interaction Design' [4], participatory design research [5], bodystorming techniques [6] and product experience [7]. Artistic methods that leverage the conceptual and material processes of Experience Prototyping include: Rasaboxes movement, RSVP Cycles, Bodyweather practices and ritual and improvisation. Each method contributed to a different aspect of the piece by allowing directed investigations of space and movement, which led to the final work highlighting the struggles of control in an ever-shifting situation.

Rasaboxes

Inspirations for the work process came from physical exercises of Rasaboxes, invented by performance theorist Richard Schechner. These frameworks for experimentation supported the prototyping process, creating a set of guidelines to test the experiences within. These guidelines are psychophysical exercises including workshops to bring out events by digging up materials in repetitive cycles or ritual experiences [8]. Rasaboxes are a physical exploration process that builds a range of feelings clustered around the emotional core using materials influenced by personal and/or historical events to immerse oneself in that experience, feel the emotions of the experience, and prototype the experience. For example, each participant will try eight different emotional and physical versions of the same experience and repetitively prototype the different versions [8]. The participants of Rasaboxes are able to access the experience without restriction and rules and give themselves over one hundred and fifty percent to the movement and emotion. In *Echoes of Balance and Push*, the artist emulated Schechner's Rasabox technique, explored different emotional and physical versions of the same experience, exploring and accessing emotional material and created repetitive movement structures to reconstruct her identity.

RSVP Cycles

Experimental teacher and postmodern dancer Anna Halprin pioneered a technique called *RSVP Cycles [9]*. This technique focuses on ritual experiences, the everyday life, including psychological, physical, community, and personal experiences. Her teachings and physical systems of incorporating the ordinary into the creative process has offered profound inspiration for the artist's modern dance style. Halprin's *RSVP Cycles* is a system of creative methodology for collaboration. The four components for the methodology include resources (time, physical materials, other people, ideas, limitations etc.), score (instructions for the work), valuation (dynamically responding to work based on values), and finally performance (creating the work) [6]. Within *Echoes of Balance and Push*, this methodology was used to create the performance by walking through these steps sequentially to create meaningful pieces that were evaluated based on the works' value as a whole and the values of the resources and score. As with Halprin's methodology to authentically explore movement through experience and ritual, the artist aimed to create "direct personal experiences using natural movement" [6].

Another element of Halprin's *RSVP Cycles* included in the artist's work is the creative process and experimentation with tactile materials. The artist's relationship with weather balloons has developed over time and through ritual and physical exercises stemming from an intuitive connection with an orb in a dream. The dream space is a place of altered consciousness filled with a succession of images, wishes, sounds, representations and vivid sensations. This space is made up of impressions from the physical world and translated and interpreted in the unconscious realm. The artist focused her experiments to use Rasaboxes and RSVP Cycles techniques to explore the materiality of the balloon through many iterations.

Echoes of Balance and Push's movement sequences transformed over time to become an investigation of a woman struggling to navigate the terrain around an old dilapidated barn in many different weather conditions. The artist is the woman, who moves around a barn in "unfixed" movement patterns while carrying a weather balloon, exploring her ability to control or be at the mercy of the environment. To design these improvisations, she used Halprin's model and created a set of guidelines with the ultimate goal of successfully moving all the way around the barn. Her actions consisted of repetitive motions such as wandering, carrying, climbing, walking, crawling, falling, and crouching to ultimately achieve her goal. Halprin's methodology is implied but not inferred and her methodologies are used as inspiration for *Echoes of Balance and Push*.

The artist was looking to solve the problem of moving a weather balloon around an environment in difficult conditions while creating meaningful personal connections. She was not always successful, but when the task is accomplished, the experience was profound. In addition to the task at hand, the artist's newborn baby was present in the space (just off camera), which created a constant split attention and potential distractions during the creative process. In the times that a task was not successful it was when the baby needed attending to and one iteration had to be abandoned, or when the weather balloon moved off screen, dropped, popped or deflated. The unsuccessful movements included slipping, swerving or banging into bushes, falling against the barn, and falling or skidding to the ground. To solve these issues, the artist began making smaller movements with the weather balloon, using repetitive gestures like only carrying it above the knee, and finally slowing down sequences to allow for the balloons inertia and let the object lead. She found the most successful movements and explorations were centered around simple, slow tasks [9].

Bodyweather Performance

Bodyweather is a performance practice that amalgamates the body with the environment using the metaphor of weather. Created by Japanese Butoh dancer Min Tanaka [10], the performer's body is constantly changing through processes occurring in- and out-side their body. Bodyweather is "the imagination used to directly affect the sensate material of the flesh and generate specific felt bodily experiences and environmental to inhabit" [10].

Transforming the body into imagery is the key concept of Bodyweather. The main exercise in the practice is "omni-central imaging." This exercise consists of a mover placing "a number of images in discrete parts of their body simultaneously…[then the] imagination is used to directly affect the sensate material of the flesh and generate specific felt bodily experience and environments to inhabit" [10]. There can be different images that depict objects or feelings for every part of the body. In *Echoes of Balance and Push*, the artist was aware that the balloon could not drop and used imagery to assist her with this task. She visualized that her arms were nets, able to hold the weight of the balloon; her legs had the speed and boundless fullness of a gazelle and imagined that she could jump over fences. She imagined she was a hybrid human. She tried to be emotionally and physically present, aware of her environment even though she was expanding her imagination using omni-central imaging. She was able to execute the movements without succumbing to the environment.

The methodology of Bodyweather was useful to portray a specific felt body experience that in dealing with the unpredictable weather and movement. In traditional Butoh dance practices, the body is seen as "being moved as a whole" from an internal or external source rather than consciously moving a body part. In Bodyweather practice, there is a certain amount of negotiation that is done to gain the necessary level of control of the movements and performance. In *Echoes of Balance and Push,* many physical and psychological adjustments were made in the performance because of the weather cycles that the artist experienced. For example, negotiating changes with the environment according to how the artist was moving around the space. Also, the whole installation is based on these ideas and the videos depict snippets of the video versions that were filmed. The movements can be affected by the weather. For example, in the snow environment. the artist had boots full of water when from moving around the barn due to the deep snow pockets and rain puddles. To complete the tasks she had set out to do, she carefully traversed around the barn, imagining her feet were flippers and it was all right that they were cold and wet. These visuals assisted her and let her glide softly without falling. Ultimately, in the environment, the internal and external forces that affect the environment can be incorporated into the movement. Symbolically, the artist feels the methodology is helpful to create a conversation about the unspoken struggles of motherhood.

Ritual Interaction and Improvisation

Ritual is the process of exploring and archiving history, religious experiences, expressions, and practices in performance between people [11]. Lian Loke et al. describes ritual practices as a way to "explore alternative ways of experiencing and representing self and the world in intimate and highly physical interactions" [11].

Figure 4. *Echoes of Balance and Push* Digital Photograph, 2014. ©prOphecy sun

Ritual experiences create structure and form by using repetitive rhythms, sounds and tones. Artists are creative by nature and the act of ritual and the addition of improvisation create meaningful and intriguing experiences that would have never been possible to discover if it was not for the repetitive nature of ritual exploration. For example, when the artist stepped outside, there was a huge shift physically working with a weather balloon in the environment and atmosphere. As the artist attempted to replicate movement sequences that she had already honed and experienced in the inside environment, she popped a balloon within the first two minutes of being outdoors. The artist had to completely change her movements and explore alternate ways to move in this new landscape. She felt that the weather was a force and the balloon and her body were caught in the middle of the changing pattern. Through ritual iterations, she learned how to move with the balloon through experience prototyping. After prototyping the movement, she shifted positively through iterations and became more confident with the changing weather patterns and began to explore movement as she had done indoors.

Improvisation is created using a set of guidelines. For instance, in John Cage's 4'33" a musical composition that consists of a pianist setting at a piano, turning pages of music, opening the cover twice, and not playing a single note of music. "What [the audience] thought was silence, become they did not know how to listen, was full of accidental sounds. You should hear the wind stirring outside during the first movement. During the second, raindrops began pattern the roof, and during the third the people themselves made all kinds of interesting sounds as they talked or walked out" [12]. In 4'33", neither artist nor

composer has any impact on the piece, and Cage has no way of controlling what ambient sounds that audience will hear. In *Echoes of Balance and Push* improvisation were created to relate specifically to the ambient nature of sound and the process of accidental discovery. Limitations were set with the sound due to using an iPhone and the artist did not realize what sounds would be more prominent in the video until it was recorded. For example, after she started recording the piece, she was aware the sound of the wind was very present. Therefore, to reduce the intensity of the sound, she made sure the microphone on the camera was not in the direct path. A positive accidental discovery included the beauty of the ambient birds that were picked up in the recording and amplified in postproduction.

Figure 5. *Echoes of Balance and Push* Installation View. At Emily Carr University of Art + Design, 2014. Digital Photographs courtesy of Amanda Arcuri.

Multimedia artist Kelly Nipper uses performance, video, dance and projections to tell stories. In her piece *NORMA-practice for conditioner*, she presents documentation of a large site-specific installation featuring female subjects doing mundane, monotonous activating for a period of time. Nipper created *NORMA* as a starting point in her interest with the science of movement. Norma was the name given to the rulers in ancient Rome who designed the layout of stress and buildings in the city. Eventually, the designers became known as the Normans. Nipper was inspired by the city planning and used the inspiration to control her movement process through a series of steps and framing ideas in front of a camera. With the use of ritual interaction and improvisation, three dancers, weather balloons, and nitrogen tanks containing thirty hours worth of nitrogen, drained slowly through hoses into the space [13]. Nipper has an interesting way of telling stories. For example, the dancer's tasks were accomplishing over a set duration, weather and the space were important to set the tone.

Nipper's work has been an influence in the creation of *Echoes of Balance and Push.* Nipper was concerned with how she set up and tore down her installation. She was part of the experience even if the experience was not recorded or used in the final installation. Using Nipper's methodologies in *Echoes of Balance and Push*, the artist created a set of guidelines similar to Nipper's like using elements of time, place, shape, sound and the body to create pieces that tell a story through experiences.

The artist believes that improvisations are essential elements of creativity and are the building blocks of collective experiences. All the potentialities arise from the act of trying something in the moment. She believes it as an action drive or reactive experience in the moment to her immediate environment and inner feelings and this response often results in an invention of new though patterns or a new practice.

A buzz, purr, railing, weather balloon, sidewalk table, dress, humming of the refrigerator, or highchair are all opportunities waiting to unfold on a sensory level. Improvisation is conventionally seen as problem solving in situ, action driven or reacting in the moment. She used it as a tool to guide and create a safe and challenging space where she could release thoughts, ideas, and finally let go. The space is a calm, meditative place where she has contemplative freedom to create work that lives in a space of improvisation, performance, and chance.

Movement Patterns

The same movement patterns (mostly figure eight patterns) were kept with minor modifications (sometimes self-imposed and other times modifications were made due to the weather) to accomplish the goal of making full rotations around the inanimate object (barn).

Location

The videos were always recorded in the same location but used different camera angles. Another issue with the location was that sometimes other people would end up in the shot. The artist did not want any human sounds or machines (for example, cars) in the shots and had to sometimes stop filming.

Object

The artist always had to carry a balloon from one point to another, in this iteration of *Echoes of Balance and Push*, she carried the balloon around an old barn.

Technology

The experience was recorded with an iPhone and then the video was quickly edited after each take. There were added limitations in the creation of the final installation artwork due to the size of the technology used to record the videos.

Figure 6. *Echoes of Balance and Push* Process Still, 2014. ©prOphecy sun

- Sound: used the iPhone microphone and the only way the sound was manipulated was when the angle of the camera was changed.
- Memory: It was only possible to record 10-20 minutes at a time due to fixed memory/storage size. The artist only had the memory that was available on the phone so she had to make decisions after she recorded a piece and if she was going to keep the video or delete them.
- Video: Was limited to what the iPhone could record and therefore, had to make sure that her body and the balloon always stayed in frame so that she could record/ document the task.

Summary

Echoes of Balance and Push explores unspoken questions regarding how one transcends the physical experience of childbirth and motherhood through tumultuous shifts of agency, control and situations. However, the complexities of the maternal relationship in the artist mirrors the universal struggles that people experience everyday. Beginning with experience prototyping [2], the artist created an experience with inspirations from Rasaboxes [8], RSVP Cycles [9], Bodyweather [10], Ritual Interaction [11], and Improvisation [12, 13] to create guided extemporization that supports exploration, evaluation and construction of a video work. *Echoes of Balance and Push* contributes to the deeper understanding of how play and repetition can create engaging and meaningful experiences and transcend these ideas and feelings onto the audience. The work's process has appropriated unique guidelines and methodologies for art and design practices into an experiential exploration of performance art.

Future work of the piece includes a continuation of the ritual and improvisation process. One future gallery piece involves using a cabinet to create viewing stations showing looping clips of the performance with a weather balloon on three separate days that highlight a physical and embodied situation of challenge. Other iterations of the piece will continue to be developed as the artist continues to experience new inspirations to contemplate the ideas of motherhood.

Acknowledgements

We would like to thank Movingstories, School of Interactive Arts + Technology, Emily Carr University of Art + Design, Darren Fleet, Owl Sun-Fleet and finally all the anonymous reviewers. This research was supported by the Social Sciences and Humanities Research Council of Canada and the BC Arts Council.

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Authors Biographies

Karen Cochrane is a Masters of Science candidate in the School of Interactive Arts + Technology at Simon Fraser University with Dr. Thecla Schiphorst. She is interested in the intersection of movement, embodiment, and health; especially in the domain of mental health recovery.

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Dr. Maria Lantin is Director of Research and the Stereoscopic 3D Centre at Emily Carr University of Art + Design. She is interested in the embodied experience of media through the design of installations and technologies that focus on the interplay of immersion and awareness. She is currently with virtual reality and motion capture technologies to study the role of physicality and movement in immersion.

Dr. Thecla Schiphorst is Associate Director and Associate Professor in the School of Interactive Arts + Technology at Simon Fraser University. Her background in dance and computing form the basis for her research in embodied interaction, focusing on movement knowledge representation, tangible and wearable technologies, media and digital art, and the aesthetics of interaction.

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Exploring Facial Expressions for Human-Computer Interaction: Combining Visual Face Tracking and EMG Data to Control a Flight Simulation Game

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Abstract

In many affective computing paradigms a user's internal state is used as an implicit control signal in an interaction. In the work presented here, we are exploring the utilization of two measurement techniques commonly used to assess a user's affective state as an explicit control signal in a navigation task in a virtual environment. Concretely, we are investigating the feasibility of combining a real-time emotional biometric sensing system and a computer vision system for human emotional characterization and controlling a computer game. A user's "happiness" and "sadness" levels are assessed by combining information from a camera-based computer vision system and electromyogram (EMG) signals from the facial corrugator muscle. Using a purpose-designed 3D flight simulation game, users control their simulated up-down motions using their facial expressions. To assess if combining visual and EMG data improves facial tracking performance, we conduct a user study where users are navigating through the 3D visual environment using the two control systems, trying to collect as many tokens as possible. We compared two conditions: Computer vision system alone, and computer vision system in combination with the EMG signal. The results show that combining both signals significantly increases the users' performance and reduces task difficulty. However, this performance increase is associated with a reduced usability due to the need to have EMG sensors on one's forehead. We hope these results from our study can help in future game designs, aid the development of more immersive virtual environments, and offer for alternative input methods where traditional methods are insufficient or unfesasible.

Keywords

Facial Expression, Facial EMG signal, Emotion, computer vision system.

Introduction

Emotion is one of the most important concepts in psychology, human computer interaction and many other areas. Emotions can be modeled either by a *dimensional approach* where emotions are coordinates in a space or a *classification approach* that categorizes emotion in few descriptive words [1]. In general, emotion can be described by four components: behavioural reactions, expressive reactions, physiological reactions and subjective feelings [2]. Gokcay *et al*. [3] categorized the methods of measuring emotions into psycho-physiological approaches such as: fMRI, EEG and EMG and qualitative approaches such as self-reporting, observations and non-verbal behaviours. Facial expressions are one of the most important ways of conveying emotion, and are controlled by facial muscles and skin movements. Facial expression can happen both voluntarily or involuntarily [7]. Hess et al. [4] investigated facial reactions to the emotional facial expressions of people as either affective or cognitive. Erickson and Schulkin (2003) [5] described the relationship between perception and presentation of facial expressions as cognitive processes. Facial expression can be analyzed through image processing and computer vision techniques [6]. Also, facial electromyography (fEMG) is another common approach to detect and measure the facial muscle activities. Of particular importance here the corrugator muscle that is associated with frowning, and the zygomaticus muscle that is associated with smiling [7]. These are commonly used to characterize happiness and sadness emotions. For example, facial expression is used to test the audience responses to new products and computer games. In game design facial expression can indicate the emotional response of the game player to different features of a game and thus be used to provide valuable feedback in the game design process [8, 9, 10, 11, 12]. In the current work, however, we use a different approach, in that we explore the usage of facial expressions as an input parameter. That is, participants actively control a 3D flight simulation through their facial expressions. Using facial expression in addition to traditional input methods such as keyboard, mouse, track pads or joysticks opens up new ways of interaction with a system, especially in situations where hand-based input is unfeasible. Examples include situations were hands cannot be used because they are tied up with other tasks, or for users with disabilities or special needs who cannot easily use input devices such as keyboards or mouse. We do not intend to imply that facial expressions should be used to replace traditional input methods, but rather explored how they might augment them.

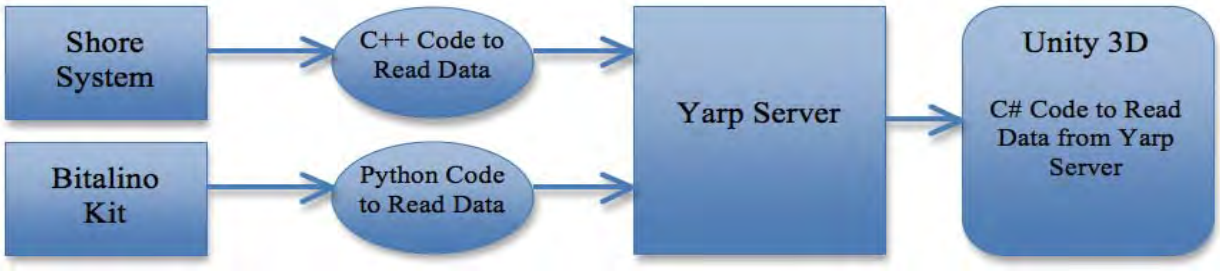

Figure 1. A schematic representation of the connection between the Shore System, Bitalino and Unity 3D environment through yarp server.

After explaining the implementation of the prototype system, this paper presents a feasibility study to evaluate the system, followed by a general discussion and outlook.

Implementation of the Prototype

The main design goal was to develop a novel user interface system for emotional interaction of the user in an immersive 3D environment where users get direct feedback about the effectiveness of their control in a game-like setup. We achieved this goal by user's facial expressions directly controlling visual changes in the environment, namely the user's locomotion through the environment created in Unity 3D. A 3D sky environment gives users the ability to have a feeling of flight in the sky and moving upwards if the user displays happy facial expressions and moving downwards if the user displays sad expressions, thus controlling one's locomotion through a path defined by a series of hoops in the air. User's happiness and sadness levels were extracted by combining information of a camera-based computer vision Fraunhofer Shore system [6] and facial EMG signal using a Bitalino kit with three electrodes placed on the user's head [13]. Using a Yarp server [14] as a middleware provides the ability to send real-time data from the Fraunhofer Shore system and the Bitalino kit to the Unity project. These sub-systems are explained in more details in the following sections.

3D Virtual Environment and Motion Control

To assess the ability of the user in controlling and moving in a 3D environment through facial expressions, we designed as simple virtual reality flight simulator where participants were tasked to use their facial expressions to control the simulated flight along a path defined by a number of hoops to fly through as shown in Figure 2. The 3D environment consists of a blue sky (skybox in Unity) with a large number of drifting clouds to provide strong optic flow. In addition, a route was defined by 30 golden hoops that player are asked to fly through, similar to a tunnel-in-the-sky display used in actual airplane flight. Using a game-like paradigm, the aim of the user is to fly through as many hoops as they can to maximize the number of collected hoops. A hoop is counted as collected if the user manages to fly through it as opposed to miss it. The hoops are spaced 25m equally apart on a forward z-axis with their vertical location in a range (-10m to 10m). The simulation was explicitly designed to be simple, such that users only had to control one degree of freedom, their vertical motion. Forward motion was controlled by the simulation. By starting the game, the user starts a flight through a route of hoops with constant gradual forward acceleration. This constant acceleration results in the user starting to fly forward with a low speed that gradually increases to make the game increasingly challenging over time. The hoops are located in different vertical positions, and users task is to use their facial expressions to control the vertical motion such that they fly through the next hoop. The user needs to show enough level of happiness to move in the upward direction and show sadness to move in the opposite, downward direction. For example, depending on the height of the hoops, sometimes the user needs to show only a close-lip smile and sometimes a big obvious smile. Note that future work would be needed to distinguish between users displaying authentic emotions of sadness and happiness versus just making facial expressions – the current prototype and study was not designed to disambiguate between them.

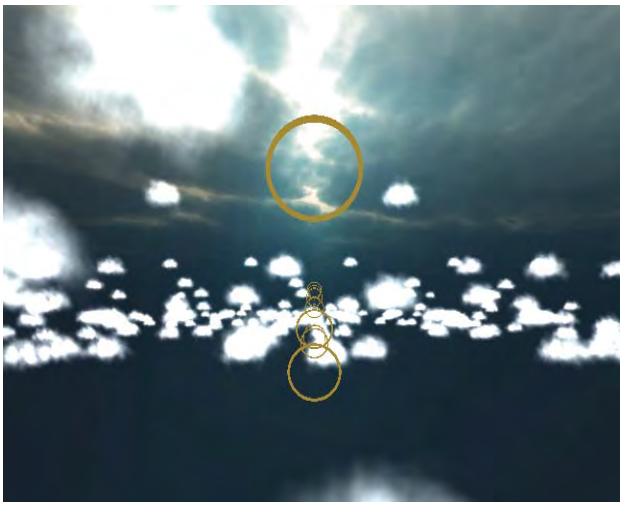

Figure 2. The 3D environment was designed in Unity 3D and consists of a sky simulation with a series of golden hoops to fly through.

User's performance was assessed by counting the number of hoops that the users were able to fly through by controlling and changing their facial expressions. For example, in some part of the travelling route the user needs to show his highest level of happiness and suddenly change it to frown very fast to be able to get two consecutive hoops one at the highest height positions and the other one at the lowest level. The user's measured happiness versus sadness values were applied as upward versus downward forces to a mass-spring system where the first person camera (player) has a mass that is connected to the vertical axis by a spring. As a result, when the user is happy the force is in positive direction and when the user is sad the force is in negative direction, similar to providing an upward versus downward thrust in an actual airplane. When the user's facial expression is neutral the player smoothly goes back to center (medium height where the position on the y-axis is zero). Although the raw sensor data might be choppy, flying up and down and then going back to the center appears smoothly due to the usage of a mass-spring control system. This was done by fine-tuning the spring stiffness and damping values of the mass-spring system in pilot studies.

Facial Expression Information from Fraunhofer-Shore System

The Fraunhofer Shore system is based on a computer vision approach to analyze and characterize the facial expressions collected by a standard web camera on a Windows computer. This system continuously returns values on a scale from 0-100 to represent the four emotional dimensions of happiness, sadness, surprise and angriness of the user as shown in Figure 3. In this work, we focused only on the sadness and happiness values of Shore system, as pilot tests indicated that they were the most reliable emotional indicators.

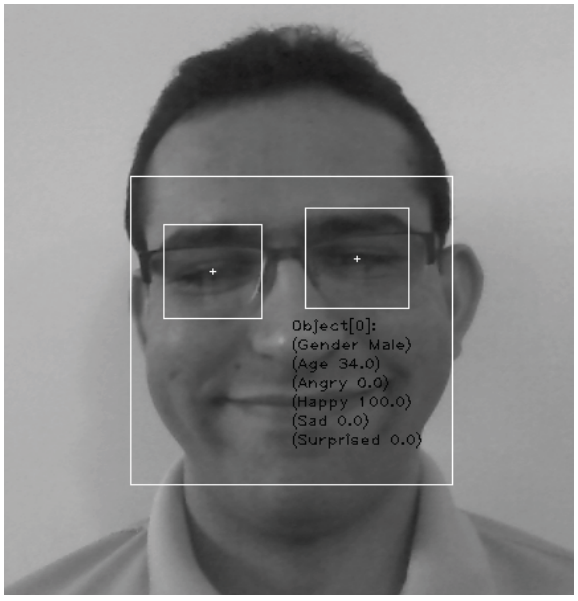

Figure 3. Using Shore system to analyze facial expressions.

In order to transfer real-time data from the Shore system to the Unity project, we used Yarp server [14]. Yarp is a middleware layer that provides the ability of transferring real-time data and communication between different software systems. For example, in this case, data from the Shore system was acquired in C++ and then transferred to the Yarp server. Then we used Unity C# scripting to read data from the Yarp server. For the purpose of using Yarp, one port is opened for sending data to the server (in the C++ code) and one port is opened for receiving data (in the Unity C# script) as shown in Figure 1. The two ports are then connected for real-time data transfer.

Facial Expression Information from Facial EMG Signal

As using facial expression to infer emotional states is inherently noisy, we combined the Shore visual tracking system with a facial EMG Signal. Getting data from the corrugator and the zygomaticus can show muscle contractions in these areas that are associated to frowning (sadness) and smile (happiness) [15, 16, 7].

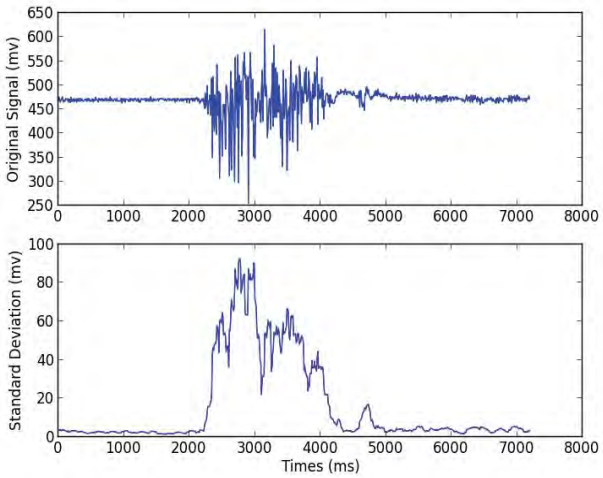

Figure 4. Standard deviation is used on original facial EMG signal to detect contraction in the associated muscles.

In order to get the EMG signal, we have used Bitalino device plugged kit. Bitalino can send the data to the computer through Bluetooth wireless technology. In this work, a typical configuration of electrodes is used: a single ground electrode was placed to the top of the forehead which is an inactive place, the other two electrodes were attached above one of the eyebrows with almost one centimeter distance apart [15] as shown in Figure 5. EMG data from the corrugator muscle is processed in a Python script. There are different approached for finding muscle contraction in the EMG signal. Using standard deviation is a common approach for detection of contraction. The contraction happens when the standard deviation of samples in a time window of the signal is more than a threshold (Fig-

ure 4.). In fact, if the standard deviation is more than the threshold we concluded that there is a contraction in the corrugator, and the standard deviation is scaled between 0 to100 and is sent to Yarp. Otherwise, there is no contraction and a zero value will be sent.

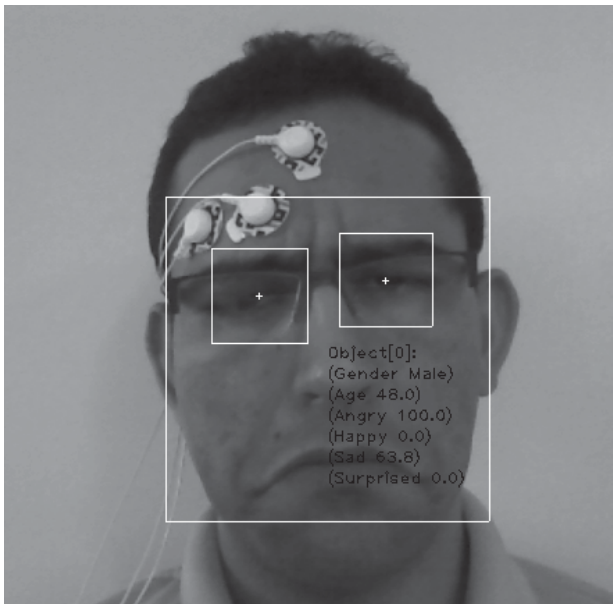

Figure 5. The location of electrodes for getting signal from the corrugator muscle to enhance the performance of the system in detecting sadness.

System Evaluation

After a pilot test of the system using only the Shore facial expression data, we realized that users can easily go in the upward direction by adjusting their happiness level. However, the performance of the Shore system was not as good for sad conditions, and did not work reliably for some participants. Therefore, we decided to test if we can enhance the performance of the system in measuring sadness emotions by combining the Shore signal with the EMG signal of the corrugator muscle. In this first implementation, this was done by simply averaging the sadness values from both Shore system and Bitalino EMG kit. To assess if thus combining the visual and EMG signal can improve facial tracking, we designed a simple user study that assessed user's performance in two conditions:

- Using only the Fraunhofer Shore system
- Using both the Fraunhofer Shore system and facial EMG signal in sadness emotions

We hypothesized that combining the visual and EMG system would allow users to more effectively control the simulated flight via their facial expressions (indicated by travelling through more hoops) and reduce the perceived task difficulty.

Experimental Design

Twelve graduate students between 22-40 years of age took part in this experiment. One of the participants was a researcher and aware of the research hypotheses, the others were naive to the purpose of the study. The participants were selected by volunteer based sampling. Each participants performed the game 4 times, twice with the Shore system an twice with using both Bitalino and Shore system. To avoid biases in learning how to use the system, half of the participants started the experiment with using Shore and then they switched to use both Shore and Bitalino and half of the participants started with using Shore and Bitalino. The experiment took between 10-15 minutes.

Procedure

First, the purpose of the experiment, the procedure, data confidentiality and risks were explained to the participants, and they signed informed consent. Participants were asked to show their emotions through their facial expression (smile or frown) to be able to fly through hoops by controlling the simulated flight in upward or downward directions.

For getting facial expression through EMG signal we first informed the participant and explained the process. Since we need to attach three electrodes to the participant's face, the researcher described the purpose of using electrodes and assured the participant that using such electrodes on the facial skin was safe and had no side effect. In order to get more accurate signal and reduce the impedance between skin surface and electrode gel, participants were asked to remove makeup or skin oil on their forehead.

Participants then performed two trials in each of the conditions (Shore-only vs. Shore + Bitalino), in counterbalanced order. For each trial the number of collected hoops was recorded as the main performance measure. After each trial, participants were also asked to verbally rate the task difficulty on as scale of 0%=very easy to 100% =very difficult.

Results

As predicted, combining the Shore system with the Bitalino facial EMG signal improved performance (Figure 6), indicated by a higher number of collected hoops (M: 15.75, SD: 2.72) compared to the Shore-only condition (M: 10.29, SD: 1.47), $t(11) = 9.223$, $p < .0001$, $\eta_p^2 = .886$. The effect size η_p^2 of .886 is considered a large effect size [17] and indicates that 89% of the variability in the performance data can be attributed to the independent variable "device", i.e., using the Shore+Bitalino vs. Shore-only to measure facial expressions.

Similarly, combining the Shore system with the Bitalino facial EMG signal yielded reduced task difficulty ratings (M: 31.92, SD: 22.93) compared to the Shore-only condition (M: 53.75, SD: 15.75), $t(11) = 3.987$, $p = .002$, $\eta_p^2 = .591$, see Figure 7. The effect size η_p^2 of .591 is considered

a large effect size [17] and indicates that 59% of the variability in the difficulty rating data can be attributed to the measurement device. When asked to indicate which system participants preferred, 10 participants (83.3%) preferred the Shore system alone, one participant (8.3%) preferred using Shore and Bitalino system together, and one participant (8.3%) did not have any preferences

Figure 6. Analysis of the number of collected hoops for two different conditions: using only Shore system for facial expression analysis and using both Shore system and the facial EMG signal. Red lines are the mean values, blue lines are standard deviation and the green lines represent 95% confidence intervals.

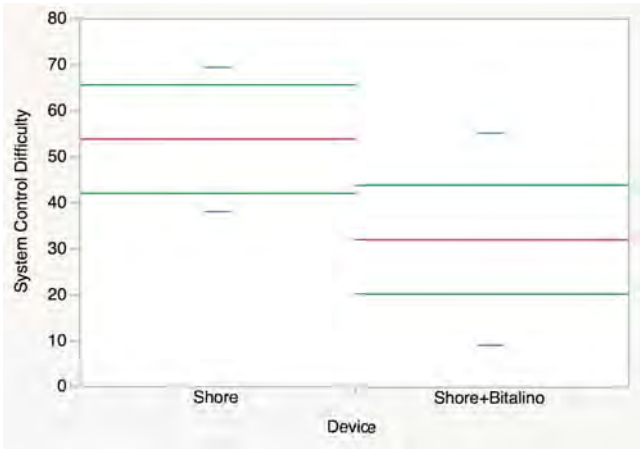

Figure 7. Difficulty in controlling the system for two different conditions: using only Shore system for facial expression analysis and using both Shore system and the facial EMG signal. Red lines are the mean values of difficulty, blue lines are standard deviation and the green lines represent 95% confidence intervals.

Conclusion

This research aims at exploring the use of facial expression in controlling a system. The system gives the users the ability to control a simple flight simulator and navigate through a series of hoops with a force that is a function of the level of user's sadness and happiness. The direction of flying, the speed and acceleration of the movement are based on the force that is applied to a mass-spring system. In this work, we used two different approaches (computer vision and Facial EMG signal) to analyze the facial expression. A user study showed that combining the computer vision system and facial EMG signal allowed for more effective control of the system and also reduced perceived task difficulty; however, it is not vey convenient for the user to use the system by some electrodes attached to the facial skin. This problem can likely be reduced by using miniature electrodes (with less than 5mm diameters) as recommended in [15]. Unlike previous work [8, 9, 10, 11, 12] that used facial expression data for passive evaluation of games, this work shows that such data can be actively used to create a more interactive and game-like immersive environment.

Future Works

This study was limited to obtaining facial EMG signal from the corrugator; in a follow-up study, we plan to add another condition that just relies on the facial EMG signal analysis from both the corrugator and the zygomaticus muscles [7]. Future works could analyze other facial expressions such as anger or fear to provide additional input channels and thus more nuanced interaction and/or additional potential movement and navigation options in a virtual environments. Such method could ultimately be useful in situations where normal hand-based input is unfeasible, for example when hands are busy, or for physically disabled users who cannot easily use traditional input devices for a variety of tasks including movement and navigation in virtual environment. Beyond using facial expressions as a mere input methods, analyzing facial expressions in real-time could also be useful for a wide variety of applications including biofeedback, emotional regulation, affective computing, advertising, user testing, and for augmenting neurogaming applications. For many of these applications, it could become essential to distinguish between users experiencing authentic emotions versus merely performing facial expressions, which might be achieved by triangulating different emotion-sensing methods and in particular including EEG recordings, which are more difficult to "fake" than just facial expressions.

Since we are well aware of to the invasive nature of the EMG and it's potential drawbacks, we would like to test other techniques such as EEG or EDR to find out which psycho-physiological approaches are most suitable for extracting facial expression data and controlling the system. Because changing facial expression rapidly and repeatedly can be tiring, there is also a potential for fatigue limiting usability and long-term usage.

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Mobile Augmented Reality Art and the Politics of Re-assembly

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Abstract

Experimental art deployed in the Augmented Reality (AR) medium is contributing to a reconfiguration of traditional perceptions of interface, audience participation, and perceptual experience. Artists, critical engineers, and programmers, have developed AR in an experimental topology that diverges from both industrial and commercial uses of the medium. In a general technical sense, AR is considered as primarily an information overlay, a datafied window that situates virtual information in the physical world. In contradistinction, AR as experimental art practice activates critical inquiry, collective participation, and multimodal perception. As an emergent hybrid form that challenges and extends already established 'fine art' categories, augmented reality art deployed on Portable Media Devices (PMD's) such as tablets & smartphones fundamentally eschews models found in the conventional 'art world.' It should not, however, be considered as inscribing a new 'model:' rather, this paper posits that the unique hybrids advanced by mobile augmented reality art— also known as AR(t)— are closely related to the notion of the 'machinic assemblage' (Deleuze & Guattari 1987), where a deep capacity to re-assemble marks each new art-event. This paper develops a new formulation, the 'software assemblage,' to explore some of the unique mixed reality situations that AR(t) has set in motion.

Keywords

Mobile Augmented Reality; Twenty-First Century Art; Assemblage; Deleuze & Guattari; Tamiko Thiel & Will Pappenheimer; Manifest.AR; Code; Embodiment; Public Art.

Introduction

Politically, the disruptions posed by AR(t) have presented a series of uncompromising critical interventions directed at the canonical Artworld (Thiel 2014:31) and at Global Capitalism (Swarek 2014:3). As an emergent form of interactive social commentary, AR(t) on mobile devices pushes into new territory and destabilises old concretions. Pioneering works by key practitioners have collided portable mobile devices with public art practice, deploying geo-locative technology at relevant sites in North America, Europe, Australia and elsewhere. Historians, theorists, as well as the artists themselves have tackled the conceptual and pragmatic implications of mobile augmented reality in public space, focussing attention on the practice of geo-location (Aceti 2011, 2013; Rinehart 2013; Ulmer & Freeman 2014; Lodi 2014; Rhodes 2008; Geroimenko 2012, 2014; Gwilt 2010, 2014; Lichty 2010-; Rhodes 2008; Thiel 2010-; Swarek 2010-; Pappenheimer 2010-, Freeman 2010-); McGarrigle 2012 -). The intention of this paper is to offer an additional chapter on the unfolding story of AR(t), through exploring the largely untapped relation between mobile AR and assemblage theory, and bringing that to bear on issues of embodiment, ubiquity, surveillance, and materiality.

Deleuze and Guattari attacked the problem of how to provide an adequate account of the forces, flows and intensities operating on the contiguous parts of a dynamic system. Their account situated the compositional drive in a material flow as an assemblage: a self-organising system of material elements drawn from a common technological lineage, where organisation is achieved by way of procedural operations vested in movement, intensity, scale, and flux. Dynamic and provisional, an assemblage always has a side facing 'vertical content' (control, authority, stratification) as well as a side that can make connections with other machines of expression, movement and so forth. The assemblage can therefore instantiate new becomings, while remaining connected to its technological lineage: existing materials are meshed together in all together different ways, allowing highly unique connections to emerge from any given matter-flow. Deleuze and Guattari announce: 'We will call an *assemblage* every constellation of singularities and traits deducted from the flow—selected, organized, stratified—in such a way as to converge (consistency) artificially and naturally; an assemblage, in this sense, is a veritable invention (1987: 406). An understanding of assemblage facilitates an examination of the material elements and relational forces that coalesce in some of the new types of hybrid mixed reality situational artwork emerging from the AR medium. The assemblage allows us to understand such works as both inseparable from the utilitarian thrust of industrial and military AR, the trivialities of entertainment and gaming paradigms, and the possibilities of new and novel aesthetic experiments.

Experimental AR artworks that can be understood as software assemblages include Blast Theory's *Uncle Roy All Around You* (2003), Janet Cardiff and George Bures Miller's *the City of Forking Paths* (2014), Julian Oliver's *Level Head* (2008), and Tamiko Thiel and Will

Pappenheimer's *Biomer Skelters* (2013-), and many of the unique works produced in the last five years by members of the Manifest.AR collective. All are iterative, that is, they produce multiple versions of themselves, with the result that the work never unfolds the same way twice. Iteration, or put another way, re-assembly, is a significant quality of the machinic assemblage, one that occludes the formation of models or repetitive design patterns. *Uncle Roy All Around You* (Benford et.al 2004) and *Biomer Skelters* both mobilise user participation and agency to shift the work as it unfolds; in the former, the participant must trace the elusive Uncle Roy and attempt to converge their path with his; in the latter, the shifting pace of the participant's heart beat effects the growth of a virtual organic biome. *The City of Forking Paths* uses the virtual qualities of AR to situate the participant in a confusing perceptual relation to a parallel world, where participants use their mobile phones to follow the artists' shamanic narrative as it meanders through The Rocks, Sydney, while Oliver leaves the source code and instructions for producing a version of *Level Head* on his website to enable the user to turn programmer/critical engineer. While the mixed reality artworks cited here are certainly not an exhaustive list of the field, these examples serve to convey the differences between the industrial and artistic threads of AR, as well as pragmatically delineate the scope of this paper.

I will be suggesting that using the concept of assemblage in relation to AR as a particular permutation of software as interface introduces a materialist media analysis into the discussion of AR that has been lacking to date. From a technical perspective, AR is any technological system which combines real and virtual, is interactive in real time, and is registered in three dimensions (Azuma 1997: 355). Caudell and Mizell (1992: 659) coined the term 'augmented reality' to describe the visual and textual layer inflected to the heads-up display (HUD) they adapted to display virtual information over structures manufactured at Boeing. Over the next ten years, potential applications in engineering allowed AR to emerge from under the motherly skirt of virtual reality (VR), to achieve its own standing as a distinct medium. However, the problematic transposition of the technology and concepts from an engineering paradigm to more culturally aligned fields is illustrated by the persistence of the information overlay approach. Two examples from the commercial world illustrate AR as information overlay. Wikitude is an interactive map registered in real space via a screen display or PMD to assist in precisely locating a geographical point of interest. Cartographic and geo-locational information is held on a web server and transposed to the local space of the user. From the mobile game industry, the massive multiplayer game Ingress, invites players join one of two pseudo-militarised factions and cooperate to build virtual portals whose instantiation asserts dominance over real space. Many of the design patterns currently deployed in the mobile AR industry proceed from the assumption that the digital screen is somewhat of a transparent analogue to a window: Wikitude is literally an overlaid map, while for Ingress the smartphone screen becomes a 'portal' for the player to look through. This has led to a situation where the weight of industry-directed AR research, is focussed on what happens within the frame of the screen, or the HUD/HMD.

AR as experimental art inhabits a different topology to that of AR as information layer, coalescing around notions of political intervention, critical inquiry, collective participation, and a deep capacity for re-assembly. When deployed in experimental and provisional formulations like the software assemblage, AR by artists presents a creative opportunity to eschew the restrictive commercial products of the AR medium and re-position its associated technologies like Portable Media Devices (PMD's) or the Head-Mounted Display (HMD). Imbued with a micro politics that explicitly values and enhances qualities of experimentation, participation, and critical inquiry, software assemblages challenge the accepted industry driven perceptions of AR as information overlay, and perhaps can operate to undo some of the trivial paradigms that have beset AR in fields such as mainstream gaming and entertainment. Entangled with the conceptual trajectory of the software assemblage is the capacity to self-organise, a key quality that separates the AR as software assemblage from AR as information overlay. For example, the mobile AR artwork *Biomer Skelters* (Thiel and Pappenheimer 2013-15) uses the participant's physiological data— derived from a smartphone fitted with a heart rate monitor— to grow a virtual biome in physical space. As the participant walks, their heart rate increases, and this increase triggers virtual plants that appear to populate the adjacent area. As the participant moves the camera/sensor, they perceive a biome appearing around them in real time, generated by the nuances of their heart rate. Using the sensors in a PMD to measure the physiological data that subsequently articulates real time actions in the biome, creates a self-organising system conjoining real and virtual to participant, mobile wireless network, and device. This is a virtual 'dynamic system' that the participant symbiotically enters to 'co-compose' the work. Participants compete with one another to proliferate the healthiest biome: in Dubai, themes of greening the desert created a kind of 'anthroposcenic' moment. Poetically, in the face of global climate change, humans are able to re-assemble nature by cultivating a virtual biome. Thiel and Pappenheimer pose conceptual answers to ethical problems by using the augmented reality medium to expose the 'rough edge' of perception itself. For a user experiencing an AR work such as *Biomer Skelters*, everyday behaviour in public space (using the PMD camera to view and GPS to navigate) is transposed to a micro-political site of affective experience. A critical engagement is unleashed, where the participant is called on

to mediate the emergence of 'machinic life' in a biome they can either make flourish or wither.

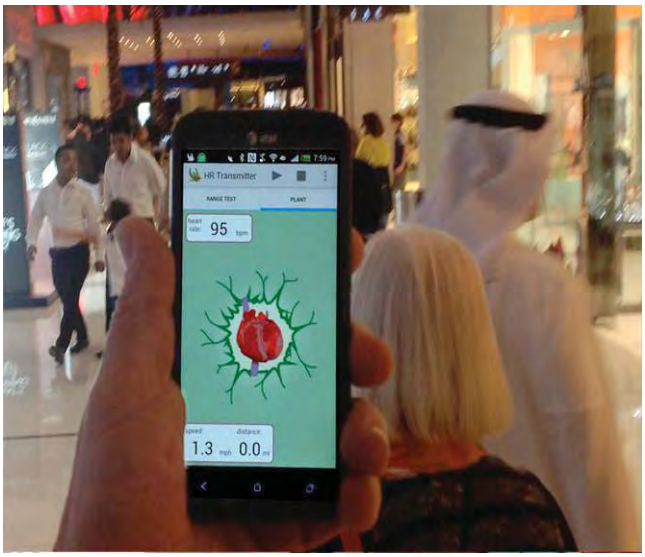

Fig 1. Still from *Biomer Skelters* (Dubai 2014). Heart rate transmitter generates data to grow plants. Courtesy of the artists.

Theorists like Mathew Fuller and John Johnston have explored the notion of assemblage as a compositional force that allows diverse material elements to coalesce according to particular affordances, intensities, flows and attractions. Matthew Fuller (2005) referenced Deleuze and Guattari's assemblage as a force for the self-organisation of matter-flows concerning people, materials, devices, cultures, all interconnected and entangled as a mediatic ecology, such as that present in London's pirate radio scene of the 1990s (2005: 13-53). Fuller's ecology traced the dynamism of such transitional and provisional assemblages, and in particular showed how the consumers were now often also producers (radio disc jockeys, artistes) of music. For Fuller, assemblages are the procedural driving force of a re-invented 'media ecology:' they are imbued with a persistent capacity to re-assemble, and do not concretise since they are in constant motion.

John Johnston (2008) has developed the concept of 'computational assemblage' to 'designate a particular conjunction of a computational system and a correlated discourse' (8). That computational system is cybernetics, artificial life, robotics, and autonomous software agents, while the theoretical discourse is assemblage theory as a processual mode of tracing the emergent and connected behaviours that lie behind organic and non-organic life. Johnston extends these ideas in relation to self-organising machines, from a framework he has termed 'machinic philosophy.' Johnston's use of the term 'computational assemblage' is specifically in regard to his work on self-organizing, semi-automonous machines and their associated software agents. However, it is of significance to my term software assemblage because Johnston's project re-situated AI and robotic agents as assemblages engaged in radical forms of becoming. This marked a critical turn away from an object-based notion of semi-autonomous machines, since becoming (as a machinic articulation of complexity) pays respect to change, transformation, and singularity, allowing Johnston to more accurately trace the trajectories machinic life is taking as machines increase in complexity toward states of self-organisation (105-161).

Mobile AR(t) from an interventionist thread, has respect neither for the gallery, nor the art world: accordingly, it is one of the most conceptually challenging and ephemeral hybrids to emerge in recent years. Simona Lodi (2014) contends that appropriations of public space by a loosely connected system of 'attacks' using emergent technology, are changing audience perceptions of curation by offering an uncompromising critique which is uninvited by the art establishment. Context and content interconnect in these uncompromising messages, such as Molleindustria's virtual 'one finger salute' attached to the Chinese Pavilion at the 54th Venice Biennale (2011) in defiance of Ai Weiwei's arrest in April 2011. The intervention aimed to challenge the 'spatial, temporal, discursive and institutional framework' (286) of the artworld and most certainly would have been removed immediately had it not been virtual. Emerging with and through AR(t) is an activist politics engaging wireless networks to achieve a critical 'detournement.' In this context, AR has been deployed as a radical political agent, mapped at specific sites where participants do not simply view 'the work' (as one does in a conventional art gallery) but activate the sensation of 'being within' a critically resonant event. Such artivist gestures have allowed AR(t) to forge a specific cultural relation with public space that was, prior to mobile technology, largely occluded. Ulmer & Freeman (2014:61) have recently pointed to the link between AR and an emergent politics of well-being in public space, drawing a parallel with the Nineteenth century town square as a paradigm for vocal disruption as a vector to a radical collective politicisation. Here, a counter-cultural version of the possibilities posed by ubiquity emerges to challenge mainstream AR.

Ulrik Ekman (2013) has argued that 'ubicomp' has not yet been 'concretised' and needs to be explored through its processual operations of emergence. Emergence, traced through Gilbert Simondon's notion of 'transduction,' is a key processual, social and material activity of ubiquitous computing. Ekman contends that ubiquity cannot be approached as a 'controlled coding' but only as an 'event to come,' a matter of an ontogenetic dynamics and its relationality playing themselves out in practice ' (2013:283). The situation of mobility brought about by ubiquitous computing, engages a relational and material capacity for re-assembly, as well as activating a micro-politics that challenges existing stratifications, such as in the Occupy AR works and others (http://manifestarblog.wordpress.com). Here, the gestures of artist and participant emerge together in a provisional

and transitional mixed reality situation. While still resisting the formation of a 'model,' some points of consistency can be noted. Firstly, a participant becomes activator, user, and audience: performing all the operations and gestures that allow an event to unfold in public. The artist, now off to the side, has gifted their agency to code. At the same time, a participant, guided by computational as well as human logic, is interpellated into a performative machine. Secondly, when engaged in such AR(t), 'thinking' is no longer the primary mode of apprehension: sensation, both haptic, aural and related to the feelings generated by a responsive site, play a greater role. Thirdly, in this post-gallery milieu, embodiment is a powerful force, via the gestures a participant needs to activate the work and also through the practice of walking about the site. Referring back to Occupy AR, we find a sympathetic affective tendency at work: the docented art tour staged by members of Manifest.AR in front of the New York Stock Exchange, a location where protestors were forbidden, reveals a strategic use of the virtual, to disrupt authority and stake out a vocal space for critical thinking. In the contexts of the Venice 2011 interventions and as well as Occupy, the virtual becomes an powerful force that cannot be moved along or arrested. Building on Brian Massumi's thought, we could say that mobile AR(t) activates the body of the participant through multimodal sensations that produce a space for disruption as a form of difference, an unfolding event where affect is highly micropolitical. AR(t) does not occur prior to the arrival of the participant: it is co-emergent and relational, affording new modes of being that, if carefully nourished, can shift and perhaps even transform the everyday.

To an extent, the participant in a mixed reality situation has been acculturated to interpret the requisite visual, haptic and sonic processes of AR(t) through a prior familiarity with the tools of pervasive computing. Katherine Hayles (1999) has outlined the difference between 'incorporating' and 'inscribing' practices, and how they operate together to produce an embodied response (1999:198). An incorporated practice (in our case, the gesture of holding a smartphone or tablet to reveal or capture a camera view), cannot be separated from its 'embodied medium' (the portable media device). The complex interrelation between inscription and incorporation (imaged poetically by Hayles as a modulating sine wave) has the effect that: '... culture not only flows from the environment into the body but also emanates from the body into the environment. The body produces culture at the same time as culture produces the body (1999: 200).' Building on Hayles perceptive account, where cultural practices are meshed to the environment through embodiment, affords a perspective into the recent failure of a much heralded AR product, Google's *Glass*. Patrick Lichty (2013) has correctly cited *Glass* as simply an 'informatic overlay'. Extending that citation in it's year of doom, we could add that, as an informatic overlay *Glass* maintained a tight relation with a prior industrial sense of AR (see Claudell and Mizell), and neglected to perceive the shift of AR into culture as a meshwork of social intensities. The failure of *Glass* is not so much technological but conceptual: in a post-Snowden era, participants in real-time mediatic assemblages are actively resistant to the idea of surveilling others, and are at least partially aware of the industrial goals of big data. In some of the social situations that emerged with *Glass*, user's were ridiculed as 'Glassholes', a low brow quip that somewhat points toward the co-emergent relation between materiality and embodiment: or, culture that is produced by the body, as the body produces culture.

Looking at software as an assemblage, theorists like David Berry and Adrian Mackenzie have developed an understanding of code as more than simply a series of repeatable, executable commands, an approach where software, along with its technical elements of data, code and algorithms, forms the procedural ground of digital mediatic assemblages. David Berry (2011) has a useful conception of code as 'computational logic located within material devices' (63), where code produces a series of materialities conjoining the activities of the end user, the creative writing of the programmer, and the devices that run executable commands, together as a relational system which can be deployed in any given cultural milieu, with quite specific affects. Following Berry, code, when embedded within technical devices, takes the role of organising agent, articulating the nuances of the medium and linking those nuances to software agents, applications, and user behaviours. AR— produced by such conjunctions of algorithms, code and software— is a particular instance of computational logic deployed on technical devices, and as such needs to be explored for its relational and material connections to a social and technical assemblage. In *Cutting Code: Software and Sociality* (2006), Mackenzie explores code as the neglected material 'background' to software. He notes: 'Code is so ubiquitous that it should be an important material for cultural practices and representation, but it is relatively invisible, backgrounded, and forming part of what Thrift terms a "technological unconscious"... .' (2006:25). Mackenzie's analysis proposes a material approach to computational logic as culturally produced by processes than conjoin code with sociality, and facilitates an understanding of the temporal and spatial relations present in events such as those emerging with AR. If, following industrial AR, we primarily perceive AR as an information overlay, we miss its capacity to provoke the multimodal perceptions that turn a passive viewer into an active participant in a radical media assemblage. For example, Cardiff and Miller's *the City of Forking Paths* (2014) places the participant in a situation where they must follow the audio-visual logic of the AR embedded video, along the exact cartography set out by the narrative, and are completely unassisted by the normal technical aids used in AR such as global positioning systems (GPS). Participants trace the multiple narrative flows presented by the work at the same time as maintaining an awareness of their geographical context: if they deviate from the 'forking paths,' they loose their place and are caste adrift

from Cardiff and Miller's parallel perceptual universe. In this way, the work operates alongside each person's unique sensory apprehensions, foregrounding the role of the body in producing a mixed reality experience, not the role of the technology.

Closing remarks

Software assemblage, as I have discussed it, operates as an emergent critical practice that repurposes existing devices, is moved by code (agential and social) as well as situated by signal, feedback, and transmission. It attempts to shift the virile stratifications of Global Capitalism through a series of affective turns, mobilising embodiment, physiology, and conceptually radical thought. It is post-gallery and occurs at a critically interventionist site where public space is utilized and politicized: perhaps a park, a street, a town square, a desert. Wherever and whenever, the future iterations of these singularities are always available for re-assembly.

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Puppetree: a remediation of theatre, from spectatorship to co-authoring

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Abstract

By drawing parallels from theatre, this paper examines new paradigms in interaction models for the viewer (user) of interactive virtual worlds. Studying the changes in the aesthetic experience of the viewer from theatre to cinema to interactive virtual worlds, changing dynamics of the author-viewer relationship across these media are highlighted. Agency of both, the author and the viewer are discussed, establishing a case for exploring interaction models based on ideas of co-authorship.

Puppetree, a digital puppetry platform, has been developed as means to develop the ideas of co-authorship, taking inspiration from the position and agency of a traditional puppeteer. The platform is built with Intel's perceptual computing that uses a motion sensing technology to detect a user's hand and translate the movement to a puppet in a 3D environment. The direct hand-control allows the user to experience the virtual environment as an extension of his immediate physical reality vs. immersing into an environment as an avatar. Exploring narrative structures that shape user-experience in such environments is in further scope of this work which requires an understanding of the logic of interactive storytelling in digital media.

Keywords

Digital puppetry, remediation, theatre, Interactive Virtual Worlds, agency, aesthetic experience, co-authorship, interactive storytelling, perceptual computing, motion-sensing

Introduction

This work began as an an inquiry into the aesthetic experience of performing arts. Theatre seemed an appropriate starting point owing to its openness to an outsider to the field. Theatre is so close to life itself that any lack of formal knowledge of the field doesn't prevent one from engaging with it. From a new media perspective, interactive virtual worlds seem as remediation of theatre. The understanding of dynamics of performance have transformed into an attempt at developing models of interaction in interactive virtual worlds based on theatre.

Inspiration to adapt this approach of looking at interaction design as remediation of theatre is rooted in Brenda laurel's work, Computer as Theatre, in which she analyses classical dramatic theory to look at effective interaction design as effective drama. The central idea adopted from her work is the concept of 'agency', the ability to initiate action. In the course of this study, action and perception have emerged as the key factors of aesthetic experience. The relationship between the author and the viewer changes across media owing to the capabilities rendered by the medium. 'Distance' that separates the author and viewer is another player in the scheme of things and is a property of the medium.

To conceptualise and build models that further the case of this study, *Puppetree,* a digital performance platform serves as a potential ground. Developed with Intel's perceptual computing, it uses a motion sensing device to detect the hand movement of the user and translate them to a 3D puppet in a virtual environment, giving him the position of a puppeteer.

Remediation

All media work by remediating, that is translating, refashioning and reforming other media. [1] This work looks at cinema and interactive virtual worlds as acts of remediation of theatre. The similarities and differences of the media are mapped to see correlation to the changes in the aesthetic experience of a viewer through each medium.

Framework

To observe the changing dynamics of an experience across media, three fundamental points of study are chosen: the author, medium and the viewer (spectator). *Author* is the formal cause of a performance. *Medium* is the material cause of the performance. *Viewer* is the witness of the performance. The interplay between these elements if the focus of this study.

Theatre

The basic minimum for a performance to happen is a performer, a space and a spectator. The performer *acts* on the the space(the material medium) to give form to his thoughts and feelings. The aesthetic experience of the performer is in 'action'. The spectator receives the performance as sensory inputs. He gets acted upon by the space and engages in interpretation. The aesthetic experience of the spectator is in 'perception'.

In the performance space, there is a 'distance' (both physical and psychological) that separates the spectator from the performer. It is mentioned in the Indian theory of aesthetic experience (the *rasa siddhānta)* that the spectator is supposed to bear the nature of the author, which enables the spectator to experience *rasa* (aesthetic pleasure). [2] According to the Indian scholars, he should have the basic receptivity to attune himself to the level of the author. If his heart is at par with the imaginative mind of the author, he can experience this aesthetic pleasure. Thus, the aesthetic pleasure of the spectator is in traversing the psychological distance that separates him from the performer. The physical separation allows the spectator to see the performance as a 'whole' and position him in a perspectival space with multiple vantage points.

More commonly in theatre, there is an author (director) who puts together a performance while working with performer(s). Performer becomes a part of the author's medium of expression. The author can be seen as acting through the performer(s), and the spectator is now engaged in attuning to the mind of the author.

Theatre *to* Cinema

In cinema, the spectator's eye is extended by the camera. The 'observed' comes closer to the observer (spectator). Quoting Walter Benjamin, these close-ups satisfy the desires of the masses "to bring things 'closer' spatially and humanly," "to get hold of an object at very close range", thus giving a notion of control over the observed. [3]

In case of theatre, the author merely *suggests* a possible path for the perceptual movement of the spectator through the theatrical space, with the aid of the adapted narrative structure. But cinema as a medium allows the author to wire this path for the spectator by using the camera as extension of the spectator's eye and manoeuvring it. In effect cinema is actually placing more control in the hands of the author, enabling him to portray in detail what he wants the user to see. The spectator's perspectival space is narrowed and his movement is controlled by the author.

As compared to theatre, two types of 'agency' emerge in cinema: of the spectator, in moving closer to the observed and, of the author, in designing the path for the spectator's movement in space. However, the agency of the spectator can be seen as a subset of the agency of the author. Cinema works in a way that obscures the presence of the author in the space. So the spectator, immersed in the space, experiences his agency as independent of that of the author. The aesthetic experience of the spectator in cinema rests not just in perception but also in action (or rather an illusion of action in the larger scheme). The pleasure derived from this new possibility to get closer to the observed overpowers the experience of psychological movement through perception. With more control in the hands of the author over the experience of the viewer, the perspectival space of the spectator gets compressed by coming closer to the performance and, in effect, distancing away from the author.

Theatre *to* Cinema *to* Interactive virtual worlds

Interactive virtual worlds, as representations of physical reality in 3D environments, borrow from cinematic vision, specifically, through the mobile virtual camera. The difference in virtual worlds is that the camera is controlled by the user (spectator) and in fact, is identified with his own sight. [4]

In designing the user's experience through the virtual environment, the author attempts to make the user resonate with the logic of the environment. The author offers multiple viewpoints to the user that are all constructed to be coherent with the overlying logic of the environment. All paths for the user are designed to lead him to make connections in the world that the author wants him to make. The algorithmic approach to design makes it possible to present a coded movement through space as a process of discovery to the user. This illusion causes the user to mistake representation for reality. Perception is limited. This illusion lies in restriction of movement, concealed from the user by offering multiple options for movement and creating a notion of free movement. The user gets immersed in this restricted movement. The control placed in the user to manipulate his environment increases immersion and reinforces the illusion.

The spectator himself becomes the performer (character). And the presence of the author becomes more obscure for the spectator, in the perceived space of the experience. As compared to cinema, there is strengthening of the agency of the spectator in terms of control over his environment and also in the agency of the author in terms of control offered to her by computing technologies for detailed design of the virtual spaces and the movement of the user within.

New technologies not only change the interactions of the user with the medium but also influence the creative process of the author. In case of theatre, the performance is live. The author maintains the integrity of the performance through knowledge of the moment and improvisation. Cinema, on the other hand, is recorded and compiled by the author and, played back for the spectator. The author is making content to be consumed in future. So the author wants to exercise more control over what the spectator sees, and there is no possibility of any improvisation.

In interactive virtual worlds the performance unfolds as the user moves through it. The user becomes part of the performance. This brings back the live nature of theatre for the performer, and hence improvisation based on the user behaviour becomes necessary. But the author is still not

present at the time of the performance. Computing technologies allow the author to manifest part of their thinking in form of a computer program and act while the performance unfolds to the user.

Computing technologies place power in the hands of the author to control the flow of the experience and thus remove her need to be present during the performance. Though the interactive virtual worlds offer agency to the user allowing him to assume the role of a performer in the virtual worlds like in theatre, but the performer isn't able to establish a similar connection with the author. The performer can rather be seen as a puppet in the hands of the author, moving through a constructed path designed by the author.

Co-authorship

This discourse highlights the primacy of the author-viewer relationship in shaping the viewer's experience through a medium. While prevalent methods of designing interactions for the viewer in interactive virtual environments explore the idea of giving the role of performer to the viewer, another possible direction to focus is a position where the viewer's role resemble that of the author i.e. to design spaces where the author and the viewer come together to co-create. This creates scope for designing experiences for interactive virtual environments that leverage the power of emerging technologies to create platforms for co-authorship.

Puppetree

Puppetree is a performance playground inspired by the model of traditional puppet theatre. Placing the user in the role of a puppeteer, it forms a potential ground to conceptualise and build models of co-authorship in interactive virtual environments. Created with Intel's perceptual computing technology, *Puppetree* makes use of its 'close-range depth tracking' feature to capture the movement of the user's hand and translate it into movement of a 3D puppet in the virtual world. This allows the user to control a stringed puppet character in a 3D space similar to the traditional puppeteers.(Figure1)

Technology - Perceptual Computing

Popular motion sensing technologies like Kinect and Wii capture and translate the entire body movement onto the virtual world. Technologies operating at such scale and distance make it more intuitive to design environments where the body traverses the screen and becomes part of the virtual environment, i.e. embody a character in the virtual world.

The close range depth tracking feature of Perceptual Computing makes it possible for the user to interact with the virtual world without using the entire body. And it becomes more significant when the hand is given direct motor control in digital environment. We use hands in our natural environments to touch, grab and act on objects around us. The micro-control that we can exercise on our environment with our hands makes most of our natural interactions. Interactions driven by a hand movement in front of the screen automatically evoke ideas of environments that are composed of objects meant to be held and acted upon.

Agency of the puppeteer

Puppet theatre, when seen as an abstraction of theatre, makes the supremacy of the author's agency most visible. In drawing the similarity between puppetry and theatre, the performers appear analogous to puppets and the director to the puppeteer. By reducing performers to puppets, the dynamics of the author-viewer relation become more visible. The puppet master's interaction with the viewer is direct. The viewer is completely aware of the position of the author. The author puts together her physical reality in front of the viewer as she constructs it through puppets. Author, while playing different characters juggles between different perspectives that hold the composition. The suggestion of life in inanimate objects is a product of the narrative style of the puppeteer and the expanse of the viewer's imagination in accepting it as reality.

In *Puppetree*, the act of translating the user's hand movement to bring a 3D virtual environment to life has given a different meaning to the user's agency in a system. The user becomes the puppeteer. Instead of embodying an avatar in a virtual environment to assume agency in that space, the user now is imparting life to an object in the virtual environment through his actions in the physical environment, still retaining the idea of his physical self. Instead of becoming a part of a larger scheme of events, the user has the complete view of the happening and in fact, he is the one composing it.

Puppetree attempts to abstract the concept of agency of the puppeteer as in traditional puppetry and transposes this agency to the user of an interactive virtual environment. The user becomes an equal author of this experience. Puppetree has emerged out as a space for co-authorship where the user is co-creating the experience.

Figure1. User interacting with *Puppetree*

Discussion

Puppetree is an experiment in co-authoring that brings together the author of the virtual space and the user as the puppeteer to create an experience. The role of the new media artist while authoring the virtual space is to design interactions and flow that allows the user to create seamless experiences. In view of this, the form of the performance platform needs to evolve further,

Puppetree has been exhibited as an installation in gallery spaces where audiences have enjoyed playing with the puppet while getting a grasp on its movement. Currently, the platform allows room for engagement for a few minutes where the user (turned puppeteer) tries to get comfortable with the new controls offered to him and experiences being a puppeteer for the first time. It hasn't, yet, been put in an environment where the user could spend enough time with it to be able to create stories.

To design for an experience through *Puppetree* that sustains user's interest over time and utilises the true potential of the platform, further work is required in two areas: firstly, building a system of gestures that gives more affordance to the user and adds character to the movement and behaviour of the puppet; and secondly, in devising a narrative flow for the user of this environment that facilitates the user to engage in the act of co-authoring. Instead of an instructional mode, a method can be devised similar to the open-scores as used by the composers of improvisational music traditions that allow variability and create room for free play by the performer. Exploring models of interactive storytelling based on improvisational traditions and surrealist games like exquisite corpse, seems to be a direction to take further from here. As a parallel thought, there is scope for implementing this platform to be used by multiple users coming together to create stories on a larger scale.

Conclusion

This work takes on a journey to understand the interactive virtual worlds as remediation of theatre and compare the experiences of both the author and the viewer. It highlights the significance of the author-viewer relationship in shaping the experience of a viewer. Emerging technologies acting as extensions of our senses open up possibilities that can be exploited to invent new forms of the author-viewer relationship.

A work-in-progress, it proposes to build *Puppetree* as a performance platform that takes the idea of co-authorship further and evolves into a platform for interactive storytelling.

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Priyanka is interested in playing with technology and bending it to discover new forms of expression. Her works are driven to find new meanings at the known boundaries of human-computer interactions. As a New Media artist, her practice is focused at understanding our relationship with the environment and investigating technology's influence on our perception of it. She enjoys sketching as much as she likes to fiddle with code. She believes in connecting the knowledge of the old with the capacity of the new.

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Pyxis Minor: App Design for Novel Social Music Experiences

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Abstract

Pyxis Minor is a social musical application built for iOS and Mac OS devices. It is intended to be of use for people of varying musical backgrounds and knowledge levels by providing a low barrier to entry for the creation of electronic music and by emphasizing the playful nature of music making. Pyxis Minor achieves disruption of existing electronic music performance and creation paradigms in order to posit a democratization of electronic music processes. This paper outlines the user interfacing principles and the design architecture which includes the repurposing of a game engine in order to create a unique social music experience.

Keywords

Sound synthesis, instrument design, app design, social music experiences, digital signal processing, user interfacing, game design.

Introduction

"Life means movement and action, and if we wish to find a meaning in it we must seek for activities which carry their own purpose and value within them, independently of any extraneous goals...There really are such activities...we must call them play." - Moritz Schlick. [1]

It is no coincidence we often use the word playing synonymously with performing when discussing a musician using a musical instrument. Although the level of skill required to truly play an instrument is subjective, it can be argued that at least some familiarity with the instrument is required. In the realm of digital electronic music creation and performance the barrier to playfulness is built on a combination of computer literacy, digital electronic music theory and a veil of jargon. As such, finding a suitable entry point for a beginner can be a difficult task.

This paper presents Pyxis Minor, a new, social musical application that disrupts established models of electronic music creation and performance. It does this by providing an enjoyable, creative platform for people of any background to explore and create electronic music by focussing on the playful aspect of the creation process in a way that was previously only available to electronic musicians. Pyxis Minor does not attempt to provide shortcuts for beginners to create electronic music expertly, instead it offers a unique platform for users of any experience level to experience an intuitive way of thinking about and constructing electronic music and subsequently attempt to democratize these electronic music processes.

Although the processes used to create Pyxis Minor are based on engineering principles, the primary conception is that the application itself is a work of software art. Pyxis Minor, as an artwork, seeks to give users an aesthetic experience in order to challenge established paradigms of electronic music creation. It does this by allowing the user to shape their own musical experience through unstructured, free play. This kind of playful user interaction is the primary medium through which Pyxis Minor becomes a unique interactive artwork. As an artistic medium, application development has an interesting issue; the success of an application as an artwork is inevitably tied to the structural integrity of the design and system architecture. If Pyxis Minor fails to present a cohesive and intuitive user experience, the success of the application both as a work of art and as an attempt to democratize electronic music processes will be compromised. For this reason, the usage of engineering principles is paramount to the success of the Pyxis Minor.

Detailed in the paper are aesthetic and user interfacing (UI) principles that guided the design of Pyxis Minor, the justification behind the principles used. This will be accomplished by establishing the context for the application before illustrating the main aesthetic decisions that have made Pyxis Minor an effective application.

Related Work

One of the main aims of Pyxis Minor is to create a playful musical experience for one or more users that can be enjoyed regardless of prior music performance experience. The key difficulty here is creating sensible user interfacing that appeals to users with varied expectations of what musical interaction should entail. Blaine and Fels discuss this problem as a matter of balancing complexity and expressivity. By increasing the expressivity of a musical controller or interface requires an increase in complexity - which inevitably makes these interfaces more difficult for a novice to engage with. [2] For this reason, in the field of electronic, collaborative musical interface/instrument design, frequently instruments or interfaces are made specifically for demographics based upon their prior experience or training, with few interfaces that cater to people of varied music performance experience. For example, an

early example of collaborative electronic performance, The Hub, required the participants to have a strong knowledge of computer music technology to participate. [3] Alternatively, interfaces such as Beatbugs, are used primarily as pedagogical tools for teaching rhythmic concepts to children who may not possess knowledge of music theory through the process of collaborative electronic music performance. [4] Although Beatbugs does make an effort to connect novices and experts, it makes an explicit distinction between the two, instead of recognizing the difference as separate ends of a scale. Additionally, the experiential value for the expert is predominantly in the pedagogical process, rather than the musical process. [4,5]

We can overcome this difficulty with several strategies. Some facets of this dichotomy can be resolved by relying on familiar, extramusical physical interactions to form the basis of an instruments user interaction. The user is able to focus more upon the causal result of their interaction, rather than the process of interaction.

The increasing prevalence of smartphones and tablets over the last decade has created a niche platform for music technology. The lower cost to entry for developers (over creating hardware) has translated to a lower cost of entry for musicians (beside the initial cost of the hardware device), allowing for music technology to appeal to a larger demographic. Additionally, the distribution avenues of the existing smartphone and tablet app stores has provided a platform for simple distribution of new musical instruments and interfaces. These reasons and the ubiquity of these devices make smartphones and tablets an excellent platform for the development and distribution of a social musical performance interfaces.

By examining the existing market, we can see there is an issue in the market of social musical performance applications. For example, Korg's WIST (Wireless Sync- Start Technology) allows inter-device syncing and communication and provides a strong platform for the development of a collaborative musical experience, however the majority of the applications listed on the WIST website are applications that emulate existing hardware instruments. [6] Kell and Wanderley observed that 282 of the 337 musical applications for iOS they examined used musical metaphors based on existing instruments or interfaces. [7] This is problematic for multiple reasons.

Unfortunately many of the modes of interaction of existing, physical interfaces & instruments translate poorly to a flat touch-screen. For example, rotary knobs are a common feature on hardware synthesisers that require a circular motion, which is difficult to achieve without tactile feedback. Due to the difficulty of achieving the motion, there is no standardized method of interacting with these as UI elements, yet a large amount of the emulations feature rotary knobs. It is often the case that hardware interfaces are effective because they are purposely designed for the specific hardware. Translating these musical metaphors may allow for familiarity for the user (if the metaphor is sufficiently recognisable), however they might not be more expressive than metaphors created specifically for touch-screens.

Most of these emulations are presented as tools, with a primary function of aiding in the creation of music as a product. In doing this, however, they ignore the creation of music as a process with it's own purpose and value that can be enjoyed for its own sake, instead focusing on the musical result. The result of this is that the majority of these emulations are proposed as tools, rather than toys.

The emulations alienate new users who are unfamiliar with the hardware counterpart. This leads us to believe that novices are not the target demographic of these hardware emulations. These emulations prioritize affordability and portability over novel experience and as such, contribute to maintaining the barrier for electronic music performance as unapproachable for users without prior, related experience or knowledge.

Pyxis minor combines affordability, portability, novel experience and low barrier to entry in a single application that is accessible to users of any prior music performance experience in order to democratize electronic music performance processes. This democratization disrupts the standard electronic performance models by providing a distributed, democratized creative platform for electronic music creation and exploration.

Pyxis Minor

Figure 1: The main screen of Pyxis Minor with 4 sequences playing back

Pyxis Minor is a social music application built for iOS and Mac OS devices. By existing as both an application, and a work of art, Pyxis Minor gives users a chance to explore an aesthetic in a playful manner, in the hopes of suggesting the movement towards the democratization electronic music processes. The visual aesthetic is based upon an outer-space theme to echo a sense of vastness and exploration as a parallel for human creativity.

In Pyxis Minor users create sequences of musical notes (defined by pitch and velocity pairs) by defining nodes upon a grid, where the x-axis defines the pitch and the y-axis defines the velocity. Users input the nodes by touching the screen or using a mouse cursor to click the grid. As the nodes are input they are quantized to clock pulses in real time. As the

user selects the first node of the sequence, or alternatively a sequence loop button, the sequence of nodes that have been input will begin looping playback how it was input, quantized to to the clock pulses. The instrument sequences are vaguely reminiscent of constellations to further reinforce the aesthetic direction of the application.

Users are able to create up to 4 sequences, that are distinguished by color, from buttons on the left hand side of the main application screen (as can be seen in figure 1). Each sequence/color functions as its own instrument/synthesizer with multiple digital audio generation and manipulation parameters available to the user (such as stereo pan, pitch octave, envelope and synthesis waveform).

Additionally, controls enable the user to play the instruments live, without creating looped sequences and to apply digital signal processing (DSP) to the instruments to further manipulate the resulting music. A small tutorial button guides the user through a 20 second demonstration of the application's core functionality.

Users are able to wirelessly connect to nearby devices in order to share and sync the quantization clock, in order to create music together. Following is an in-depth look at the key aesthetic design principles of Pyxis Minor.

Aesthetic Design

In Pyxis Minor, a combination of 3 design principles is crucial in the absence of a widely established musical interaction metaphor (such as piano keys or drum pads). Kell and Wanderley suggest that there needs to be a transparency between musical mapping and the user in order for a musical app to be easy to understand for a beginner. In the absence of a musical mapping metaphor from an existing musical instrument or interface, Pyxis Minor uses familiar elements described by Kell and Wanderley, specifically mapping pitch to x-axis movement (low to high from left to right) and mapping volume on the y-axis (lower volumes equating to the bottom of the screen). [7] The three main principles guiding the user interface construction in Pyxis Minor are minimalism, clarity and stylization.

The visual design was created to be minimal, using pictographs instead of typed labels where possible. This makes the application more accessible to foreign languages without the need for localization. The visual design is minimal in the sense that although the application has many features, they are obscured where possible if they do not add expressivity to the application, or their meaning is unclear. Additionally, where possible the GUI displays only relevant functionality simultaneously, whilst refraining from giving the user too many menus to navigate through.

The design principle of clarity is reflected in the visual design relying upon pictographs that are somewhat universal in their meaning, for example, adding a sequence uses an addition sign, looping a sequence uses a circular, looping arrow and deleting all sequences uses a trash-can pictograph. The two exceptions to this are the waveform selection buttons, as they are visual representations of the literal waveforms, and the effect selection buttons, as there is no standardized pictograph for audio effect types. In these cases, the third design concept is utilized.

Stylization is intended to aid users by making connections between concepts through visual aids, as is the case with the audio effect pictographs. Stylization is also present in the subtle use of animations and transitions between interface screens to aid user understanding of the application mechanics and give overall polish to the application. Together, these three core design principles create a cohesive user experience, where interaction is fun, responsive and intuitive.

Pyxis Minor is an application that attempts to democratize electronic music processes. It does this by providing an opportunity for users of varying musical backgrounds to experience a fun and creative way of making music. Users can structure their own musical experience as they see fit, allowing for a solitary or collaborative experience.

The application is built around a belief in the importance of playfulness. This guides the design of the application from the bottom up, including the technologies used to create the experience as well as key details of the interaction. Structurally, Pyxis Minor includes a foundation built from a video game engine, yet, unlike most video games, does not provide a goal orientation to drive the user experience. While the lack of a clear purpose or goal can sometimes hinder this mode of interaction, it substantially furthers the other key principle by distributing and democratizing control of the experience and the outcome. There are no features for saving sequences or preset sound design, rather, the user is encouraged to explore with the application and avoid permanence by continually changing and manipulating the resulting music and sound design.

The application is based upon the idea that satisfaction of electronic music can be found in the processes, as opposed to only the products. Pyxis Minor can be thought of as a toy, rather than a tool and as such, the resulting social music performance experience of the user(s) can be as important as the sound and music that Pyxis Minor helps them create.

Future Work

Although publicly available for free on the Apple App Store, there is still future work to be done on Pyxis Minor. An implementation of a step sequencer like interface would allow users to modify the temporal aspect of sequences.

An additional layer of user controllable audio effects to allow further musical expressivity. This audio effect layer will go in place of the reverberation effect. By sharing the effect parameters over the network connection another element of co-operative and collaborative play can be introduced.

Early experiments in using accelerometer data to manipulate effect parameters is promising for providing additional ways of controlling the resulting audio. By using conformal mapping techniques applied to accelerometer data input, we can provide new expressive element that makes use of iOS devices specific capabilities. By applying these techniques to sound manipulation and effect parameters Pyxis Minor will add another dimension of expressivity to further user's enjoyment and creativity.

The main architecture of the application can be repurposed in order to create a suite of applications that are all able to be used wirelessly together. This would allow users further freedom by selecting their own preferred method of interaction.

This could be accomplished by rewriting the logic of the system and changing the audio presets, whilst leaving the game engine, audio engine and syncing technology intact.

Additionally, further research into the appropriation of game engines to create playful musical experiences could be pursued by investigating other popular game engines and their integrated audio engines.

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Ajay Kapur is currently the director of Music Technology at California Institute of the Arts. He received an interdisciplinary Ph.D. in 2007 from University of Victoria with a focus on intelligent music systems and media technology. Kapur graduated with a BS in Engineering and Computer Science from Princeton University in 2002. A musician at heart, trained on drumset, tabla, sitar and other percussion instruments from around the world, Ajay strives to push the technological barrier in order to explore new sounds, rhythms and melodies.

[Session 24]

Virtual Reality

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Hearts and Minds: The Residue of War

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Abstract

Hearts and Minds: The Interrogations Project is an interactive installation made for the CAVE2™ [1] large-scale 320-degree panoramic virtual reality environment that visualizes stories of violence and the post-traumatic stress experienced by ordinary American soldiers who became torturers in the course of serving their country. During the American-led counterinsurgency and counterterrorism campaigns in Iraq in the years after September 11, 2001, the torture and abuse of detainees was a commonplace tactic. The project is based on interviews of American soldiers and attempts to extend and make accessible difficult narratives based on the actual testimonies involved. By bridging together different stories and environments, the project uses visualization to provide conditions for stories to unfold—stories that connect the homes that soldiers come from and return to, with distant experiences of war. The immersion of the CAVE2™ virtual reality theater allows for a different type of affective experience of the narrative, activated through the visceral immersion in the visual and auditory environment. The project represents a complex contemporary issue and provides a platform for discussion of military interrogation methods and their effects on detainees, soldiers, and society. The project was developed through a unique international collaboration between artists, scientists, and researchers from five different universities.

Keywords

Virtual reality, interactive installation, performance, immersive environments, visualization, art, storytelling, torture, digital humanities

Introduction

This interdisciplinary work interweaves the *New Text* ISEA 2015 theme as it addresses language in an immersive environment. It directly answers the ISEA question ”How can text, code, and practices in electronic literature be explored in the frame of disruptive change?” The project attempts to extend and make accessible difficult narratives of war and abusive violence based on actual accounts from soldiers involved. The work offers models for engaging with testimony and oral history. It uses visualization to build new discourse around challenging topics and to bridge concepts that enable storytelling. While many uses of visualization technologies are focused on providing accessible representation of “big data,” in this case, the technologies are being used to represent a complex contemporary issue and to provide a platform for discussion and debate of military interrogation methods and their effects on detainees, soldiers, and society.

Hearts and Minds makes use of the CAVE2™ environment for a multisensory artwork addressing a complex contemporary problem: as American soldiers are returning from the wars in Iraq and Afghanistan, it is becoming increasingly apparent that some of them participated in interrogation practices and acts of abusive violence with detainees for which they were not properly trained or psychologically prepared. This has in turn left many soldiers affected with Post-Traumatic Stress Disorder after their return home. More than 1.8 million US troops have served in Iraq and Afghanistan, with 37% having been deployed at least twice [2]. The mental health impact of these wars is still being researched, as many veterans are at risk for developing chronic PTSD. At this point, American soldiers and citizens are left with many unresolved questions about the moral calculus of using torture as an interrogation strategy in American military operations.

Development and Technology

Hearts and Minds bridges art, computer science, and social science research. Artist Roderick Coover and writer Scott Rettberg worked with the research scholars John Tsukayama and Jeffrey Stevenson Murer to distill central themes and stories from the significant and extensive scholarly research project—based on hundreds of hours of original interviews with veterans—carried out by Tsukayama [3]. These interviews include revelations of a highly sensitive nature, including narratives of participation in acts of abusive violence that entailed violations of human rights. The interviewees granted Tsukayama the right to use their stories in his dissertation and in subsequent research outcomes derived from it, provided that their identities remained anonymous. The tapes of recorded interviews were destroyed after transcription, except for short samples to prove their authenticity, and Tsukayama did not retain any personal contact information for the soldiers he interviewed. The text was condensed into an accessible and coherent set of stories that would preserve the accuracy of the testimonies while voice actors would perform the roles of veterans, further assuring their anonymity.

Coover and Rettberg worked with artist Daria Tsoupikova and scientist Arthur Nishimoto at the Electronic Visualization Lab at the University of Illinois at Chicago to transform this controversial and challenging research into an accessible form through visualization and dramatization. The team developed an interactive virtual environment with imagery, 3D models, and panoramic photographic backgrounds to bring story elements together. Working across these environments allowed new kinds of connections to be made between home spaces and battlefields, and between domestic objects and the memories they become attached to. The voice recordings performed by Philadelphia-based actors were integrated with interactive media elements into an interactive 3D environment.

Models, 3D environments, textures, and some animations were developed in Maya (Autodesk Inc., CA). Maya speeds up the production process through its rich selection of tools supporting all stages of modeling, including surface creation and manipulation, texturing, lighting, rigging, and animation. The visual, auditory and narrative elements were brought together in the Unity platform (Unity Technologies Inc., CA), software that is typically used by computer game developers. The getReal3D plugin for Unity developed by Mechdyne Corporation was used to run Unity across the CAVE2™ cluster [4]. User interaction was scripted using the Omicron [5] input abstraction library developed by EVL. Because the project was developed in Unity, however, it is portable to other interactive environments.

Figure 1. *Hearts and Minds* performance in the CAVE2™ panoramic virtual theater.

The CAVE2™ is powered by a computer cluster connected to high-speed networks to enable users to better cope with information-intensive tasks. It is approximately 24 feet in diameter and 8 feet tall and consists of 72 near-seamless passive stereo off-axis-optimized 3D LCD panels, a 36-node high-performance computer cluster, a 20-speaker surround audio system, a 14-camera optical tracking system, and a 100-Gigabit/second connection to the outside world [1].

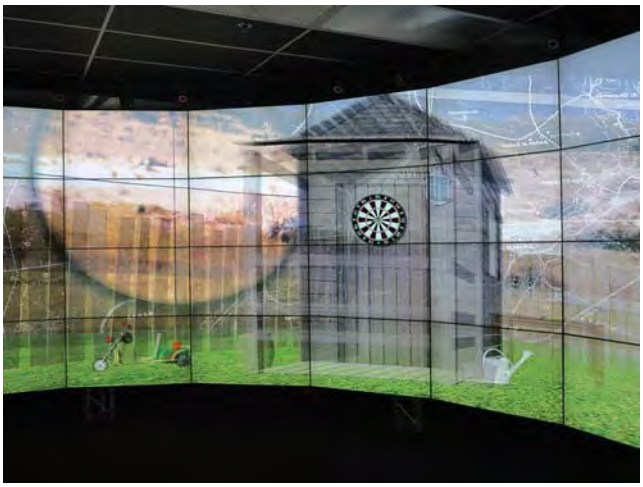

Figure 2. Shed scene from *Hearts and Minds*. Performance in the CAVE2™ panoramic virtual theater. When each trigger object is selected within the 3D visual space, the domestic space falls away and a surreal desert landscape is revealed.

Performance

In its first iteration, *Hearts and Minds* was presented as public performances at the University of Illinois Chicago Electronic Visualization Lab in June and July 2014. Chicago-based performance artist Mark Jeffrey led a performance of the interactive work. As the audience entered the space, they found themselves in a temple environment listening to each of the four soldier character's stories of enlistment—why they originally chose to become soldiers and what motivated their perspectives on the purpose for military service (Figures 1, 2, 3).

Jeffery then led the audience to the boy's room, where activating four individual objects launches stories of first encounters with abusive violence in military experience, such as in hazing rituals during basic training, or after first arriving in Iraq. When each trigger object is selected within the 3D visual space, the domestic space falls away and a surreal desert landscape is revealed. This transition serves as a metaphor for the interior state of the individual solider, as it is coherent with accounts of soldiers experiencing Post-Traumatic Stress. It is also intended to bring audience members into a "listening state" where they can focus on the individual voices and the issues they raise. Objects in a living room space and a suburban backyard move us further into the field of battle, and there we encounter harrowing stories of interrogation, torture, and moral conflicts confronted differently by each of the characters.

As the actor moves through the rooms, he carries a steel chair—an object that also plays a role in many of the interrogation stories. As he resituates the chair in the space of the CAVE2™, he and the audience are transported from one space to another. The fourth room, the kitchen space, features stories told by soldiers of their return home, and how each of them has dealt with the things they did and saw, and how the choices they made have defined and

haunted them. Each of five rooms represents a difference aspect or stage of the complex narratives of torture and its aftermath that solders revealed. As the performance closes, the actor stands in the center of the temple space. The sound of an individual human heartbeat is heard as the lighting in the room reddens to a hue the color of blood, and then to darkness. The audience is left alone with the stories and issues confronted in the piece. The performance is followed by a discussion session [6].

Figure 3. War scene from *Hearts and Minds*. Performance in the CAVE2™ panoramic virtual theater. During these battlefield scenes the audience listens to stories of interrogation, torture, and moral conflicts confronted differently by each of the characters.

An important component of the performances of *Hearts and Minds* is that the experience of the artwork is followed by an audience discussion. The ultimate purpose of this work is to promote dialogue and debate about the contexts and circumstances of the use of torture in battlefield torture in recent history. In this sense the project shares an aim with Augosto Boal's Theatre of the Oppressed, in that attempts to offer audiences "the aesthetic means to analyze their past, in the context of their present, and subsequently to invent their future, without waiting for it." [7] During the first iteration of performances, these discussions were intense and reflective for everyone concerned. Audience participants expressing views ranging from shock and disgust at the acts conveyed, to conservative defense of post-9/11 policies, to veterans' expression of gratitude that these types of stories, known from their own experience, could be shared to promote greater understanding of the impact that war has on those who fight it. During a 2015 presentation of the project at the Oslo Human Rights Film Festival [8], discussion participants included both a veteran police interrogator, who shared his experience that more humane methods of interrogation than torture were universally more effective, and a number of prisoners of conscience who had themselves been subject to abusive violence and felt provoked by the work to share their own experiences as victims of torture. It is hoped that in the future the project will be presented to different groups ranging from high school students to veterans' groups. The project might be used to help in the processes involved both in changing military interrogation policy and in addressing the true costs of institutionalized torture both on American policy and on individual soldiers left with deep psychological scars.

Accessible Versions and Alternative Platforms

One of the challenges for makers of immersive virtual reality artworks, particularly those developed in CAVEs and other custom-built VR environments is that these artworks tend to be more often read about in the literature of the field than experienced first-hand. The CAVE2™ at the EVL for example is a graduate research lab facility with keycard access at the center of a large brick engineering building on the UIC campus. *Hearts and Minds* has been shown there at several special events and on specially arranged tours, but it is not the ideal situation for an artwork intended to reach a broad audience. While it is not possible to transport the large-scale CAVE2™ environment, because *Hearts and Minds* was developed in Unity, it is possible to port the application to other environments. In order to make the work more accessible for veterans' groups and others particularly concerned with the issues highlighted by the work, the *Hearts and Minds* team is developing three other versions of the project: a Mac OS standalone application suitable for demonstration and performance, a Unity web-player version which will be published on the World Wide Web and will be accessible freely to the public, and a version suitable for iPad and other mobile devices. The computer installation of the project was first exhibited at Art gallery during the VISAP'14 Conference in Paris, in 2014. [9] Application users are able to move through the environments and narratives using Xbox controller. This version has been used for performances in cinema environments in Paris, Bergen, and Oslo. The web-player version was first demonstrated at the HASTAC 2015 conference at Michigan State University. Both the web player version and the iPad version will be made publically available at the ISEA 2015 conference in Vancouver.

Future Research

The *Hearts and Minds* team is interested in investigating further the potential uses of this artwork in other contexts. We are seeking social science collaborators who are working with veterans for example to explore whether the project might be of use as part of PTSD therapy programs. More fundamentally, the artists plan to make the project, along with supporting materials including the *Hearts and Minds* applications, the original text of Tsukayama's dissertation, documentation materials, and interviews with project collaborators available for classroom use in a variety of educational environments to raise social consciousness of the effects and toll of battlefield torture. Most importantly for future work, the artists are excited by the interdisciplinary collaborative model realized by the project and hope to develop further projects that wrestle with and

communicate the intricacies of other complex societal challenges through immersive interactive artworks accessible both in the CAVE2™ and in other platforms.

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Author Biographies

Daria Tsoupikova is an Associate Professor in the School of Design and the Electronic Visualization Laboratory (EVL) at the University of Illinois at Chicago. Her research and artwork include development of virtual reality (VR) art projects and networked multi-user exhibitions for VR projection systems, such as the Cave Automatic Virtual Environment theatre (CAVE2™), as well as the design of interactive educational multimedia for children. Her VR research, publications and artwork explore the relationship between the aesthetics of virtual environments, traditional arts, and the effect of VR aesthetics on the user's perceptions and emotions. Her work lies at the crossroads of artistic and technological innovation, and explores the potential of new media and interactivity in relation to traditional arts. Her current works are applications of computer graphics art to various research domains such as educational multimedia, cultural heritage and virtual rehabilitation for stroke survivors. Her work was exhibited and published at ACM SIGGRAPH, IEEE VR, ISEA and many other venues.

Scott Rettberg is Professor of Digital Culture in the Department of Linguistic, Literary, and Aesthetic studies at the University of Bergen, Norway. Rettberg was the project leader of ELMCIP (Electronic Literature as a Model of Creativity and Innovation in Practice), an EU- and HERA-funded collaborative research project, and a founder of the Electronic Literature Organization. Rettberg is the author or coauthor of novel-length works of electronic literature, combinatory poetry, and films including *The Unknown*, *Kind of Blue*, *Implementation*, *Frequency*, *Three Rails Live*, *Toxi•City* and others. His creative work has been exhibited online and at art venues including the Chemical Heritage Foundation Museum, Palazzo delle Arti Napoli, Beall Center, the Slought Foundation, The Krannert Art Museum, and elsewhere. Rettberg is a native of the Chicago area and was a visiting researcher at UIC while on sabbatical during Spring 2014.

Roderick Coover is Director of the Graduate Program in Film and Media Arts at Temple University (Philadelphia) and Founding Director of the Documentary Arts and Ethnographic Practice Program. He makes films, interactive cinema, installations and webworks. Some of his latest projects include the interactive series Unknown Territories (unknownterritories.org) about exploration in the American West and the edited book, *Switching Codes: Thinking Through Digital Technology In The Humanities And Arts* (Chicago 2011). A pioneer in interactive documentary arts and poetics, his works are distributed through Video Data Bank, DER, Eastgate Systems and elsewhere. His creative work has been exhibited online and at art venues including SIGGRAPH, Documenta Madrid, The American Philosophical Society Museum, Chemical Heritage Foundation Museum among others.

Arthur Nishimoto is a doctoral student in the Department of Computer Science and Research Assistant at the Electronic Visualization Laboratory (EVL) at the University of Illinois at Chicago. His research interests include user interaction on large scalable resolution display environments, virtual reality, and video game design. He has previously developed interactive applications on the EVL CyberCommons multi-touch wall including the 20-foot Virtual Canvas and Fleet Commander which has been exhibited at SIGGRAPH and Supercomputing. He is currently working on user interface design for large multi-touch walls as well as designing immersive interactive applications for the CAVE2™ Hybrid-Reality Environment.

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Senseparation

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Abstract

This paper describes an interdisciplinary joint project that focuses on the cross-border networking of people between virtual and real space. We set up an encounter between two persons located at different places to experience the proximity between two people without any textual or verbal communication. In our experiment, one person in a virtual reality (VR) installation (CAVE) or wearing Oculus Rift glasses is able to interact with another person located in a dark room wearing a vest with vibration motors, compass and controller. The person in real space is represented as an avatar in the VR environment. The one in the real space is able to perceive the person in the virtual world with tactile and auditory senses. Spatial audio in the dark room supports the representation of the proximity of the two people and gives an intense spatial experience. The person connected to the VR environment can interact with the avatar and touch it by means of a 6 degree of freedom input device. Touching the avatar gives also visual feedback on the avatar. We separated tactile, visual and auditory feedback for this encounter in order to increase the intensity of the distant meeting.

Keywords

Telehaptic, Wearables, VR Environment, Performativity, Tactile Feedback, Interaction, Virtual Reality, Spatial Sound

Introduction

Research in the field of Human Computer Interaction (HCI) aims to make the communication with the digital data more human and intuitive. Encounters in the virtual world and over distances are quite common today.

Ways of getting in touch with people have changed completely since the Internet has become part of daily life. For hundreds of years people usually met personally in real life and then perhaps became friends. Nowadays it is often the reverse. People often meet first on the Internet before meeting in real life. One real world impact of digital communication is that we dispense with the bodily nearness to our communication partners.

Despite all the advantages of digital communication this means a disruption in our habits. In digital communication we are limited to reading, listening, seeing and interacting verbally and visually. What about the body language, the body expressions and gestures, the expression of emotions, the warmth, the breath, the personal charisma and the smell of a person? Based on these thoughts, we have developed a concept of a telehaptic encounter between two people in distant places.

Related Work

Solve et Coagula (SeC)–mating man and machine by Stahl Stenslie combines interaction between a person, equipped with a bodysuit with built-in pressure sensors and vibrators, and a virtual cyberorganism. The artificially intelligent virtual creature speaks to the user through spatial sound and is able to touch him or her. SeC 'attempts to sensorially pair man and computer together'. While the user experiences SeC in an immersive VR world with visual, tactile and auditory stimuli, these are separated in our project: the VR user has a visual experience while the other user perceives auditory and tactile feedback. [1]

Can you see me now? by Blast Theory in collaboration with the Mixed Reality Lab is a chasing game which overlaps a part of a physical with a virtual city by the use of handheld computers connected over the internet. This game is closely related to our project in terms of interest about proximity between participants in the real and virtual world superimposed. [2]

Sommerer and Mignonneau communicate body sensations and smell with touch-devices shaped as gourds. They share private body sensations like heart beat, blood volume pressure, pulse, skin conductivity, sweat and smell, with strangers over the mobile phone network. These sensations are perceived via vibrator motors, ventilators, micro-electro-mechanical and micro-bio-electrochemical actuators. They investigate how technology has changed our lives by exchanging privacy for mobility and connectivity. [3]

Concept

The goal was to stage a telehaptic performance with tactile, auditory and visual feedback and to get information on triggered emotions. The sensory experience takes place in two different locations. By means of an avatar, the user in the virtual reality is able to interact using an input device with the person in the real space, in a dark room wearing a vibro-tactile vest. The position and orientation of the avatar corresponds to the position of the person in the dark room. Each contact between the user in the VR environment and the avatar gives an additional visual feedback on the avatar in the VR environment. In return, the person in the real space is able to perceive the other person with tactile and auditory senses. Vibration motors in the vest give tactile feedback at the contact points. We selected three different touch patterns for the interaction with the avatar: hit, touch and bump.

We opted for the CAVE as the interface of the encounter to achieve a higher degree of immersion and presence and thus achieve an intensification of the encounter. Sound in the dark Room supports the representation of the proximity of the two persons.

Figure 1 Vibro-tactile vest

Design

We designed the vest, the avatar and the virtual world environment in which the avatar is presented and the sound.

Garment Design

Wearables show [4] or hide [5] the integrated technology. We have combined both options.

In our weareable design we played with the exciting contrast of cool technology and warm materials like fabric and felt. This idea represents our basic concept, where we combine human encounters, human proximity and thus warmness with functionality and the coolness of technology. Felt as a material on the one hand symbolizes warmth, on the other hand felt provides isolation - both aspects that may play a role in a virtual encounter of people in the virtual world. We applied wires clearly visible on the vest, similar to a "network" pattern, alluding to the type of encounter [Fig. 1]. For tactile feedback we integrated 16 vibration motors. We added a belt made of elastic band to ensure that the vest is tight enough so that everybody can feel the vibration feedback on the skin and gets the impression of wearing a second skin.

We decided for a futuristic design, since the project is about a visionary form of communication.

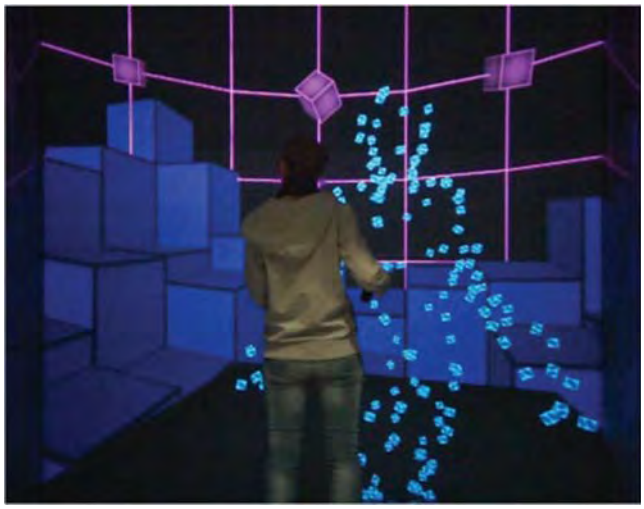

Figure 2 VR environment

Avatar Design

The degree of abstraction was a key element in the design of the avatar. First, the avatar provides enough mental room to imagine a real person behind it and is gender non-specific. Second, it is a pleasant and non scary counterpart. Based on the research on the Uncanny Valley effects [6], we decided against a photo-realistic rendering of the avatar.

Inspired by existing projects [7, 8] we have chosen a visualization in the form of a cube cloud. These cubes convert into a human silhouette when the two people come closer to each other as shown in Figure 2. The colors of the cubes are neutral in light blue hues combined with a blue-white gradient.

VR Environment Design

The VR environment where the avatar and the real person meet consists of a floor plate which is the same size as the dark room. It is surrounded by a larger virtual globe that is open at the top and is only restricted by a wire frame combined with blocks [Fig. 2]. This design element reflects the networked encounter. The lower part of the globe consists of a geometric architecture with blocks. This part of the virtual environment acts as a form basis, balancing the weightlessness of the virtual world.

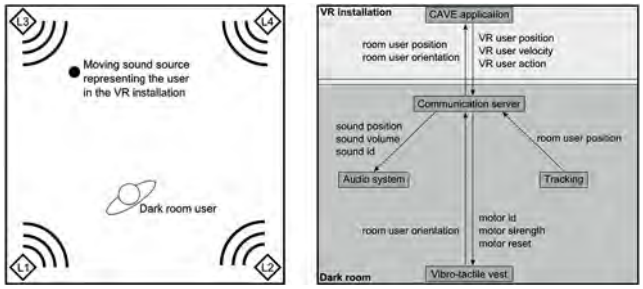

Figure 3 Spatial audio system, VR installation

Sound Design

We use five separate sounds for the sonification of the VR user in the dark room: position and velocity, as well as the three touch patterns hit, touch, and bump. Position (harmonic, calm sound) and velocity sounds are constantly played back as spatial sound in order to experience the exact location of the person in the VR installation and therefore the proximity of both participants. The velocity is experienced by a heartbeat sample, repeated in the corresponding frequency, ranging from relaxed to nervous. The main concern of the sound design consists of not losing these semiotic links between action and sound. [Fig. 3].

Technical Description

Following the concept with its design the Senseparation project was implemented using a variety of technologies. As described two locations interconnected by a network are required to experience the Senseparation installation, a dark room and a VR installation [Fig. 3].

Dark Room

The dark room is equipped with position and orientation tracking for a single user and a spatial audio system. Additionally a vibro-tactile vest is used for the haptic experience. A communication server connects these components for exchanging data among them and the VR installation.

Dark Room Server The communication server exchanges data between all components involved: VR installation, audio system, tracking, and vest. The VR installation's user position, velocity and action data is received, transformed and forwarded to the spatial audio system to move and play back the sound sources accordingly. Additionally all action events are sent to the vest to trigger tactile output. The vest requires the id of the motor to activate, the strength of the motor vibration and a reset after the action is finished. In return, the dark room user position data, received from the tracking system, and the orientation data, received from the vest, are forwarded to the VR installation for placing the avatar visualization.

Audio System The spatial audio system is realized in Pure Data, using the Ambisonics technique. [9] In our setup, the audio signal is sent to four individual speakers [Fig. 3] located in the corners of the room. If the VR installation's user is located in the upper right corner, the corresponding speaker will produce a continuous sound with a high intensity, the two adjacent speakers use less intensity and the opposite speaker is (almost) silent. If the user moves to another position, the intensity of the speaker will move consecutively. The VR installation's user position is constantly played back as continuously moving sound in the spatial audio system, while the velocity of the user's movement re-triggers a heartbeat sound in corresponding beats per minute. The VR installation's user actions hit, bump and touch trigger separate sounds only during their occurrence.

Tracking The tracking system consists of a single Kinect camera, used in depth mode, to capture the dark room user's position.

Vibro-Tactile Vest The garment consists of a vest, elbow cuffs and a belt, which are equipped with a total of 16 small vibration motors: 4 along the spine, 4 on each shoulder, as well as one on each elbow and hip. The motors are encased in 3D printed mounting plates and sewn onto the inside of the garment. An embedded micro controller (Arduino Pro Mini 3.3v) receives commands from the dark room computer via Bluetooth (HC05 Bluetooth module) and drives the motors accordingly. To allow a finer grain of detail, each motor can be driven using 64 steps of intensity using pulse width modulation. Due to the low frequency of the pulses, the motors can not only be actuated at different speeds, but can also generate a tingling sensation when using very short pulses that merely make the motors jitter rather than rotate. To allow for a more accurate orientation sensing than using only the Kinect, a compass module (Honeywell HMC6352) is connected to the Arduino's I2C bus and continuously sends its orientation to the dark room computer system at a resolution of 0.1 degrees. A lithium polymer battery provides the necessary power to drive the micro controller, Bluetooth module, compass and motors.

Virtual World

The virtual world of Senseparation is the counterpart to the dark room. It is run on a VR installation and communicates via network with the remote communication server.

Hardware Components The virtual world can be displayed with an arbitrary VR installation. The tested set-up makes use of a 5-sided CAVE installation incorporating a six degree of freedom (6DOF) optical tracking system. [10] Multi-display installations are typically driven by a cluster, which has significantly affected the application design from the software development point of view. This setup is hard to reproduce, since CAVEs are typically static installations at few locations. An alternative, easily reproducible setup consists of an Oculus Rift as an immersive display as well as a Razor Hydra as a low cost 6DOF input device. Interaction space is limited with this setup and the visual quality is slightly degraded compared to the CAVE setup, but the system is highly portable and can be setup nearly anywhere.

Software Components The virtual world client of the Senseparation installation is a C++ application which uses OpenSG as scene graph in order to support cluster as well as server systems. [11] The VRPN is used for tracking purposes. [12] The virtual environment is loaded in form of a textured VRML model. [13] Lighting situations are static and are stored in a texture. The avatar representation as well as the dynamics of the scene are implemented fully inside the application. Simple transformations like rotations inside a transformation stack are used to create a whirlwind like appearance. In case the avatar is touched with the input device, the cubes pulsate based on a sinusoid scaling pattern. The navigation in the virtual world is limited to navigation inside a plane, in order to reduce complexity and focus on the actual interaction. The user determines the direction by pointing with the input device and moves using a button from the input device.

Conclusion

Senseparation establishes a critical reflection about distant encounters between and real space. With Senseparation as an ongoing research project, we continue our investigation in opening the limits of digital communication: as a first step, we implemented the characteristics of someone getting close as tactile and auditory feedback on the one side and abstract visual output on the other side. Additionally different physical contacts are perceptible. Participants can compare the experience with isolated visual versus tactile and auditory senses.

Initial observations showed, that the users' reactions are ambivalent in terms of the triggered emotions. Most users felt comfortable about the VR environment. Also, the appearance of the avatar was evaluated in a positive way. The avatar was described as non scary and gender unspecific. It gives enough space to imagine another person. The situation in the dark room was described as ambivalent. It was confirmed that the sound reflects the proximity of the other person very well. The vibration feedback however needs to be optimized. Body contacts could be felt, but they are not detailed enough to reflect real touches. However, the positions of the vibrations motors were described as well located.

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Unified Physical and Digital Experiences:

Exploring Art and Digital Media via Augmented Reality Interface

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Abstract

Advancement in human computer interaction technology has transformed our world to become increasingly connected and interspersed with digital media and information. This has given rise to a new form of environment called 'mixed reality' that opens a hybrid landscape for artists, designers and researchers to explore in creative and innovative ways. This paper presents the development of a framework for creating immersive augmented environments and showcases two of my Augmented Reality (AR) projects, exURBAN Screens and MADA AR Posters. Both projects explore augmented interactions with smart devices, focused on human-computer interactions and human-real world interactions. The projects utilize contextually and geographically aware artistic AR contents and code design. These projects demonstrate the successful use of a Mixed Reality framework for employing augmented interaction methods with smart devices in exhibitions and public environments. Developing video see-through display technologies such as AR glasses and other wearable smart devices are expected to take this experience to new heights. I can envision future environments becoming increasingly hybridized and fused, employing augmented interactions to enhance our sensory perception of the environment through computer mediated reality. This will create new pathways for sharing information and promote new forms of digital media and art. The paper concludes with my project findings and a vision for future development.

Keywords

Augmented Reality, augmented interaction, Mixed Reality, hybrid environment, digital media, art, smart device, computer-mediated reality

Introduction

Human beings rely on their senses to perceive the world around them. Our everyday experiences rely on our cognition and perception of reality. Jaron Lanier, CEO of VPL, coined the term 'virtual reality' (VR) [1] which was popularized by others [2, 3] and is now widely used. Descriptions of VR include the notion of both electronically simulated environments and of 'goggles 'n' gloves' systems that act as a personal interface for exploring virtual environments [4]. VR is used to enhance human-computer experiences and facility expanded perceptions of reality. In contemporary life, advanced smart devices such as iPhones, Android phones and tablets enable us to interact with computer-mediated environments in more creative and innovative ways than those envisioned in the early days of 'virtual reality'. Furthermore, our view of real and virtual worlds have started to blur with the advent of computers and the internet. We now associate virtuality with everything that is computer-generated or that exists in cyberspace. This is a simplistic view of virtuality, which can be considered more deeply as images that form part of the imagination, rather than the objects from which images are derived. In recent years, the separation of real and digitally derived images has started to disappear, with the emergence of hybrid environments. My primary research interest is in exploring the relationship between humans and smart devices such as video see-through displays, and focusing on not only human-computer but also human-real world interactions within the domain of mixed reality environments.

Creative Inspiration

I have been greatly influenced by works in different fields of the humanities, particularly philosophy, aesthetics, linguistics and anthropology. These areas of research explore humans and their relationship with physical and conceptual realities. I feel it is necessary to understand human cognitive abilities and their perception and representation of the real world in order to design a mixed reality environment that is immersive and aesthetically appealing.

Mixed Reality (MR) provides creative ways to add together real and virtual worlds [5]. It can be observed in many spaces such as digital billboards and movies. MR is often discussed in view of the technological and visual display aspects, however, it is more than just a display technology. In my design approach, I refer to MR as a transformative tool and propose MR as an aesthetic metaphor for both human-computer interactions and human-real world interactions. MR can support interactive and responsive environments and has the potential to enrich human experiences through interactive computer-generated contents. It utilizes virtual information to aid

multisensory perceptions of human environments.

To address this concept, I refer to the definition from Migram's 1994 classification of real and virtual environments [5]. Figure 1 expresses the levels of reality-virtuality overlap.

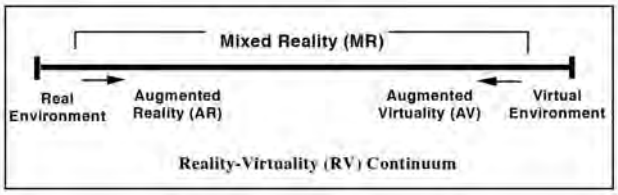

Figure 1. Simplified representation of a RV Continuum

Reality is at one end of this continuum virtuality is at the other. In between the two are AR and Augmented Virtuality (AV). Many key developments are taking place in two domains: AR and Virtual Environment (VE). AR has been used to supplement real world objects with information, through techniques such as QR, AR codes and products like Google Glass. By contrast, AV consists of virtual worlds like Second Life, or other game environments that employ some representation of real world objects [6, 7] such as a live video stream projected onto the surface of a virtual object.

This classification is useful for categorizing implementations of digital technology but the concepts of reality and virtuality can also be considered as images inside the human imagination. The human imagination represents real world objects as images, and their construction can come from transformations of existing images. Following the conceptual model developed by Brian Massumi [8], the virtual is also a product of 'topological transformations' of images in the imagination. This view of the real and virtual shows them as being conceptually tied and not opposing ends of a continuum, however this paper is concerned with the mixture of digital content and the physical environment so the term 'virtual' is used in the context of digitally constructed content.

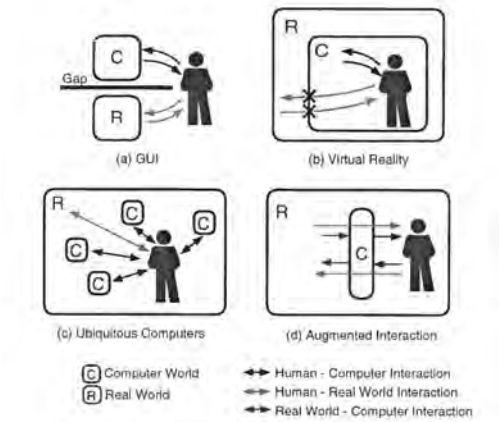

Figure 2. A comparison of HCI styles

The difference between AR and AV can be understood by how the world is represented through computer-generated images using AR and AV. AR and AV aim to create different forms of environment using computer generated imagery. The interaction between human, computer, and environment can be seen more clearly through the perspective of Jun Rekimoto's diagram [9] in Figure 2. This model allows for dynamic forms of interaction between people and real world environments. At the same time it allows for human-computer and computer-real world interactions as seed in the Augmented Interaction diagram. It is an open model that that shows potential effects over a range of experiences, resulting from the combination and manifestation of human, computer and real world interactivity.

Paul Milgrim and Fumio Kishino have defined three key factors for the level of immersion in AR [5, 6]:
- Extent of Presence Metaphor (EPM): The extent to which a person feels immersed in a virtual or augmented environment.
- Extent of World Knowledge (EWK): A measure of the level of information that the simulation or AR environment possesses regarding the real world objects so that it can blend into the real environment.
- Reproduction Fidelity (RF): The accuracy with which physical world objects are represented in Augmented reality. The higher the fidelity, the better the representation of physical objects.

Synopsis

This section describes part of my ongoing PhD practice-based research. Specifically it outlines two projects that utilized practical applications of AR that I undertook in the last three years.

My first AR project, *exURBAN Screens*, undertaken in 2012 in partnership with the City of Frankston, the Frankston Arts Centre and Monash University in Australia. My role as an interaction designer and researcher in this collaboration was as follows:

- To investigate the usage of smart devices based on consumer AR tools such as Layar, Junaio, Google Goggles, and Wikitude
- Development and design of an AR mobile application to support the festival program
- Design a special edition AR exhibition of artworks by Brian Alfred
- To enhance the visitor's experience using the AR application by providing a digital tour guide

My second AR project, *MADA AR Posters*, was undertaken at the Monash University Caulfield campus in Australia for their 2012 open day. The project comprised of AR posters designed by John Warwicker that displayed artwork from different students and faculty members. The art was separated into two categories. Physical and digital works. The physical works consisted of 12 posters, displayed on a glass wall. The augmented version of each poster was viewable on user's display by using a custom made AR application for smart devices. The major goals of this exhibition were:

- Redesign and revamping of the faculty (MADA) / department site-specificity and identity
- Exploration of art in an AR environment [10]
- Promotion of the department's vision and academic endeavors

Framework of Mixed reality in Exhibition and Public Environment

My approach to augmented reality design is two pronged. It suggests a design perspective and information-centric view. The information-centric view involves GPS data, image processing and dynamic content while the design view focuses on the combination of digital media content with artistic expression. This systematic approach supports the creation of a new form of AR mobile application by considering how to communicate effectively with state-of-the-art techniques and how to design interactive digital contents.

Design Model

When designing two AR projects I adopted two slightly different model approaches based on the development of the framework.

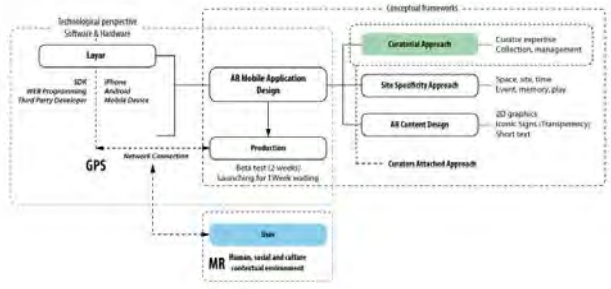

Figure 3. The design model for exURBAN Screens project

exURBAN Screens focused on AR design in the context of site-specificity such as outlined by Miwon Kwon [11]. Kwon defines site-specificity as a tactic or critique of the institution: of the museum/ gallery space. She further describes it as a phenomenological model of "lived bodily experience" as a cultural framework [11]. To explore these concepts in interaction design, I integrated reinterpretation of AR as a process of hybridized images from the real and the virtual defined by Massumi [8] into a form of smart device application design. The application displays not only an artistic expression of their artwork but also disseminates detailed information about the artist and interpretations of the artwork. This site-specific content is triggered by users actions such as finding a new relevant site. The design utilized PGS data and real-time event information for the creation of the AR environment.

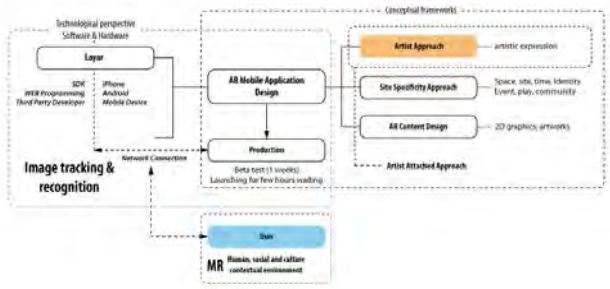

Figure 4. The design model for MADA Posters project

MADA AR Posters: This project was planned for Monash University Open Day. It was a combination of a marketing approach and creative communication method to show the University's identity and campus space. The design focused on highlighting various events and displaying artistic works with image tracking and recognition. My goal was to unify a collection of diverse designs and artworks from staff members and students to reveal a more consistent identity of the University. It was also important to carefully consider the space, through which many visitors would pass. To develop the design concept I referred to Jeff Kelly's concept of 'place' and 'space'.

According to Kelly, site (or space) represents the physical characteristics of an area, like its location, mass, light and material processes, whereas place represents the practical, social, cultural, psychological and historical dimensions [12]. I hold a similar view of the distinction between space and place. 'Space' refers to a physical location, that is, a visible, measurable and quantifiable area, whereas 'Place' refers to the symbolic, historical or social meaning associated with a particular location. Place is subjective to an individual or group of individuals, and therefore can be a crucial factor in the creation of an identity.

There are common themes underlying both of these projects:

- The integration of art and information expressed in a mixed reality environment
- The use of the latest readily available technologies to improve and enhance the viewers experience

- The concept of digital 'flâneur' [13] or Urban Explorer, where the viewer is both an observer and a participant in the event
- Geographically and contextually aware design, which blends the augmented information with the environment and the event

Design Outcomes from AR Mobile Projects

Figure 5. and Figure 6. show captured screens from two AR applications running on smart devices.

Figure 5. Images from exURBAN Screens application

Figure 6. Images from MADA AR Posters and screens from AR application

Conclusion and Further Research

Overall the AR projects were a success. Based on user feedback gathered on-site via face-to-face conversations, both of these projects provided valuable information by creating interactive experiences and providing an entertaining interface. In order to produce rich augmented interactions in mixed reality environments, the effective use of multimedia content and technical tools are required to be used in an appropriate way. Unique, creative AR contents and physical artistic code design is aesthetically appealing to the user's augmented interactions. However, the important foundation of AR interface construction is the creation of a hybrid physical-digital place. A place that includes audience, inter-audience communication, interaction with digital information and artistic expression. Thus, the objectives of AR is not just to replace the real world with digital content, however, it should consider creative, new means of communication and interaction to enhance the user experience in real-time.

In future works I am to further explore the outlined framework for producing augmented interactions in dynamic and increasingly connected environments. These explorations will come in the form of computer mediated exhibitions or/and public places that provide new interactive experiences with the aim of creating unprecedented opportunities for AR artists, designers and researchers.

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VR Panoramic Photography and Hypermedia: Drawing from the Panorama's Past

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Abstract

Since the 1787 patent of the immersive 360-degree painted panorama by Robert Barker, the panorama has been used as a narrative storytelling tool. With VR (virtual reality) panoramic photography in tandem with the notion of hypermedia, the VR panorama can further advance the idea of storytelling as both an object and an interface. Using the principles of Robert Barker's patent of the panorama as a point of departure to explore the conceptual relationship between painted and screen-based panoramas, this paper will explore: how the potential for a hypermedia system can be found in the painted panorama; the unique qualities of the computer-based panorama; and discuss related hardware advances for the digital panorama, which appear to bring us closer to Robert Barker's original intent as an immersive image space for the masses.

Keywords

VR Panoramic Photography, Hypermedia, Narrative, Painted Panorama, Immersive Image Spaces

Introduction

VR (virtual reality) panoramic photography is the science, art and practice of creating interactive and navigable immersive 360-degree screen-based images, which usually depict a place and/or event. While some may equate VR photography's beginnings to Apple Computer's Quicktime VR Authoring Tools Suite and QTVR (Quicktime Virtual Reality) software introduced in the early 1990s for creating and displaying screen-based digital panoramas, it can be argued that the development of VR panoramic photography has a much longer history that can be traced back to the introduction of immersive image spaces and the invention of perspective. Nevertheless, its closest relative is the painted panorama, which was patented in 1787 by Robert Barker. [1]

While the word "panorama" has become commonplace – evoking such ideas as sublime vistas – it should be noted that the term, which is referred to in this paper, had not been formulated until the late 18th century. Its usage was much more restricted than it is now. It was through the Irish painter Robert Barker's invention called *la nature a coup d'oeil* (known today as a panorama) as well as the "panopticon" – a unique round architectural prison design with a central observation platform – that is thought to have inspired the creation of the word "panorama." [2] In the Parisian *Dictionary of Building Terms, vol. III* published in 1881–82, "Panorama" is defined as "a building in which a painting referred to as a *panorama* is exhibited, that is to say painted on the inside wall of a rotunda, covered by a cupola or cone-shaped roof. These paintings attempt to be faithful reproductions of what a place looks like when viewed from all angles and from as far as that the eye can see." [3]

Since its 1787 patent, the panorama has been used as a narrative storytelling tool. One of the tenets of the "panorama" as described by Barker has remained the same in its development, whether analog or digital, which is to strive for creating a completely immersive environment that "feel[s] as if really on the very spot." [4]

With computer-based panoramas in tandem with the notion of hypermedia, the VR panorama can further advance the idea of storytelling, as both an object and an interface. Using the principles of Robert Barker's patent of the panorama as a point of departure to explore the conceptual relationship between painted and screen-based panoramas, this paper will explore: how the potential for a hypermedia system can be found in the painted panorama; the unique qualities of the computer-based panorama; and discuss related hardware advances for displaying the digital panorama, which appear to bring us closer to Robert Barker's original intent as an immersive image space for the masses.

The Tenets of the Painted Panorama

Created as a commercial endeavor to entertain the general public, the goal of the painted panorama was to create an immersive image space that reproduced the real world with such skill that viewers would have difficulty distinguishing between "reality" and the illusion that the panorama created. [5]

Robert Barker's *la nature a coup d'oeil* (a.k.a. panorama) invention did not just consist of an uninterrupted cylindrical painting, but also the unique structure that housed it. Barker's patent had certain requirements that needed to be met to make this immersive environment convincing. According to Barker's patent, not only did the painting need to be accurate and provide "an entire view of any

country or situation," but the architectural structure needed to meet certain criteria according to the patent's directive including the following:

- Upon entering the painting from below, a balustrade or circular structure must be in place, prohibiting the viewer from going too close to the painting in order to maintain the desired illusion.
- Not only should the observation platform be elevated to further establish the illusion of a scenic vista, but there should be some kind of barrier above like an umbrella shaped roof, as well as below to prohibit viewers from seeing the top and bottom of the painting.
- The painting needs to be lighted entirely from above so that light is reflected off the painting, providing a uniform level of light throughout the gallery. [6]

Many panoramic structures required viewers to pass through a long darkened corridor and up a staircase, entering the circular painting area from below in order to create a transition between the viewer's daily life and the illusion of the panorama. [7]

An example of a panorama that meets these requirements and which still survives today is the *Panorama Mesdag* located in The Hague, The Netherlands. The monumental painted panorama, which measures 14.2 meters high (46.5 feet high) and 115 meters (over 377 feet) in circumference, opened to the public on August 1, 1881. Much like the criteria listed above for Barker's panorama patent, the viewer goes through a long, darkened hallway and then up a staircase to enter a gazebo, which rests upon a dune that looks out upon the 360-degree curvilinear painting of Scheveningen and The Hague – transporting the viewer back to daily life in 1880. [8]

Providing a "false terrain," discarded baskets, nets, ropes and anchors nestled within the sand are thoughtfully placed between the gazebo (viewer's area) and the edge of the painting, creating a sense of seacoast life in the late 19th century for the viewer. With the natural light piercing through the skylights against the painting's subdued color palette, it appears to bring the panorama to life. The panorama is realistic yet painterly, creating a subtle illusion of movement.

As did many of the panorama painters, Hendrik Willem Mesdag strived to capture a realistic and accurate depiction of his subject matter. The panorama provides a snapshot of daily life in The Hague and Scheveningen, from the fishermen and sailors going about their work to a woman in the village putting out her clothes to dry. As the viewer scans the shore, one can see horses pulling a boat up to the shore, and from afar sailboats on the horizon. Looking into town, the viewer can see villagers fixing nets and going about their daily lives, providing a better understanding of the coastal community's living heritage.

Usually, the public sought panoramas that depicted the unusual and foreign. The themes for the panorama ranged from locations such as Pompeii or Cairo or Jerusalem to events such as the Battle of Gettysburg. [9] While some panoramas may have taken more artistic liberties than others, the painted panoramas attempted to be an accurate account of a place and/or event through rigorous research. This was not only a requirement of Barker's patent, but visitors would be quick to identify inaccuracies. As Stephen Oettermann points out, "It was not only concrete objects that needed to be represented accurately in a panorama, however. The precise date and time of the event also had to be taken into consideration. This entailed careful study of conditions of light and shade, the position of the sun and colors of the landscape at specific times of the day." [10]

Souvenir programs of the panorama were also part of the experience. Bought when visitors purchased their tickets to the panorama, the programs helped visitors orient themselves to the exhibition. These programs typically contained a drawing of the panorama, which was marked with numbers and descriptive text to identify the panorama's significant features. Guides ranged in size from single sheets to booklets ranging from sixty to eighty pages with accompanying commentaries. [11]

Narrative and the Panorama

The potential for hypermedia using the digital VR panorama can be found in the painted panorama. In the book *From Text to Hypertext*, Silvio Gaggi argues that a paradigm shift occurred from pre-modernism to modernism in that the subject becomes unstable, fragmented, and decentered, leading to the post-modern potential of hypertext or hypermedia using such examples as Pablo Picasso's *Demoiselles d'Avignon* (1907). Nevertheless, it is in this author's opinion that the painted panorama offers another node to Gaggi's "decentered subject," as it emphasizes the marginal micro-narratives as much as it does the thematic focal point using curvilinear perspective. An example of this "decentered subject" can be found in such works as *The Jerusalem Panorama of the Crucifixion of Christ* (1903) located in Altötting, Germany.

In order to support his theory, Gaggi uses Perugino's *Christ Giving the Keys to Saint Peter* to show how a premodernist artwork offers a unified ideology with multiple narratives using linear perspective. [12] The fresco *Christ Giving the Keys to Saint Peter* (1481), which was completed in 1481 and is located in the Sistine Chapel, offers the viewer a window seat into Christian thought. In the foreground, the focal point of the painting, Christ, is handing over the keys of heaven and earth to his disciple, Peter, who is kneeling, where he also announces his intention to build a church. Located in the mid-ground are two micro-narratives, which depict earlier stories in Christ's life: the stoning of Christ and tribute money. The middle structure in the background refers to the Dome of the Rock, an important site in Jerusalem for Christianity as well as the other Abrahamic religions. The two round-arched porticoes are introduced as a compositional device to divert the viewer from the center. The use of linear perspective unifies the multiple narratives and draws the viewer to the

main focal point of the painting, which is the interaction between Christ and Peter.

Using Pablo Picasso's *Demoiselles d'Avignon* to contrast Perugino's *Christ Giving the Keys to Saint Peter*, Gaggi argues that *Demoiselles d'Avignon* decenters the subject with the flattening of the picture plane and the rejection of illusion found in pre-modernist paintings. [13] The painting in-part is no longer about the illusion of space, but is rather questioning it. The subject matter has been diverted from the painted to the conceptual. Gaggi writes that Picasso's "painting decenters the subject – both the represented subject and the viewing subject. Renaissance space is self-consciously subverted, the various planes pushing forward to create an approximate congruence of illusionistic pictorial space and actual flat space surface of the canvas, like sides of a cardboard box unfolded and flattened in a messy two-dimensionality." [14]

The contrast between Picasso's *Demoiselles d'Avignon* to Perugino's *Christ Giving the Keys to Saint Peter* is important to consider when looking at the painted panorama as a storytelling tool, as the subject is also "decentered." However, in the case of the panorama, the absence of a centralized focal point is due to curvilinear perspective. The perceived visual focal point shifts from a central point to multiple coordinates within the panorama, depending on the viewer's location. This is especially evident in the *Jerusalem Panorama of the Crucifixion of Christ*, a panorama completed in 1903 and located in Bavaria's principal pilgrimage center, Altötting. Under the personal initiative of the painter, Gebhard Fugel, who specialized in Christian art, along with his partners, the architect Georg Volkl and the painter Josef Krieger, the *Jerusalem Panorama of the Crucifixion of Christ* attempted to create a panorama of "vigorous realism," which opposed the sentimental style of religious art of its time. [15] Stephen Oettermann writes in *The Panorama: History of a Mass Medium*, "Their insistence on exact realism made progress slow…[A]ccording to one account, the artists set up real wooden crosses in their studio and 'fastened' models to them, in order to be able to paint from life. [16]

While the macro-narrative of the panorama is of Christ's death on the cross, it also presents many micro-narratives into the other events that occurred at the same time as written in the *Holy Bible* and interpreted by Fugel and his team, such as the disciple Peter kneeling near Jesus's burial site and a regiment of Roman soldiers returning from Golgotha, the site immediately outside Jerusalem's walls where Jesus was crucified. As the viewer wanders away from the thematic focal point – the crucifixion of Christ – and explores other parts of the Jerusalem panorama, the marginal micro-narratives presented within the panorama become central. With this in mind, in the case of the painted panorama, there is no primary axis or focal point where particular coordinates have priority over any other – except as the viewer determines – potentially offering several micro-narratives within the overall macro-narrative of the panorama. Not only is the panorama capable of standing on its own as a storytelling tool, but the decentered focal point within the panorama opens up opportunities for expanded narratives using the notion of hypermedia.

The VR Panorama and Hypermedia Narratives

Much like the painted panorama, a VR panorama is an immersive 360-degree panoramic viewing of a place and/or event. Nevertheless, the VR panorama not only has the ability to act as an object, whether stand-alone, like the painted panorama, or within a larger project, but it can also act as an interface. The VR panorama has its own distinct attributes, which reveal not only its homage to the painted panorama but convey its potential within the digital domain:[1]

- Immersive: provides an experience of entering into a simulation or suggestion of a three-dimensional environment.
- Integrative: the ability to combine image, sound, text, and image into a dynamic 360-degree panoramic form.
- Interactive: the ability for users to manipulate and affect their experience with the panorama, and potentially communicate with others through its interface.
- Hypermedia: When the panorama is used as an interface, it has the potential to link separate media objects (text, image, video, other panoramas) to one another.

The hardware and software that support the viewing of the panorama metaphorically acts much like the architecture that houses the panorama painting as described by Robert Barker in his patent. While the VR panorama as an object offers a temporal and spatial excursion to a place and/or event much like the painted panorama, using the VR panorama as an interface and linking objects to it in order to create a hypermedia system provides a wealth of opportunities for user exploration and investigation.

In the essay, "Database as a Genre of New Media," Lev Manovich proposes that the computer offers a new form of cultural expression. He writes, "The 'user' of a narrative is traversing a database, following links between its records as established by the database's creator. An interactive narrative (which can be also called 'hyper-narrative' in analogy with hypertext) can be understood as the sum of multiple trajectories through a database. A traditional linear narrative is one, among many other possible trajectories." [17] By integrating a database of images, stories, and descriptive information that links to pertinent objects within a panorama, one may create a hypermedia narrative using a search-and-discover navigation system. In *Hypertext 3.0: Critical Theory and New Media in an Era of Globalization*, George Landow reasserts this idea when he writes, "All hypertext [or hypermedia] systems permit the individ-

[1] This list of vr panorama attributes was influenced by the book *Multimedia: From Wagner to Virtual Reality* edited by Randall Packer and Ken Jordan.

ual reader to choose his or her own center of investigation and experience. What this principle means in practice is that the reader is not locked into any kind of particular organization or hierarchy." [18]

Stemming from the work of Vannevar Bush, who perceived the computer as a database and information retrieval system to help both scholars and decision makers with managing information, and Ted Nelson, who coined the terms "hyperlink" and "hypertext," a paradigm shift occurred when literary theory and computer hypermedia converged forming the notion of hypermedia narrative. [19] For the purposes of this paper, "hypertext" and "hypermedia" are used interchangeably; although hypermedia is a much more inclusive term, as it includes not only text, but also such media objects as images and video. It should be noted that this author defines "hypermedia narrative" as the linking of separate media elements to one another, creating a thread of associations that form a narrative. However, having a user click a series of random links does not necessarily generate a "hypermedia narrative," as the system requires a designed structure with a collection of media objects that refer to each other in one way or another.

The use of a hypermedia system using the cylindrical panorama as an interface can be found in Zoe Beloff's interactive film *Beyond* (1995–1997). According to Beloff, *Beyond* "explores the paradoxes of technology, desire, and the paranormal posed since the birth of the mechanical reproduction…Just as the earliest film makers struggled to find a new visual language through the newly developed technology of cinema, here I aim to invent in a personal way, a new digital articulation of space and time that both grows out of cinema yet goes beyond it." [20]

When the participant begins *Beyond*, a small black and white movie appears at the center of the screen with camera shots of the Hindenburg blimp flying above New York City coupled with pages of text being stacked upon one another. The participant is then introduced to the first panoramic landscape interface. The viewer moves the mouse from one side to another, encountering a 360-degree view of a landscape depicting the grounds of an abandoned mental institution with collaged icons that invite further investigation. The user has an option of choosing multiple "hotspots" to explore. Once the selection has been made, the viewer may be confronted with graphics, text, collaged fragments of early 20th century film footage, animations, or another panorama.

While Beloff reveals that there "was no predetermined 'master plan.' Just some rough ideas in my head," there is a definite hypermedia structure that enables a narrative to emerge through an exploratory investigation of the project. [21] As users move through the web of panoramic interfaces in *Beyond* and explore the various media objects, they continually shift the center. Landow asserts that hypertext or hypermedia "provides an infinitely recenterable system whose provisional point of focus depends on the reader, who becomes a truly active reader in yet another sense. One of the fundamental characteristics of hypertext is that it is composed of bodies of linked texts that have no primary axis of organization." [22]

Another project that uses a similar exploratory-like hypermedia system is the interactive installation written and produced by Sarah Kenderdine and Jeffrey Shaw, entitled *Place Hampi*. Completed in 2006, *Place Hampi* is an interactive immersive environment that incorporates augmented stereographic panoramic projections of Vijayanagara, a UNESCO World Heritage Site located in southern India. *Place Hampi* examines Hindu mythology through user-controlled investigations within its immersive environment. [23] Differing from Beloff's intimate CD-ROM, Kenderdine and Shaw's monumental installation consists of a rotating platform placed centrally within a large circular projection screen, which allows the viewer to interactively rotate the projected image and discover at his or her own pace. *Place Hampi* offers sixteen cylinders or panoramas that re-present selected areas within Vijayanagara. Once selected, the viewer becomes engulfed within the chosen panorama, much with like the painted panorama. However, in this case, there also may be embedded moving imagery within the panorama and one can navigate from one panoramic cylinder to another, allowing the viewer to explore and examine place in whatever order chosen.

It should be noted that both *Beyond* and *Place Hampi* further the traditions of the panorama and cinema by offering an extended cinematic environment where user-centered search and discover become central to its design. The participant becomes the assembler of their own experience through choice, as opposed to traditional cinema, which offers a strict linear experience of beginning, middle and end. It should be noted that while these two works provide successful examples of "search and discover" hypermedia narratives, they do not represent the full range of hypermedia narrative patterns existing, which can capitalize on the use of the vr panorama as an interface.

While the notion of hypermedia narratives may appear liberating for both the reader and author, it may also be considered confusing, as the reader or user may become disoriented while navigating through the information space. [24] The process of creating and reading hypermedia differs from printed text, as the cause and effect relationships are obscured and it requires structures that can help orient the reader. [25] The VR panorama provides such structure, as it may act as both an object for investigation and interface for further exploration. The VR panorama can be the catalyst for a storyworld of mystery and inquiry that encourages search and discover. As Landow writes, "Storyworlds, which contain multiple narratives, demand active readers because they only disclose their stories in response to the reader's actions." [26] The painted panorama *Jerusalem Panorama of the Crucifixion of Christ* is an example of a 20th century analog "storyworld" where the viewer engages with many micro-narratives within an overall macro-narrative, providing a cross-over link from the analog painted panorama to the digital panorama's potential in regard to the use of hypermedia for narrativity purposes. Furthering the hypermedia relation-

ship between the analog painted panorama to the digital panorama's potential is the painted panorama's souvenir guide, which acts almost like an intermediary step between the painted panorama as an interface and the textual blocks of information necessary for the further understanding of the panorama. In other words, the painted panorama's souvenir guide can be seen as a precursor to the potential of integrating the use of hypermedia in the development of VR panoramic photography projects.

Advances in the Presentation of VR Panoramic Photography

While the term "virtual reality" has become much broader than its original intent, much like the shift in the definition of the panorama, its original meaning referred to an interactive environment that fully immersed its users in a three-dimensional world generated by a computer. [27] The term grew from such ideas as Morton Heilig's 1955 essay "The Cinema of the Future," which proposed a multisensory cinematic experience and Ivan Sutherland's 1965 essay entitled, "The Ultimate Display," in which he conceived of a head-mounted display that married the computer to the promise of what is now known as "virtual reality." [28] Sutherland writes, "The ultimate display would, of course, be a room within which the computer can control the existence of matter. A chair displayed in such a room would be good enough to sit in. Handcuffs displayed in such a room would be confining, and a bullet displayed in such a room would be fatal. With appropriate programming such a display could literally be the Wonderland into which Alice walked." [29]

While fulfilling this vision is still a way off, it appears that the next step has arrived for VR panoramic photography to become totally immersive by using such HMD (head-mounted display) hardware devices as the Oculus Rift unit (http://www.oculusvr.com/rift/). The Oculus Rift is a new virtual reality headset that allows users to immerse themselves inside their favorite games and virtual worlds at an affordable price [30]. It combines stereoscopic 3-D, 360-degree visuals and a wide field of view to create a believable immersive environment. [31] The device enables the body to turn around and inspect various parts of the VR panoramic image by constantly updating the image in relation to the movement of the head, much like the experience when visiting a painted panorama. In addition, metaphorically similar to the long darkened corridor that the visitor passes through before entering into the painted panorama, donning the headset prepares the user to enter into another reality. With this type of spatial immersion, viewers may have an emotional and intellectual response to the VR panoramic image – something not possible with the current monitor-based display. With such HMD devices as the Oculus Rift, the VR panoramic image can now be viewed within a completely immersive environment, which appears to be similar to Robert Barker's 1787 intent as stated in his patent, but using the technology of present time. In addition, the HMD appears to be an effective platform to advance hypermedia narrative construction practice and theory using vr panoramic photography as an interface by offering an individuated immersive experience for interaction and play.

Concluding Remarks

The painted panorama offers an entry into the potential of hypermedia with the digital VR panorama, as it decenters the subject allowing for the traditionally marginalized micro narratives to take on greater importance, as seen in the *Jerusalem Panorama of the Crucifixion of Christ* when compared to Perugino's *Christ Giving the Keys to Saint Peter*. The use of hypermedia provides depth to the panorama, as in the panoramic projects mentioned above, which is not possible within the traditional painted panorama acting alone. Landow reaffirms that hypermedia systems "permit the individual reader to choose his or her own center of investigation and experience. What this principle means in practice is that the reader is not locked into any kind of particular organization or hierarchy." [32] The integration of hypermedia into the digital panorama allows for branching systems that enable further investigations into the micro-narratives of the panorama.

Nevertheless, hypertext or hypermedia systems can add confusion to the reader. As Christiane Paul writes in *Digital Art*, "Hypertext reading and writing in many ways differ from the process of creation and reception of printed texts. A reader whose expectations and reading interests are fueled by the question "What is happening to whom, and when and why? may be disappointed and frustrated…in the sense that the narration may seem to presuppose knowledge and information the reader will come across only later in the reading." [33] As a result, structure and intent need to be carefully considered when designing a hypermedia system for a panoramic imaging project. Like a detective, the user engaging in a hypermedia system must take an aggressive approach or will encounter very little in the way of story or "world." [34] Consequently, further research and practical investigations in narrativity using contemporary museum education and game theory are crucial to the furthering of hypermedia systems for panoramic imaging purposes.

In the 1997 essay entitled, "The Dream Life of Technology," Beloff writes, "I am fascinated by long outdated forms resurfacing anew in the digital realm. Such are panoramas. Actual panoramas painted around specially constructed circular rooms are a popular form of entertainment in the nineteenth century…they now reappear in the virtual realm." [35] While the painted panorama as an art form still continues today, the residual from the painted panorama offers new possibilities within the digital realm. It appears that with the introduction of such HMD displays as the Oculus Rift, which are designed for consumer consumption, that Robert Barker's original intention for creating a completely immersive environment that "feel[s] as if really on the very spot" will again come to fruition using the digital media technologies of our time. [36]

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[Session 25]

Sculpture

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Creating Observational 3D Sculptures

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Abstract

Technology has been used to assist in communication and concept development by artists, designers/inventors, engineers, clients, manufacturers and others. [1-3] The use of technology to aid artists capture what they see has been used since the Renaissance with the introduction of the camera lucida and the camera obscura.

A modern method to assist in capturing how people see is to use eye tracking technology. The data collected from eye tracking experiments is widely believed to reflect what within the viewing space is being assessed. The analysis of this data can be output in statistical form, or as 2D graphic overlays placed on top of flat images. The innovation described in this paper is the application of a new methodology developed to allow quantitative eye tracking data to be used as a basis to create 3D sculptural forms.

This paper is structured with first a brief explanation of eye tracking, leading to the description of the new 3D eye tracking methodology. The results from the test and the final output are reviewed in the analysis including the lessons learned and the possible areas for improvement.

Keywords

Eye tracking, 3D sculpture, virtual avatars, 3D scanning, rapid prototyping, subsurface etching.

Introduction

Technological developments and artistic works have always been closely related whether as a direct link or in an abstract sense. Developments in technological tools used for analyzing vision have had profound effects on how we see the world. It questions the way we perceive objects, the way we acquire knowledge and how we comprehend the world. Within the realm of art, technological developments have had a distinct impact on artistic representations. One of the most interesting periods for comparison when looking at the introduction of new technology and its affect on the development of art and the perceived differences between vision and representations can be found by examining the attitudes of the Italian Renaissance artists to those of the 17th Century Dutch artists.

Italian representations were based on the conceptual notions of perfect beauty and poesis. Artists selections from nature were chosen with an eye to heightened beauty and mathematical harmony - an ordering of what was seen according to the informed choices and judgment of the artist based on particular issues and concepts rather than as a form of representation where the single most important reference is the natural appearance of things. [4]

In contrast Dutch 17th century Renaissance painting was heavily influenced by the use of technology to assist in the act of seeing. During the century several experiments were carried out to perfect the accuracy in which technology could mechanically assist seeing. New technologies became very popular during this time with a number of different styles of “cameras” and optical lenses being designed to address the popular needs of the artists to help them in their observations of nature. [5] This new technology that could enhance sight through microscopic close ups, reflections and enhancement of distant views was seen as a new way of gaining knowledge and brought insights into how we see.

It is interesting to note that David Hockney’s research into the use of mechanical aids in Renaissance paintings has revealed that the aforementioned Italian artists also used the camera obscura but only as a reference tool for placement accuracy without incorporating any of its effects directly into their landscape paintings. [6]

Each technological tool type influences the nature and structure of artistic conceptualization and production. Each tool type has it's own characteristics, as well as its own strengths and weaknesses. For the development of observational 3D sculptures described in this paper the modern day electronic tools of the computer and eye tracker were used.

Computers have been used for the creation of artworks as early as the 1960s. Michael A. Noll, a researcher at Bell Laboratories in New Jersey created some of the earliest computer generated images, among them Gaussian Quadratic in 1963. The works of John Whitney, Charles Csuri and Vera Molnar in the 1960s remain influential today for their investigations of the computer-generated transformations of visuals through mathematical functions. [7] Eye trackers have also been used to create art, however, from the literature review undertaken it appears that they

have only been used to create two dimensional representations. One of the most high profile experiments using an eye tracker and bespoke software to draw images was the Eyewriter project which helps people suffering from ALS (Lou Gehrig's disease) such as the legendary LA graffiti writer, publisher and activist, named Tony Quan, aka TEMPTONE, who was diagnosed with ALS in 2003, a disease which has left him almost completely physically paralyzed… except for his eyes. [8] The graffiti produced with the technology was projected onto buildings and walls in Los Angeles. Regarding exhibitions of eye tracked art, one of the most recent was at the Riflemaker gallery in London in March 2015 where they exhibited 2D portraits drawn by the artist Graham Fink who uses custom eye-tracking software to transform his gaze into a medium. [9]

Duchowski, describes eye tracking as a tool that collects data on eye position, gaze path; time spent looking at a stimulus or fixations at objects along with numerous other variables. [10] The data collected from eye tracking is used in experiments to determine where the users are looking. This is widely believed to reflect what within the viewing space is being assessed. Eye tracking experiments have been performed for several decades already and on various research fields. [10] However, researchers have emphasized that some common details e.g. scanning path, number of gazes, percentage of participants fixating an area of interest, and time to first fixation on target area of interest were interesting measures for research, but that they have often been overlooked during analysis in many studies. [11-12]

Eye tracking glasses such as the one used in this research, the Tracksys ETG (see figure 1) work by capturing a user's focus whilst looking at an object. This is accomplished through special hardware including glasses with built in infrared cameras, and specialized software which gathers X, and Y locations by tracking the user's pupil once a calibration session have been undertaken. Fast movements of the eyes (saccades) are recorded along with fixations gaze points, which are then combined into scan-paths. Most eye tracking systems come with some form of analysis software that helps to abridge the data gathered into meaningful statistics or visual results.

The uses of eye-tracking methods have made possible the close examination of the conscious and unconscious gaze movement of a respondent in visual systems research. [13-15] The human visual system starts with eye movements, which are linked to perceptual systems; it is the close relation of these movements to attentional mechanisms, saccades, that can provide insight into cognitive processes, e.g. language comprehension, memory, mental imagery and decision making. [9]

Richardson and Spivey cited early empirical findings from Perky, Clark, Stoy, Goldthwait, and that the frequency of eye movements increases during mental imagery.

Figure 1. Tracksys ETG 60Hz binocular tracking glasses.

[16-21] In addition, their recent work suggests that eye movements were related to both memory of specific perceptual experience and cognitive acts of imagination. [16] Levy-Schoen emphasized, 'to the extent that eye movements are reliable correlates of the sequential centering of attention, we can observe and analyze them in order to understand how thinking goes on.' [22] The use of eye-tracking for aesthetic-based research by Fischer et al. Russo and Leclerc, Malach et al. and many other works reported in Jacob and Karn were founded on similar grounds; namely the correlation of eye movements and visual perceptual systems. [11],[23-25]

From the literature review undertaken it appears that eye tracking has never been used as a basis to create 3D sculptural work. However, within the field of art, eye trackers have been used to investigate visual exploratory behavior of paintings. [26-33] The areas receiving high densities of fixations have been understood as indicating the observer's interest in informative elements of the image. [27] The studies of aesthetic judgment driven by neural primitives have mainly focused on the analysis of image composition, i.e. the relation among visual features of an artwork. [28]
To begin, the entire visual field is processed in parallel to generate a mental plan that is weighted according to the task. Next, eye movements are performed in order, visiting the strongest or most interesting feature first and proceeding to the weakest or least interesting. From this bottom-up driven process, aesthetic experience appears to be influenced by elements such as balance contrast and symmetry. [29–33] Further work has identified other properties that attract the attention of an observer to specific areas of interest (significant regions of an image). [34] These factors include curves, corners and occlusions as well as edges, lines, color and orientation and contrast of luminance. There is also evidence that a modest degree of complexity increases the aesthetic appeal of visual stimuli. [25-37]

To use eye tracking to create a sculptural shape an object on which the form could be based was required. It was decided that a human face as a 3D form held enough of these areas of interest and complexity to act as the main

source of inspiration. Faces are special objects in human perception. Infants learn about faces faster than other objects. It is as if we are born with visual systems primed to learn to recognize important humans, such as our own mothers. [38-40]

Observing the face would also engage the use of top-down cognitive processes with intentional direction of attention as well as focused attention in terms of eliciting the simulation of emotions and sensations. Several studies have shown that the face is generally the first part of the body that is scanned in portraits activating a constructed visual encoding, instead of the more common analysis of individual features. [42-45] This is thought to be due to the face being constituted of a set of 3D objects which seem to be mentally represented in a holistical way. [44-46] Research has shown that when observing a face the observer can prioritize their gaze towards 'diagnostic' features. There is reason to believe that both the familiarity with the human face, and its typical representation can often result in a gaze strategy where the goal is to get as much information as possible. [47-49]

From the research undertaken into eye tracking of faces it appears that the first point of interest of the face is towards the internal region, particularly towards the eyes and bridge of the nose. [50-55] This first point of interest might be anchored onto a position which provides a perceptual span that either covers the whole stimulus or that maximizes the area of the object which is included within the region of high resolution acuity. [50],[58] This extended scanning of the face would be ideal for capturing large amounts of eye tracking data to construct a facsimile in the form of a 3D sculpture.

Eye tracking 3D objects

The main goal of the research was to see how it was possible to translate the transitory visual dialogue created by observing a model into a tangible three dimensional object. To capture eye tracked points from an observer viewing a 3D object using 2D eye trackers, and then translate this captured data back into a virtual 3D space, a number of issues that needed to be addressed. The premise was to capture where the observer was looking at the 3D object. Take these points and the relative positions of the observer and the 3D object and place them in a virtual environment. Within this virtual world, re-project the eye tracked points from the observer to the virtual 3D model. Where these points intersected the virtual model, voxels could be created highlighting where the observer had spent time looking. These points in space would then be the basis to create a 3D sculpture (see figure 2)

Firstly through observational studies it was shown that observers do not keep their heads still when reviewing an object. Even if an observer is looking at a relatively small object, small head movements are observed which often pre-empt the movement of the eyes by tilting their head in the appropriate direction. If an object such as a sculpture is observed the user will naturally move around the object and tilt their head to get a better view of the static object. Therefore some sort of tracking system to record the relative position of the head would be required.

A number of options were available; firstly an electromagnetic positional tracker such as the Polhemus Patriot system could be applied. This uses a single sensor that contains electromagnetic coils that emit magnetic fields. These fields are detected by the aforementioned sensor. The sensor is connected to an electronic control unit via a cable, the sensor's position and orientation can then be measured as it is moved. As the sensor is tethered via a thick chord to the control unit, the use of these sensors is limited. Previous research into eye tracking objects by Lukander used a polyhemus system fitted to a users head to track the head position and then directed the gaze points on to a mobile phone face using a computer software. This only required the relative head position to be calculated and accounted for as the phone was held in a fixed position on the users lap. [59]

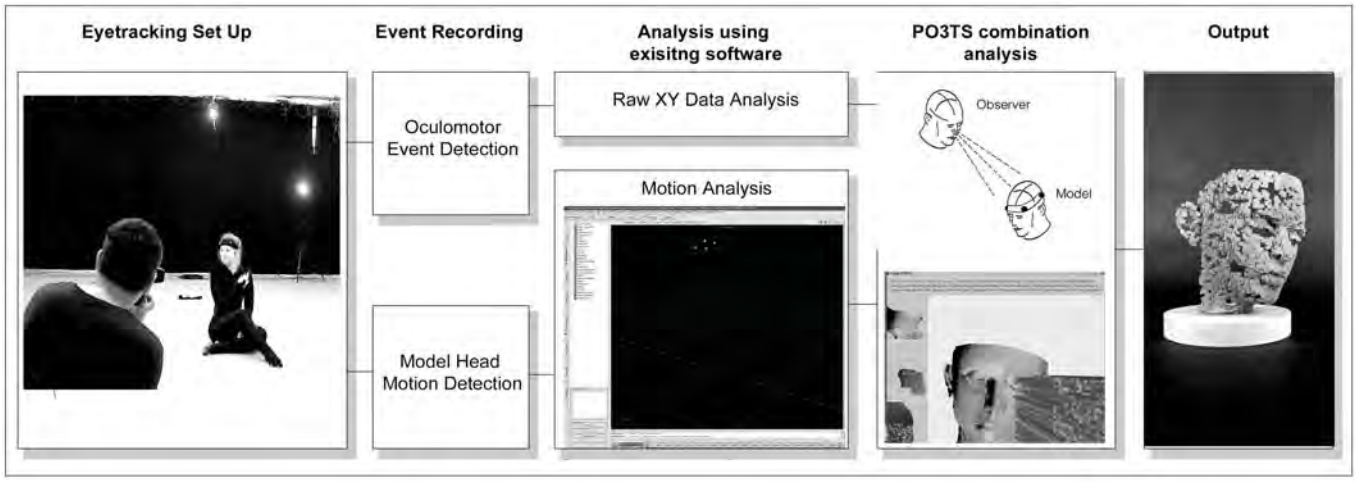

Figure 2. Graphical representation of the methodology to produce 3D sculptures from eye tracking data.

To avoid tethering, the second option is to use optical motion capture. The two most common forms are either Passive or Active. Both systems apply markers to a user and then use special video cameras to track the marker's position. Reflective (Passive) optical motion capture systems use infra-red LED's mounted around the camera lens, along with an infra-red pass filter placed over the camera lens. The light emitted from the camera mounted LED's are reflected off the markers, which are then captured, by the cameras. The advantage of this system is that the markers do not need to be powered, but the system can suffer from unwanted noise or loss of marker positions, resulting in the need for extra post-production time to clean up the data. Optical or Active motion capture systems are based on pulsed-LED's measure the Infra-red light emitted by the LED's rather than light reflected from markers. These systems have the advantage that the LED's are generally smaller than the reflectors but on the negative side each LED needs its own power supply.

The chosen route used in the experiment was to use the passive system. Similar to Lukander, markers were originally placed on the observer. After some experimentation it was found that the movements of the head of the user whilst observing the model, combined with the eye tracked positional data caused too many inaccuracies with the recorded data. To overcome this issue, more markers were added to the observer, but the system could not be calibrated enough to eradicate the inaccurate readings. The solution was to attach the markers to the model's head, which only slowly turned (see figure 3). The observer was able to keep their head still by resting their chin on a chin mount. With this arrangement there was the downside that the observer would often look at the markers, rather than just the head, but the accuracy was greatly increased. The markers also had another advantage as acting as calibration markers on the model.

Figure 3. Model with passive markers.

Once the relative 6-axis positions and rotations of the object was recorded the next stage was to import all the data into a 3D CAD system. The relative positional coordinates were exported from the biomechanical software associated with the passive tracker system in to a new bespoke software package developed by the author entitled PO3TS (Positional Observational 3D Tracking Software). The model's head was scanned using a NextEngine 3D scanner and then also imported in to PO3TS. To this model the appropriate motion patterns were applied so the head became animated.

An avatar head of the observer using their eye distance parameters was modeled and imported into the new software. The eye tracking data was then also taken in to PO3TS and parsed to select individual gaze fixation points along with their increment number and time stamp. The gaze fixation points in relative XY coordinates to the head were applied to a plane at the same distance as the scanned model's head. These points were then projected using a vector from the observer's eye, through the point on the plane to intersect with the virtual head's surfaces. Where these projected points intersected with the surfaces an intersection point was created in the shape of a cube. (see figure 4). The alpha setting of the material applied to the intersection cubes was set at 50%. The more spheres the darker the area became, so creating a basic 3D heat map which could be used for comparison with the 2D heat maps created by the eye tracking software.

To gauge the accuracy of the system the passive markers were used as calibration targets. The observer looked specifically at the center of one and then asked to look at the next. The eye tracking data was then put through PO3TS. Reviewing the results through the software it showed that the gaze position data applied was on average accurate to within +/- 2 degrees of the fixation of actual target. This meant that areas of interest could be easily identified, but specific details on the head may have been difficult to identify with the PO3TS system by itself. In anticipation of any issues regarding accuracy of the plotted points within the PO3TS system a time stamped video showing where the observer had looked at the model through the use of a red laser dot was also recorded.

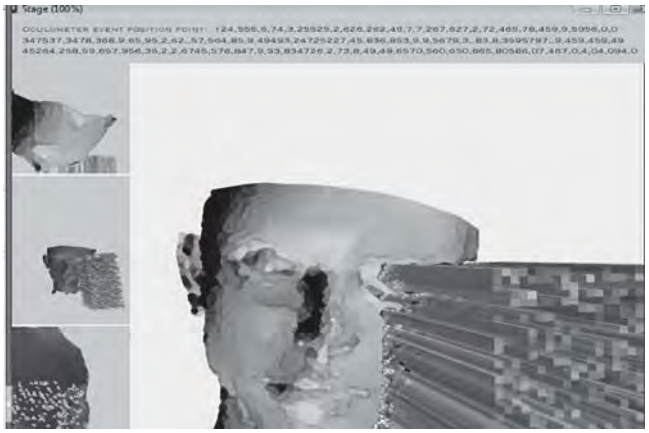

Figure 4. Processing section of eye tracked points using PO3TS software.

Analysis

The software which comes with eye tracking systems produces a number of parameters that can be useful as outputs for analysis. Jacob and Karn reviewed 24 eye tracking usability research studies and listed six of the most commonly used parameters: overall fixation count, percentage of the total time spent on each area of interest, average fixation duration, fixation count on each area of interest, average dwell time on each area of interest, and overall fixation rate. [11] Within the PO3TS system the following were used:

- average fixation duration on each area of interest.
- fixation count on each area of interest.
- transition fixation points between different areas of interest to see how the participants looked between areas of interest.

All three of these parameters are based on the location and duration of saccades and gaze fixations. Saccades are the rapid movements between fixation points during which the brain does not receive visual information. Gaze fixation points are created when the participant's eyes are relatively still and focused on a specific target. There are several definitions of fixations and their duration. The common fixation duration is between 200 and 300ms. Different systems use different algorithms to calculate them. Within the PO3TS system minimum, only fixation duration larger than 250ms were used. Using these three parameters different results could be produced by adjusting the information input into the PO3TS system.

Before the tests began it was assumed, as stated by Hammer & Lengyel, that areas of interest which caught the viewers' attention could easily be located by the help of eye-tracking. [12] The new PO3TS system could undertake this task within +/-2 degrees of accuracy. Replicating existing research, internal parts of the face; eyes, nose and cheeks, were explicitly focused on more than the rest of the face. This occurred whilst the model's head was still and also whilst it moved with the same regions being the main areas of interest whilst the head was positioned at different angles (see figure 5). The only difference being that the cheeks had more gaze concentration when the face was oblique to the observer.

Figure 5. Observing the model whilst being motion tracked.

The resultant information created a number of cluster areas of interest. The fixations indicated that the visual attention of the observer was predominantly targeted at the center of the face just below the eye sockets in addition to the eyes. However, the other areas of interest around the face were not sufficiently linked together to be able to be output to a 3D rapid prototyping machine without a lot of support material being needed between the regions.

To overcome this linking issue, a sculpture was created using subsurface laser engraving. Sub-surface laser engraving is created by focusing a laser below the surface of a transparent material where it causes small fractures to appear so that the points are seen as being suspended in the material (see figure 6). The materials used for this engraving needs to be of high-grade optical quality to minimize distortion of the beam. This type of process is often seen in 'crystal' souvenirs.

This produced an interesting sculptural form, but was restricted by the size of single crystal block available and the inherent cost of this material. To develop a larger sculptural piece the observation of the model's face required further data to hopefully produce enough data points so that they linked together to be able to form a viable structure for 3D printing. This required the observer to consciously try and look over more of the face of the model. This was a forced experiment and it was interesting to note that the gaze point collections of the first observation were different as the observer was trying to be more systematic. There is evidence that eye movement patterns are affected by the cognitive task based on studies of humans on high-level scene perception as well as from visual aesthetic studies. [27] Zangemeister and colleagues also found that the gaze patterns of the same artworks whether abstract or realistic changed as a observation task was changed. [55-56] During this extended observation there were more wayward points observed then the first sessions. This is also a problem with many existing eye tracking systems where Goldberg and Wichansky suggest "recalibration every few minutes". [57]

As the PO3TS system produces relative coordinates within space it was possible to introduce minimum and maximum 'observer to model' variables to eliminate some of these wayward tracking points. The parsed data could then be extrapolated from the PO3TS system into Rhino CAD software. Within Rhino some post production cleaning up took place which allowed for the resultant voxels to be output as a water tight 3D object that could be converted into an stereolithography model ready for 3D printing (see figure 7).

Figure 6. 'Crystal' suspended point sculpture

Conclusion

Technology has been used for many years to enable artist's to produce their work. The PO3TS system is another tool, it does not produce a finished object but facilitates creativity by converting the narrative of vision to the production of unique sculptural forms.

Even though there are a number of restrictions the findings from the research did show that the PO3TS system can be used with 3D models to create sculptural forms that capture the original representation whilst maintain an abstract form. The author is further developing the methodologies and the software to be able to output variations of the forms, both in their complexity and in the nature of the data collected. Possible future outcomes could be from multiple observers viewing the same object to create a collaborative sculptural piece. The methodology could also be used to capture more transient moments such as capturing the movement of a moving object such as dancers.

Figure 7. 3D printed sculpture using connected voxels

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Beyond teaching design and multimedia courses, Kevin's interests in New Media Art have manifested in a number of related academic journal papers, conference paper presentations and had his art exhibited in galleries in the UK, Australia and the UAE. Kevin's main area of interest is the personal perceptions of vision, using augmented, virtual reality and eye tracking tools to create engaging art pieces.

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Disrupted Architecture: Reimagining Buildings through Sound

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Abstract

This paper discusses work which changes our perceptions of the built environment, and uses as examples two sound installations, *Machines for Singing* (2006) and *Torch Song* (2011), which are designed to make audible hidden forces and events within the fabric of a building and to disrupt our preconceived ideas of architecture. Continuing a long lineage of soundart works which engage with architectural space, the pieces stream sounds collected from around a building to a listening point. By hearing the effect of human and environmental forces on the sounds (*Machines for Singing*) or controlling them via a custom-made interface (*Torch Song*), visitors gain a renewed understanding of the forces at play within the structures around them.

Keywords

Sound Art, Architecture, Interactive Art, Installation, Composition, Music Concrete

Introduction

This paper discusses one of the longest-running themes in soundart practice, that of the disrupting our understanding of architectural space using sound, referencing the works *Machines for Singing* (2006) and *Torch Song* (2011). These pieces disturb our concept of architecture as merely a static stage set against which human life is played out, and recast it as a living, breathing entity. Buildings are usually perceived as immobile structures, built of impermeable materials, solid and unchanging. However buildings respond to their environment in a similar way to their builders, expanding in heat, contracting in cold, weathering, creaking and decaying over time. Like us they are born, live, and die.

The works aim to increase peoples' awareness of the hidden life of a building and disrupt our preconceptions about the built environment by presenting sounds captured in real time from the building's structure as an audio composition. Both pieces stream sounds from around a building using a mixture of microphones, contact mics and electrical transducers. *Machines for Singing* creates a composition from sensors responding to the behavior of the structure and its inhabitants, while *Torch Song* allows visitors to activate and play with the sounds directly by shining torches onto light sensors in a custom-built control panel. In both cases the soundscape of disembodied clicks, hums and drones that results brings new readings to the room and building in which the pieces are presented; the sounds seem at times soothing, at others mysterious and threatening and confront assumptions that buildings are silent, static and dead. The sound extends the architecture, giving it a sense of a building as a living thing – to paraphrase Goethe, 'unfreezing the music' – a place full of unseen, unexplained events, subject to time and decay, and shot through with electrical and hydraulic nervous systems.

Sound and Architecture

Soundart as a discipline – especially as it emerged in the 1970's and 80's - has historically been concerned more with the physics of sound and audio phenomena, and exploring frequencies and wave dynamics, than with established musical qualities. That is not to say soundart can't possess harmony and rhythm, but the freeing of sound from distinct tuning systems and instrumental composition by early practitioners yielded a freedom to explore the medium rather than the message, including its relationship to the environment. By focusing on space, sound artists immediately aligned themselves with sculpture and installation, and made a claim on the territory of fine art. From Goethe's famous quote 'Architecture is frozen music' has developed a distinguished body of work investigating the relationship between sound and space [1].

One of the canonical works in soundart history is *I Am Sitting in a Room* by Alvin Lucier. In this piece a recording of Lucier talking is repeatedly played back and re-recorded in the same room, so that over time the resonant frequencies of the room and audio equipment become dominant and turn the speech into a series of notes - as Lucier says, "any semblance of my speech, with perhaps the exception of rhythm, is destroyed. What you will hear, then, are the natural resonant frequencies of the room articulated by speech" [2]. There are many other works which deal with sound and the built environment; Max Neuhaus' *Times Square* in which a composition emerges from a grate in the street and mixes with the sounds of New York city [3]; LaMonte Young's *Dream House* which uses standing waves caused by sound bouncing off the walls to create areas of high and low intensity sound that the visitor can

walk through [4]; more recently Susan Phillipsz made recordings of London's medieval songs which were then played into outdoor spaces in the city, and songs that were long ago heard in those streets once again rang out, collapsing the centuries in a sort of sonic psychogeography [5]. There are many other practitioners in sound-space; Bernhard Leitner, Bill Fontana and Mary-Ann Amacher are more artists who deal with sound, spatiality and architecture. Of course the topic is also of concern to architects; Juhani Pallasmaa suggests that "we stroke the boundaries of the space with our ears" [6]. When formalized as scientific enquiry the collision of sound and architecture forms a large part of the field of psychoacoustics, the phenomena of which (reflection, refraction, interference etc.) video artist Bill Viola refers to as "like a set of mystical visions of nature" [7].

A piece that allows the public to engage sonically with architecture like *Torch Song* is *Playing the Building* by Talking Heads frontman David Byrne, in which an old organ controls solenoids and vibration motors to allow the public to sonically activate parts of a building by pressing its keys. The piece is interactive and focuses on the sounds of the building, and not (as in many other works, and psychoacoustics) what buildings *do* to sound. However this work imposes artificial excitation into the building and is heard acoustically, whereas *Torch Song* and *Machines for Singing* use amplification to reveal sounds of the structure that are already present.

The sound of *Machines for Singing* and *Torch Song* continue the traditions of composition based on chance events, championed by John Cage in the 1960's [8], and of composing with environmental noise; layers of hums, buzzes, crackles, whistles, gurgles and so on are overlaid into a surprisingly musical collage. This idea was expounded by Luigi Rusollo in the Art of Noises Manifesto and realised using his *Itonarumori* noise machines in the early 20th century [9], continuing through the music concrete of Edgard Varese, Pierre Schaeffer and Iannis Xenakis, utilizing the new-fangled tape machines to chop, join and reverse sounds in the 1950's. Schaeffer's idea of 'reduced listening' leads to today's acousmatic music which attempts to divorce sound from referent altogether, resulting in computer-generated and manipulated sounds which share the spirit of Russolo's work but are aesthetically a world away [10].

Machines for Singing

The first piece in this series is a collaboration with UK artist Rowena Easton. The installation, with its title derived from Le Corbusier's dictum 'a house is a machine for living in', aims to give voice to a building. It consists of a seating unit and a number of speakers in the listening room – in the original installation this was a ring of 8 speakers on concrete plinths arranged around the edge of the gallery. A hidden computer, audio interface and amplifiers in an adjoining room collected sounds from transducers around the building, processed them and fed them into the listening area. There was no direct interactivity, no visual representation of the sounds and the visual impact of the piece was kept purposely minimal in order to force visitors to attend to the sounds themselves and the originating structure around them.

Eight sound transducers were used around the building. Accelerometers (high-gain contact microphones) were placed on heat exchanger units, studs in the walls, scaffolding supporting the auditorium seating, air conditioning ducts and ceiling beams. The sounds gathered were fed via an audio interface into a Mac running MAX/MSP. Four of the sounds were defined as 'background voices' and played constantly, but were programmed in MAX to move around the listening space using an ambisonic patch; as the volume of the sounds was proportional to their proximity to the center of the listening circle, they appeared to fade up and down in volume as they moved. The remaining four sounds were defined 'foreground voices' and had a more instantaneous quality, being switched on and off abruptly by the activation of PIR and magnetic reed switches around the building.

The sounds were processed within MAX but the amount of digital manipulation was kept to a minimum so the character of the original sounds was preserved. Consequently all the voices were filtered (to remove the high-frequency hiss characteristic of the accelerometers, and to bring out the character of each sound) and the background voices were pitch shifted to give them a broad overall harmonic range, and to render audible infrasonic parts of the sound spectrum.

Four strain gauges were placed on metal and glass areas of the building to measure the expansion of the structure due to heat. These were mapped to the pitch of the background voices, meaning the composition was higher in pitch during the day and lower at night. In addition two PIR sensors (in the cafe and entrance hall) and two reed switches on the toilet doors gave an indication of the occupants' use of the building (visitors would be reassured to know that the sounds triggered by the toilet door switches were sourced from elsewhere in the building). These sensors were fed into MAX via an analogue-digital interface, and triggered the foreground sounds.

The sound of the installation can best be described as waves of ambient sound washes punctuated by more agressive and sometimes narrative bursts from the foreground voices. Judging by the comments book and conversations at the exhibition, visitors appeared incredulous that a building could produce the sounds they were hearing, and found the experience absorbing, contemplative and sometimes threatening. Many visitors thought the sounds were recorded or highly processed, and until reading the accompanying information panels, did not realise that what they were hearing was a fairly true-to-life version of sounds that were happening at that moment in other parts of the building. An aim of the installation was to incorporate some element of the special use of the building; in this case, sounds from the theatre which provided a interesting dynamic to the composition when performances were taking place.

Torch Song

Torch Song develops the ideas first explored in *Machines for Singing* into an interactive artwork, presented in a dark room, that creates a sonic composition from the infrastructure of a building.

The piece combines a custom made control panel with readily-available DIY electronics and open source software. The interface presented to the public is a white-painted wooden cabinet with a transparent Perspex top, resembling a display cabinet, approximately 158 cm wide x 42 cm deep x 7 cm high. It contains a line of 8 photocells, 16 cm apart, each mapped in control software to a sound sourced from around the building as a live stream using a selection of contact microphones and electrical transducers. The origin of each sound is written underneath the photocell on a piece of card. Torches are provided fastened to the front of the cabinet on wires (fig. 1).

Behind the control panel is an arduino microcontroller, which reads the values from the photocells and sends them to a Pure Data software patch running on a computer. The patch takes in the audio streams from around the building via an 8-channel soundcard and sets the volume of each one depending on the brightness of its respective photocell. The outputs are panned across a stereo mix and presented on two speakers placed either side of the control panel.

The interface presented to the visitor is purposefully minimal comprising just the control panel, torches and loudspeakers; the rest of the equipment is hidden out of sight. Although there is a lot more technology involved in *Torch Song* than meets the eye, it is vital to the purpose of the piece that the visitor is drawn into the soundworld of the building and the joy of composing with ambient noises, and not distracted by bright computer screens or blinking LEDs.

Presentation starts by selecting the sounds. For the first presentation, at the exhibition *Spotlight*, Oxford U.K., on 2nd December 2011, approximately 50 sounds were recorded on a pre-installation research visit to the site, from which 8 were chosen, focusing on pitched drones and hums and rhythmic clicks and glitches. The final sounds were sourced from a window, a radiator, the air conditioning, a cast iron staircase, a wooden floor, an electrical junction box, a power supply, and a data router. On installation day these sources were rigged with contact microphones or electrical transducers.

Visitors controlled the live-streamed sounds of the building by shining torches onto the photocells - the brighter the light, the louder that sound. The torches could be set to flash, creating rhythmic effects, or faded across the face of the photocells, encouraging experimentation with composition. Many people spent time with the work playing and composing with the sounds. Visitors enjoyed the audiovisual link and the quality of the sounds, but were often unaware at first that the sounds originated in real-time from the building as they were so unlike our normal experience of architecture (and were fascinated when they were informed of this). The control panel was large enough to accommodate multiple players; visitors engaged in collaborative compositions and a lone composer, engrossed in the work for about 10 minutes, seemed annoyed to find their work interrupted by the arrival of a stranger.

Figure 1. The *Torch Song* interface in use. Photo: Adrian Pawley.

Disrupted Architecture

"Wow ... amazing! So used to having quiet gallery spaces, where the space falls into the background in favour of the work. Refreshing for the building to finally speak up and be the main focus."

"…after a time huge variety of sounds and moods, sometimes like gears starting up. Found the whole experience very calm, but also absorbing. Threatening sometimes."

"Made me think about living buildings in a very different way."

The quotes above, from visitors to a *Machines for Singing* install, indicate the shift in perception that the works hope to encourage. Both of these pieces emerge from, and contribute to, one of the longest-running themes in soundart practice – that of redefining spaces using sound, and have themselves been used by the author as the basis for further explorations into the relationship between sound and the built and natural environment in *Presence Room* and *SolarWork#2* (both 2012). As we have seen soundart has long courted the built environment, although *Torch Song* and *Machines for Singing* seem somewhat unusual in using the architectural space as a source of sounds rather than a modulator of pre-made audio content.

The focus of both of these works is a disruption of our preconceptions about architecture. By hearing amplified creaks, crackles and groans, electrical flows, water in pipes, the hum of motors and external sounds filtered through the structure – many of which are hard to comprehend as emerging from a building – we are forced to reconsider what a building is and how it responds to both environmental and human forces. By linking sounds to strain gauges measuring the expansion and contraction of the building we get an idea of how it 'breathes' – in during the day, and out at night. By pitch-shifting infrasonic audio events in its fabric into audible range we gain an extended understanding of structural forces at play. By setting sensors on doors and walls in remote parts of the building we sense the passage of people through the structure, and by linking sounds to a control panel we are able to make waves of industrial, ominous or beautiful sound emerge from the darkness by simply waving a torch over a sensor. The building is not physically disrupted, apart from perhaps drilling a few holes … but in the minds of visitors it is pulled apart and opened out into something new and transformed. This form of playful, thoughtful engagement with sound and architecture is the raison d'etre of both works and the hope is that having experienced them the visitor's idea of what a building is are forever disrupted. Both pieces force us to consider the building not as a container or backdrop for the living, but as a living thing itself.

Acknowledgements

I would like to thank my collaborator on 'Machines for Singing' Rowena Easton, Brüel & Kjær, Sound Solutions and Oxfordshire Visual Arts Development Agency for their help in realizing these projects. The interface in Torch Song was inspired by a visit to an exhibition by Peter Vogel, whose amazing work I can never say enough good things about [11].

Documentation

Documentation of the pieces can be found on my website:
Machines for Singing: http://evolutionaryart.co.uk/mfs.php
Torch Song: http://evolutionaryart.co.uk/torch.php

C|NET blog post about *Torch Song*:
http://cnet.co/1tPw9Hm

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homunculus.agora (*h.a*), an architectonic art installation

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Abstract

This article provides an overview of the development process and motivations behind the creation of *homunculus.agora* (*h.a*) an architectonic installation made of 41 sculptural bodies that were installed in the Main Gallery of the Markham Museum for two exhibitions that spanned from September 2013 to August 2014.

Keywords

architectonic, interactive, biomimetic, emotive, file-to-factory, digital fabrication, design pattern, embryogenesis.

Introduction

homunculus.agora (*h.a*) (*fig. 1*) is a large-scale architectonic installation of 41 sculptural bodies that were organized in a fluid-like cluster. The sculptural bodies are implanted with electronic circuits that give them the ability to express behavioural qualities through light and sound events. A selection of the homunculi are touch sensitive and are positioned on the floor to invite people to touch the work. In doing so, the touch sensitive homunculi react with emotive sound and light responses. *homunculus.agora* derives its name from an alchemically made creature that looks like a miniature of its creator. This is a metaphor for the relation of the technology we create to ourselves, which is deeply connected to our bodies and the way we perceive the world. The term *agora* is a Greek word describing a place for gathering [1]. The Homunculi gather in the museum to facilitate an exchange of emotive expression that contributes to an ecology of form, light, and sound. It becomes a gathering place for people to reflect on the connection we have with the environment and the world around us.

Previous Works

homunculus.agora is a solo work that was developed using knowledge and experience gained from my involvement with several collaborative works that integrate interactive technology in an architectonic installation context:

The emotive *InteractiveWall* (2009) [2], a collaboration between *Hyperbody* [3], *Festo* [4], *Burkhardt Leitner constructiv* [5], was a dynamic wall composed of seven separate wall components that display real-time behaviour. The components bend themselves back and forth, displaying patterns of light on their skins, and projecting localized sound in response to the presence of a participant.

Figure 1. *homunculus.agora* (*h.a*). ©2014 M.D. Hosale.

protoDECK (2009 - 2011) is a project developed by Marco Verde and MarkDavid Hosale for *Hyperbody*, TU Delft, The Netherlands [6]. A key physical subject of the *protoSPACE* 3.0 lab, *protoDECK* is a tool as much as it is an expression of architectural and interaction design. Designed as an open system, *protoDECK* is both physically and behaviourally a modular system developed to embody multi-modal interaction, and to be adaptable to the research and education needs of *protoSPACE* 3.0.

The *Quasar* series (2007-2013)[7], which included *Quasar* (2007)[8], *Quasar 2: Star Incubator* (2012)[9], and *Quasar 3 [danger du zero]* (2013)[10] was an iteration of immersive interactive light and sound installations realized in collaboration with Los Angeles-based architect Jean Michel Crettaz and various other collaborators. The name of the series is derived from a mysterious astronomical occurrence, known as quasars, which are understood to be extremely ancient and highly luminous events that occur in the furthest known reaches in our known Universe. The significance of quasars to the work is that they represent the edge of what can be seen and known, they are a demarcation of our epistemological horizon.

An interactive sound layer was developed as part of Philip Beesley's sculpture, *Sybil* [11] for the 18th Biennale of Sydney, June 27 - September 16, 2012. *Sybil* fuses textile based sculpture, distributed computing, mechatronics, and living chemistry. *Sybil* is an iteration of Beesley's *Hylozoic Series* [12]. The installation is articulated with a variety of intricately designed and fabricated biomimetic sculptural objects that are kinetic and respond to the presence of overseers in the exhibition space. These responses trigger change reactions of behaviour that propagated throughout the installation. The interactive sound layer involved a 12-channel, peripheral speaker system that monitored the sculpture's internal communication network and triggered global audio events that generate higher order emotional responses within the work.

Motivation

The motivation behind creating *homunculus.agora* was to explore the emotive connections we form with the technological objects we make. I believe we form these connections because the technology we make is part of our ideas, our culture, and our bodies and therefore is part of ourselves.

In legend a homunculus is an alchemically made creature that looks like a miniature of its creator. There are several recipes for making a homunculus, but they all commonly call for the use of the creator's ejaculate as part of a potion in which the homunculus is grown. After the creature is a fully formed homunculus, "…he comes out and puts himself at your service. And they never die. Imagine: they'll even put flowers on your grave after you're dead!" [13]

Conceptually, we form similar connections with our own technological creations as the alchemist did with the homunculus. A product of our culture, technology, in turn, shapes our culture, our minds, and our bodies, having a lasting impact on the organization and manipulation of our World. As we pass on the technology remains, it holds our thoughts and extends our impact beyond the grave to future generations.

The plan of *homunculus.agora* is a reflection of the *Ontario Green Belt* [14], which is a protected horseshoe shaped zone that surrounds the Greater Toronto Area (*fig. 2*). *homunculus.agora* responds to this non-urban territory recognizing it as techno-symptomatic of the urban condition. The *Green Belt* is in part designated as a "wild" (i.e. non-human) zone, in part agricultural, motivated by the desire to strike a balance between nature and human development. The *Green Belt* can be understood as a homunculus in itself, as it is a territory that has been constructed through human intervention, taking its shape based on existing (and anticipated future) urban population growth and development. Although the establishment of the *Green Belt* is motivated by the desire to strike a balance between nature and human development, this territorialisation takes its shape based on existing human development and is constrained by the future needs and ambitions population growth and development. This is not intended to be a criticism of the motivations behind the *Green Belt* per se, rather it is an observation that the formation of these zones is an extension of innovation and technology, and in turn an extension of ourselves. In this manner, human territorialisation/extension covers the entire planet. No stone is left unturned, nothing is unaccounted for.

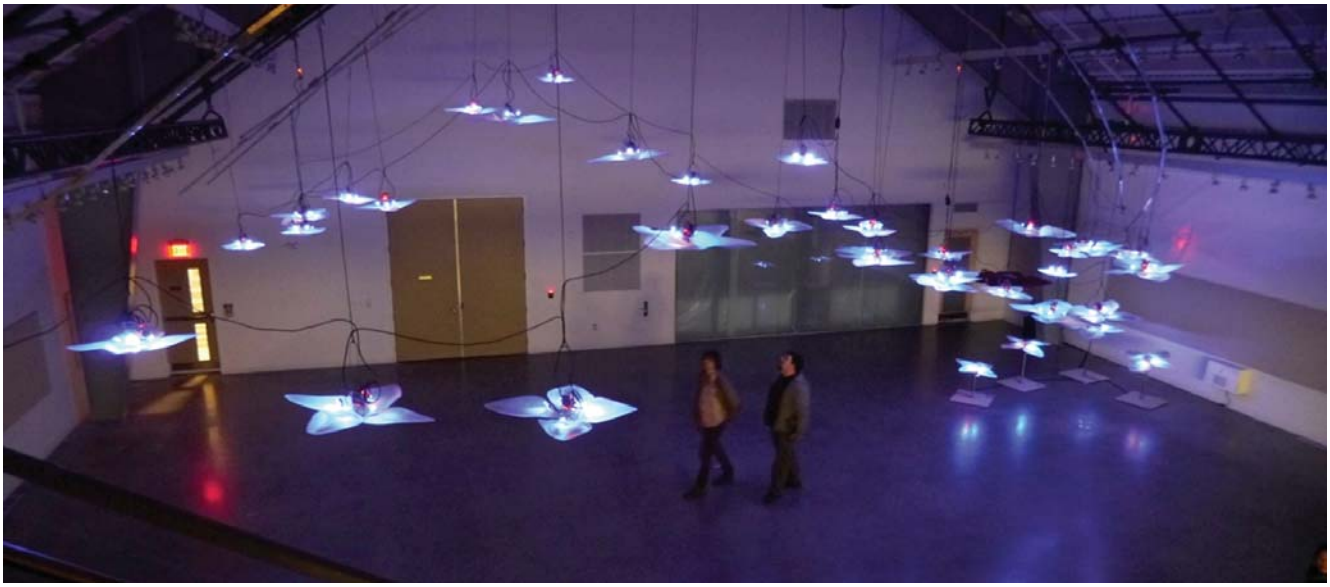

Figure 2. The plan is most observable from the balcony above the work. ©2014 M.D. Hosale

Technical Description

The sculptural bodies of *homunculus.agora* are computationally derived, digital forms built as part of a file-to-factory digital fabrication process that involved generative modelling, CNC milling, and casting of a fibre-composite exoskeleton in the York Digital Sculpture Lab (YDSL) and nD::StudioLab. The fibre-composite endoskeleton is translucent and is embedded with dynamic lights causing it to glow from behind. Loudspeakers are embedded in each of the petals of the homunculi, giving a musical voice to its behaviour. Each homunculus exhibits a continuous flow of ever-changing light patterns and sound events, which is an individual expression of their life cycle based on the generative logic of the work.

Behaviour

Behaviourally, the *homunculus.agora* installation can be understood as a simulated ecology, and is therefore a reflection of the *Green Belt* in behaviour as well as in form. The concept of ecology is present in the social interaction that the work facilitates, as well as in the behaviour of the light and sound events in the sculpture itself. As described above, the term *agora* is a Greek word describing a place for gathering [15]. In this context the *homunculi* gather in the museum to facilitate an exchange of emotive expression in a behavioural ecology of light and sound. It also serves as a gathering place for people to reflect on the reciprocal connection we have with the environment and the world around us. It is a context for a marketplace of ideas.

The life-cycle behaviour of *homunculus.agora* consists of a continuous cycle of high and low energy activity that mimics resting and wake rhythms in living beings. The generative logic and its behaviour are executed by a central computer that interfaces with an *n*D::node, described below.

When unattended, or simply observed, *homunculus.agora* exhibits a continuous flow of ever-changing light patterns and sound events, which are an expression of the life cycles that make-up the generative logic of the work. A subset of the homunculi were mounted on the floor and fitted with sensors to make them responsive to a person's touch. When someone touches the petals of one of the floor pieces it responds with a display of localized light activity near the location of contact and with a corresponding sound. This display is the expression of pleasure that starts as a localized event, but soon dissipates throughout the cluster of the *homunculus.agora,* merging the individual oscillating life cycles of the cluster together. Each petal-like limb is stimulated independently from another allowing for several people to interact with the work simultaneously.

The experience of interacting with a homunculus is like communing with an affectionate creature that expresses itself through a visual-musical language. To deepen this connection a *homunculi* is an interactive sculptural object that is intended to exhibit an affordance of play. This is achieved through the multi-sensory expression of the *homunculi*'s simple animal-like behaviour through the modalities of sound and light; and through responses to the caresses on its shell-like body when being touched.

Fabrication and Form

The sculptural bodies of *homunculus.agora* have an uncanny organic quality consisting of four petal-like limbs that have appearance of being fleshy, plant-like, and artificial in the same instance.

Inspiration for the shape of the pieces came from the illustrations of Theodor Kerckring (1671). Kerckring who was among a group of thinkers in historical medical practice, known as *ovists*, that believed embryogenesis of humans begins exclusively in the egg, and that humans are fully formed from the beginning of conception (*fig. 3*) [16].

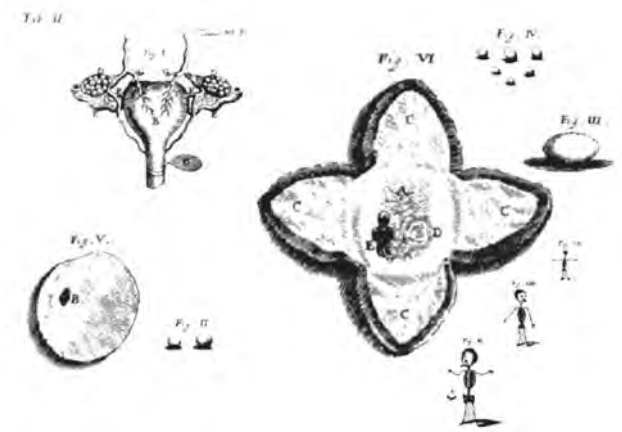

Figure 3. Theodor Kerckring's drawings of the "little man inside the egg." Images taken from Kerckring, Theodor. *Anthropogeniae ichnographia*. Frisius, 1717. *Images are public domain.*

When designing the sculptural bodies it was important to consider how the forms physically related to the human body so that they would be relatable to the human experience. Five forms were generated as polymorphic mutants of the same species in *Rhinoceros 3D* modelling software (*fig. 4*) [17]. Then negative moulds were milled using a large CNC-mill located in the YDSL. What followed was a painstaking manual process whereby the pieces were cast in a low VOC bio-based resin called *Super Sap* by Entropy Resins [18], using a sustainable fibre composite substitute for fibre glass called *Aqua-Veil* by Aqua-Resin [19], and assembled by hand over the course of several weeks with a team of six people. It was purposefully not a factory precision process. The manual assemblage of the pieces gave rise to further mutations in the pieces, so much so that no two are exactly alike, lending to the organic look of the work (*fig. 5*).

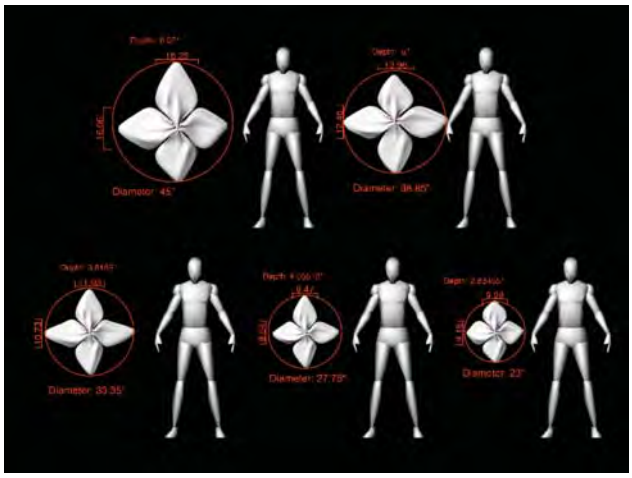

Figure 4. A screen shot from *Rhinoceros 3D* showing how the five base forms used in the work in scale to a 5'10" human body. ©2014 M.D. Hosale

homunculus.agora exists as a cluster of 41 sculptural bodies suspended in the gallery space at the Markham Museum in an area of 18 x 9 meters. Each individual of the cluster varied in size and shape, but are approximately 75 - 175 square centimeters in diameter. While the sculptural bodies were statically suspended in the gallery, the shape of the cluster has directionality and undulates like a wave or fluid system, which is intended to give the feeling of movement and energy. As described above, the plan of *homunculus.agora* is a reflection of the *Ontario Green Belt*, which surrounds the Greater Toronto Area (*fig.2*).

Figure 5. A series of images showing the fabrication process of *homunculus.agora*. *A total of 168 forms were cast and sculpted to make 42 pieces.* ©2013 M.D. Hosale

Hardware System

homunculus.agora uses a custom designed microcontroller platform, called the *n*D::node [20], to control its behaviour. An ongoing research project, the *n*D::node is a low-cost, *Arduino*-based hardware platform [21] developed to facilitate the creation of scalable, component-based media art works at architectonic scale. The *n*D::node forms a networkable system capable of handling hundreds of nodes that can be spread over large distances providing control (via LED's and actuators) while receiving real-time sensor data from the local environment (*fig. 6*). The result is a high-resolution bidirectional feedback system that can be embedded in the material systems of architectonic objects. The inspiration for the development of the *n*D::node stems from the problem that currently there are no low cost, ready-made, off-the-shelf solutions for the deployment of large networks of micro-controllers that can communicate with each other and/or with a central computer system bi-directionally. Systems that do exist are generally high cost, proprietary, and complicated to use, and as such, they are out of the grasp of most media artists and architectural researchers. To this end, the *n*D::node is being developed as a low-cost, readily deployable, open-source solution. *n*D::nodes bridge the divide between the virtual and physical by providing a ready to use platform for sensing and actuation that can be used in conjunction a wide rage of projects that require these technologies. *n*D::nodes could be integrated in every aspect of the Interactive Digital Environments facility, including the walls [22], ceiling, floor [23], and in stand alone objects in the space. Results from this work could be equally applied to large scale installations and related projects that require large arrays of localized sensing and control, such as those found in the fields of architecture, media arts, exhibition development, and related creative industries.

Figure 6. Overview of the *n*D::node system as used in *homunculus.agora*. ©M.D. Hosale 2014.

*n*D::nodes are developed to be a modular with the intention that the modules can be used to adapt to different projects easily. In previous projects modularity happed at the level of design and once manufactured the modules were populated on a single circuit board, such as with the *QYUnode* used in Quasar 2 and 3 (*fig. 7., right)*. However, in *homun-*

culus.agora this approach was not feasible due to the small space constraints of the piece and the larger circuit needed. So, it was decided to move some of the modules (such as sound, light, sensing) off board resulting in the system pictured above. Moving to this multi-board modularity has other advantages as it allows for different *n*D::nodes to have different arrangements of modules in the same system, and it allows for rapid prototyping of future projects due to the reconfiguration of existing modules, and its easy interfacing to new modules and prototype circuits.

The result is a system that is, topologically, very similar to the system developed by Robert Gorbet and Philip Beesley for the *Hylozoic Series* and related projects [24]. However, there are major differences in the communications system and the logic and organization of the boards, which I will not elaborate on here. However, it is noteworthy to acknowledge that 1) the *n*D::node is compatible with the *Hylozoic* system as it was integrated into the *Hylozoic* system for the purposes of a performance given at DEAF 2012 [25]; 2) there has been a sharing of ideas of the design of the boards and the technical details; and 3) while the two projects have developed independently (even before I ever met Beesley) there was clearly an influence of the *Hylozoic Soil* system on the design of *n*D::node having read their publications and analyzed their work.

Figure 7. previous versions of *n*D::node used in other projects in chronological order from right to left. ©M.D. Hosale 2014.

Software System

The challenge of developing nonlinear interactive systems in my work has led me to the ongoing development of a software framework, called *WorldMaker Universe* (WMU). The inspiration for the development of WMU was to provide a strong connection between the hardware, software, and conceptual components of my research in order to maintain a fluid connection between the virtual and physical aspects of my work [26]. The framework facilitates the creation of expressive and emergent behaviour in interactive installation environments by encapsulating common use elements of the software design of interactive environments into a ready to use set of abstractions. The organization of this framework is based on a model of nonlinear narrative that is a composite of operations (data generators), structures (scaffolds for data flow), and personae (the interactive input and output representation of data). Each of these elements can vary independently of each other. Many of the concepts and terminology that help define this framework are taken from design patterns, as used in computer science, such as those found in *Design Patterns: Elements of Reusable Object-Oriented Software* [27]. This system proved beneficial in the development of the behavioural aspects of the work described above.

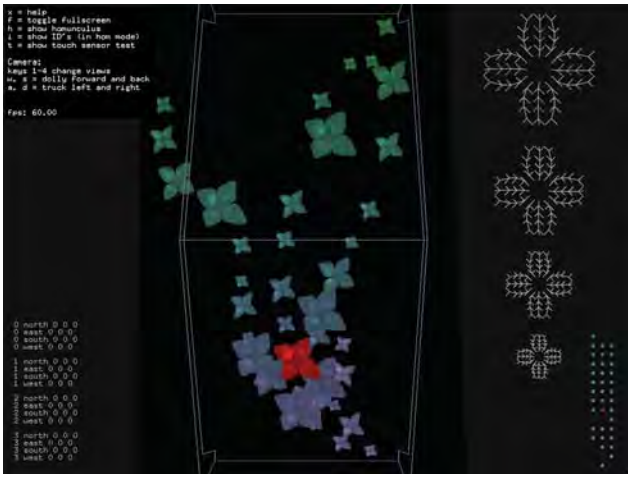

Figure 8. *homunculus.agora* software with the simulation and design for *Apple Mac*. ©M.D. Hosale 2014.

The software was developed using *OpenFrameworks* a C++ framework for the development of computational art [28]. *OpenFrameworks* facilitated the deployment of the software on multiple platforms, which proved beneficial for both prototyping and dissemination. One of the challenges of the work was the duration of the install (collectively for a year from September 2013 - August 2014). This meant that there would need to be a central control system for the installation that was robust but affordable. Another issue during this period was difficulty in travelling to the museum on a regular basis to update and monitor the piece. Therefore a software workflow was developed for the installation that included simulation, behavioural design, and deployment in the same code base. For speed and convenience a simulation and design version was developed for the *Apple Mac*, which allowed for development of the behavioural patterns remotely (*fig. 8*). And despite the vast differences between these the computing platforms, the deployment target platform was a *RaspberryPi Model B* [29] (*fig. 9*), which was low cost and had a small form factor. The software workflow was effective, but didn't entirely alleviate the need to travel to the museum for refinements of the system. Currently efforts are being made to connect the two platforms over the Internet so that updates can be made to the system without being onsite. A significant technical challenge, and assuming it is solved it will allow for newer topologies that will effect the dissemination of this and newer artworks, such as telematic interfacing between users and the work, and the work with other works.

Summary of Exhibitions

Land|Slide Possible Futures

homunculus.agora was commissioned by curator Janine Marchessault for the *Land|Slide Possible Futures* exhibition, which took place at the Markham Museum, Markham, Ontario, Canada, from September 21st to October 14th 2013 [30]. *Land|Slide Possible Futures* featured over 30 artists who were invited to respond to various themes related to urbanism in the context of a heritage museum in the Greater Toronto suburb of Markham.

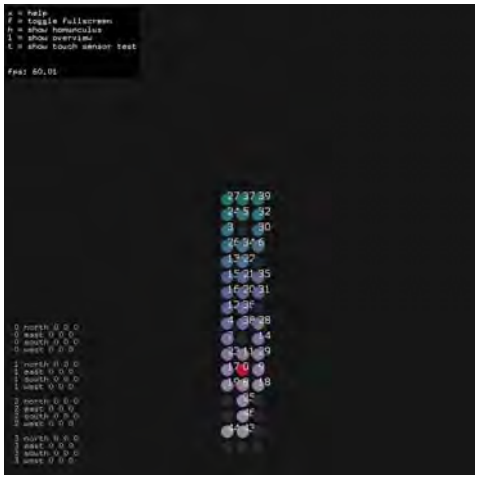

Figure 9. *homunculus.agora* software, deployment version for *RaspberryPi Model B*. ©M.D. Hosale 2014.

Farm To Table

homunculus.agora was asked to remain in the Markham Museum in order to be part of the *Farm To Table* exhibition from January 31st to August 17th, 2014 [31]. *Farm To Table* was an interesting exhibition in that it featured three artists along with a variety of historical and educational displays centred on the theme of food production. *homunculus.agora* was asked to contribute to the exhibition because of the work's connection to the Greenbelt and its agricultural activities.

homunculus.alpha (h.α)

homunculus.alpha (h.α) was presented at the *re-new 2013*, *Digital Arts Forum* from October 28 - November 3 at PB43, Copenhagen, Denmark [32].

homunculus.alpha (h.α) is a single sculptural body that served as a prototype to the larger cluster that appeared in the Markham Museum. Although chronologically the alpha was shown after the cluster was mounted, it was in fact the first one created. It served as the basis for the largest pieces in the cluster. I was interested in showing the single object for reasons of transportability and simplicity, but also was a context to see what kind of emotive connections could be derived from the individual. The results were mixed, but the effort proved useful, as there were a number of technical and behavioural problems that had to be solved before the piece was even able to be mounted that ended up influencing the development of the larger cluster as a whole.

Conclusions and Future Work

homunculus.agora is intended to be an adaptive work that can be installed in many kinds of situations. In the future it would be interesting to explore different configurations and topologies for the work such as exhibiting it in smaller, more intimate rooms, or building it up from the floor, rather than suspended, and other shapes entirely. In terms of the behavioural qualities it would be interesting to extend the sensing to be responsive to real-time environmental data as well as the surrounding ecology. Unfortunately, as of the writing of this text there is no current plan to exhibit the work further, but the development of the core technologies that made this work possible, such as the *n*D::node and the *WorldMaker Universe* (WMU) are under continuous development. Because of the advances in the simulation software and the modular hardware, *homunculus.agora* will prove to be a fertile development context for the *n*D::node and the WMU for foreseeable future.

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Author's Biography

Mark-David Hosale is an artist and composer who use technology as a means of expression. Mark-David has a Ph.D. in *Media Arts and Technology* from the University of California. He is an Assistant Professor in Digital Media in the *School of Arts, Media, Performance, and Design* at York University, Toronto, Ontario, Canada. He has had works exhibited and performed internationally at conferences, universities, and festivals; and has given lectures and taught at institutions in Denmark, The Netherlands, Norway, Canada, and the United States. The connecting tissue of his interdisciplinary interests lies in his exploration of nonlinear narrative as a representation of information, time, and space. His research and work also explores the boundaries between the virtual and the physical world. Whether as part of an installation or performance work, the virtual spaces he creates are technologically transparent, sophisticated and virtuosic, as well as intuitive to experience and use.

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Noise Square: Physical Sonification of Cellular Automata through Mechatronic Sound-sculpture

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Abstract

As Burraston and Edmonds state, "creating patterns and sequences is necessary for the creative artist working spatially and temporally within a chosen medium". [1] Accordingly, cellular automata's capability of creating a wide range of evolutionary and generative patterns has made them of special interest to musicians and sound artists. While this has led to a great number of works of sound art and music that integrate generative patterns of cellular automata in one way or another, the sonic output of these works has been primarily retained within the realm of electronically produced sound. Followed by a concise overview on a selected number of these works, this paper presents a proposed audiovisual installation in which cellular automata is incorporated in the medium of mechatronic sound-sculpture, where the sound is generated physically and in the acoustic realm, through a mechanical apparatus.

Keywords

Generative Art, Cellular Automata, Mechatronic Sound-sculpture.

Introduction

Cellular Automata (CA) were originally introduced in the 1960s by Stanislaw Ulam and John von Neumann in the course of their studies on growth and reproduction processes. [2] They are a dynamic system in which time and space are discrete. Considering that music is a time-based system in which "a finite set of discrete values (e.g. musical notes, rhythms, etc.) evolve in space and time", cellular automata are highly applicable to musical systems. [3]

Cellular automata are comprised of one or multiple dimensional arrays of cells. Each cell can have a finite number of states (e.g. dead or alive), which are determined by simultaneous local transition rules. Transition rules are extracted from configurations of a neighborhood of cells of specific length or range or the cell's previous state. According to Dale Millen, in the context of a musical composition based on cellular automata, the composer can select or define each of the features above (i.e. the number of dimensions, cells, and states, the range, the type of transition rules, and the initial state of the system). [4]

The first instance of cellular automata used in music is perhaps Iannis Xekanis' composition *Horos* (1986). According to Varga, Xenakis was particularly interested in using the simplicity of cellular automata process to create complex and sophisticated results. [5]

Related Works: Cellular Automata in Music

An overview of different approaches in applying cellular automata to the production of electronic music and sound art is given in Burraston and Edmonds' article in *Digital Creativity* journal, sound synthesis and MIDI sequencing techniques being the prominent methods. [1] LASy and Chaosynth are two noteworthy examples of using cellular automata in sound synthesis. The properties of these synthesizers are examined in detail by Miranda. [3]

The utilization of cellular automata in the MIDI domain is discussed in "Cellular Automata in MIDI based Computer Music" by Burraston et al. [7] There has been an extensive body of work dedicated to the design and development of MIDI-based cellular automata systems. Beyls, Millen, and Miranda were some of the early pioneers in this field who contributed to the movement from slightly different angles. As one of the first composers to experiment with cellular automata, Beyls investigated one-dimensional and two-dimensional cellular automata to develop systems equipped with a MIDI mapping process for both non real-time and real-time compositions and performances. [8][9][10] Millen and Miranda investigated systems (CAM and CAMUS) that were primarily based on two-dimensional and three-dimensional models of Conway's Game of Life, this itself being the best-known example of two-dimensional cellular automata. [11] The characteristics and functionality of these systems, in addition to a number of other significant MIDI-based cellular automata compositional platforms are discussed and compared in detail in Burraston's article. [7]

In an instance of using cellular automata in an audiovisual installation, Bill Vorn utilized a two-dimensional cellular automaton inspired by Conway's Game of Life, in his work *Evil/Live* in 1997. [12] An 8×8 grid of cells represented by light bulbs were attached onto an aluminum structure, and the light patterns were constantly changed according to the cellular automata activity governed by the computer. Each light bulb also corresponded to an audio event that was generated by a sampler. The audio patterns were triggered via MIDI messages and played back

through the loudspeakers that were also attached to the aluminum structure. Vorn has expanded this work into *Evil/Live 2* and *Evil/Live 3* by increasing the number of matrices and cells and adding new levels of interaction.

Another example of using cellular automata in an installation work is Alan Dorin's *Liquprism.* [13] *Liquiprism* was an interactive piece, based on the idea of generating polyrhythmic patterns through six different two-dimensional cellular automata that formed facets of a cube. Dorin's goal was to highlight the conceptual conflict between the inherent regularity and determinism of cellular automata, and the resulting complexity and fluidity that can be obtained by their interaction. Here, the sonification is accomplished through connecting *Liquiprism* to an analogue modeling synthesizer with the triggered sounds varying between simple squelchy tones and pure sine tones: "Each face of the cube is assigned a different MIDI channel and each of these is assigned a different voice on the multi-timbral synthesizer". [13]

In a rather rare instance of using cellular automata in an interactive live-performance involving musical robots, where the sonic output is a result of a physical process rather than a digital one, Jingyin He has applied the two-dimensional Game of Life cellular automata onto a grid-based MIDI controller in order to interact with a number of mechatronic idiophones and membranophones (The Karmetik Machine Orchestra). [14][15]

In his 1990 article "Generative Processes and the Electronic Arts", Alan Dorin mentions the wind-chime as a physical example for such generative process-based systems. [16] Yet, referring to the physical processes as 'exceedingly complex' and difficult to control, Dorin argues that the computer "provides a practical alternative for the artist interested in exploring generative processes". [16] That is perhaps one of the main reasons underlying the occurrence of the great majority of the instances of using cellular automata in music in the electronic sphere.

Noise Square: an Audiovisual Installation[1]

With the rapid developments of DIY technologies in recent decades, it is now possible more than ever before, to achieve a well-defined and highly controlled sonic output through a mechanical process and in a physical manner. The integration of mechatronic systems coupled with micro-controller programming in works of music and sound art has grown largely over the past few decades, and has led to an extensive body of work, ranging from complex robotic models of conventional musical instruments to reductionist and minimalistic sound-objects and sound-sculptures. [17][18] The programmability and autonomous capabilities of these systems, in addition to their high degree of responsiveness and predictable functionality calls for their utilization in the context of generative art. The proposed installation, *Noise Square,* is an audiovisual work in which generative patterns of a 1D cellular automata are sonified through a set of four mechatronic sound-sculptures entitled 'Mutor', developed by the first author.

Mutor

Mutor[2] is a sound-sculpture in which "the sound of a DC motor is controlled and manipulated through mechatronics and microcontroller programming, in terms of frequency, timbre, and amplitude". [17] As shown in Figure 1, the instrument is comprised of a DC motor enclosed in a transparent acrylic cube with a pivoting side, a push-type solenoid attached to the edge of the pivoted side, and a small LED light panel mounted on the back of the cube. Microcontroller programming is used to control the motor's rotation speed, solenoid movements, and light panel's luminosity. The communication is performed via MIDI messages and different MIDI velocity values create different speeds of rotation, and therefore, a range of different buzzing tones, whereas solenoid's binary actuations fed by MIDI note-on and note-offs result in shutting and opening the door, modulating the amplitude and timbre of the noise in a rhythmic manner. The LED panel contains three bright LEDs that are connected in series and corresponds to the solenoid inputs, lighting the Mutor on and off synchronously.

Figure 1. A set of four Mutors

The corporeal existence of Mutor as a sound-sculpture, in addition to its organic and bodily way of sound production, which is visually accentuated in synchronous LED light patterns, paves the ground for its placement in an installation setting, where physical and visual elements of the work are of great prominence. On the other hand, the privilege of autonomy provided by the use of mechatronics and microcontroller programming enables the possibility of having multiple units of Mutor programmed to function in an autonomous ensemble scenario. As a result, considering the gird-based structure, binary behavior, and outstanding visual manifestation of cellular automata, they can be exploited as highly harmonious compositional platforms in

[1] Video documentation of the demo realization can be found at: http://vimeo.com/114290748

[2] http://www.m-h-z.net/mutor

this context, creating the opportunity to employ an ensemble of Mutors in the self-governing and generative setting of an audiovisual installation.

Realization

Noise Square employs a set of four Mutors, placed next to each other in a row. A one-dimensional cellular automaton of four cells with the neighborhood range of one is used as the generative input source, each Mutor representing one of the cells. A grid of 4×15 cells—whose sizes are mapped to the dimensions of the Mutors—projected on a screen (or the wall) behind the Mutors, in addition to the row of Mutors itself, would be displaying the states of 16 sequential generations of the CA at all times (Figure 2).

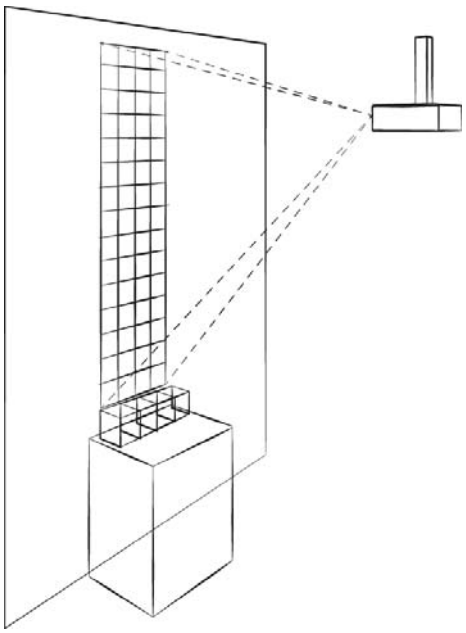

Figure 2. *Noise Square*: the set-up.

As the CA develops, the generations (rows) continuously step through the grid from the bottom (Mutors) row to the top of the grid, as the cell states in the bottom row determines the status of the Mutors. Therefore, four columns of the grid can be thought of as four vertical step sequencers constantly driving the instruments. Initially, a random ruleset (among the 256 possibilities) is applied to the CA, and its corresponding number is scaled down to the range of 0 and 127. This scaled number is then used as the input values for the motors, creating a rich and continuous drone chorus. A live (white) cell creates a MIDI message with the velocity of 127, which then lights the Mutor on, and causes the solenoid to push out and open the cube's door. A dead (black) cell creates a MIDI velocity of 0, turning the LED panel off, and returning the solenoid to rest position, which shuts the cube's door (see Figure 3). The CA develops at the rate of 8 generations per second, giving each step the duration of a 16^{th} note in a BPM of 120. Every 64 steps, the CA rules is reset to another randomly chosen rule, changing the tone of the motors, and the CA's evolutionary behavior that determines Mutors' rhythmic patterns.

Figure 3. *Noise Square*: demo realization.

Discussion

From a conceptual perspective, Mutor aims to draw attention to the sound of a DC motor by removing it "from its everyday context where it is unwanted and ignored", flaunting its physical presence, and making it more accessible through the binary and metric rhythmic patterns. [17] Therefore, it can be argued that although using a different medium, Mutor somehow employs the same conceptual agenda as many contemporary examples of digital glitch music: that is to use grid-based and pulsating rhythms in order to bring the ignored and unwanted aural artifacts of modern technologies to the foreground, making them accessible, and appreciated. [19] Accordingly, the instrument is designed in a way that makes it perfectly capable of creating recurring motions and pulsating rhythms. The effect of these grid-based rhythms is perceived as subtle, but highly ordered timbral modulations of the motor's noise, and punctuated by the percussive sounds caused by shutting of the cube's pivoting door. In this way, Mutor aims to create a platform to explore the potential aesthetic values of a DC motor, by regulating its noise timbrally, and "musicalizing" it on a rhythmic grid. As noise philosopher Jaques Attali argues, what all kinds of music have in common is "the principle of giving form to noise". [20]

With this in mind, in a context where grid-based rhythms are of essential prominence, the grid-based structure of cellular automata gives it an edge over the other algorithmic and generative methods. Cellular automata in fact share the very structural essence of the Mutor's temporal scaffold, i.e., employing basic binary elements to create a much more complex output. Furthermore, the minimalistic, cubic, and grid-based form of Mutor along with the synchronous square light panels sit perfectly with the black and white cells of the cellular automaton grids in terms of aesthetics. Considering the visual significance of an audiovisual installation work, this concrete and visionary connection between the instrument and the input source

can further strengthen the audiovisual expressivity and tighten the semantic-syntactic relationship.

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Authors Biographies

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Ajay Kapur is currently the director of Music Technology at California Institute of the Arts. He received an interdisciplinary Ph.D. in 2007 from University of Victoria with a focus on intelligent music systems and media technology. Kapur graduated with a BS in Engineering and Computer Science from Princeton University in 2002. A musician at heart, trained on drumset, tabla, sitar and other percussion instruments from around the world, Ajay strives to push the technological barrier in order to explore new sounds, rhythms and melodies.

[Session 26]

Robots

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Augmenting Virtual Worlds with Musical Robotics

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Abstract

This paper introduces the concept of augmenting the experience of interacting with virtual worlds by making use of musical robotics systems. By creating or interpreting real-time control data from the music and sound-effect channels of interactive software while it is being used, signals for controlling robotic musical instruments and other acoustic sound-creating devices can be generated. These acoustic instruments add a physicality to virtual environments by bringing previously virtual sound into the real world. A proof of concept is described, making use of a set of custom-built robotic pitched and non-pitched percussion instruments playing in conjunction with a well-known vintage video-game. The system is presented as an installation of kinetic art and sound for participants to experience. The design of the robotic sound-objects, their control systems and the software used is described and the paper concludes with an outline of future work and a summary of some of the many potential applications for this technology.

Keywords

Virtual Reality, Video Games, Music, Sound Effects, Musical Robotics, Solenoid, MIDI

Introduction

Musical robotics is an emerging, multi-disciplinary field which combines the arts with engineering and involves actuating physical sound-making apparatus with computer control as a means of musical expression. By utilizing robotic musical instruments and sound objects, musicians are able to create compositions and installations in real acoustic space that were previously impossible to play by human performers or loudspeakers. Whereas sampled sounds are reproduced perfectly upon playback, acoustic instruments will exhibit slight variance upon each actuation even when activated in the same position and velocity. This naturally provides a sense of realism and authenticity to the experience of listening to them.

One important element in the motivation for making use of musical robotics, is that they have the ability to be synchronized reliably with other instruments in an ensemble or installation as well as with other types of media. In this paper, an installation is described which demonstrates the synchronizing of custom-built robotic musical apparatus with video game worlds to provide players with a novel experience that sees in-game sounds and music leap from the virtual world to the physical world. First, a background which briefly provides some historical context to this work will be offered, before describing the installation presented. Details regarding the design and construction of both the hardware and software elements of the installation are discussed, and the paper is concluded with plans for future work to be carried out and a summary of potential applications for this technology.

Background

The field of automatically actuated musical apparatus has a long and rich history spanning hundreds of years, with its period of greatest popularity in the 19th century with the prevalence of sophisticated orchestrions and player pianos. In the early 20th century primarily due to the rise of the loudspeaker, automated musical instruments experienced a period of decline. However in the 1970s, the affordability of transistors and computing technology brought musical robotics pioneers such as Trimpin and Godfried Willem Raes to create robotic sound objects and musical instruments capable of being controlled in real-time for installations and concerts. The advent of the MIDI standard in 1983 brought about a new level of interconnectivity and synchronization to these instruments, and in the over 30 years since, the field has expanded to include countless practitioners world-wide. 1 and 2 provide further detail into the history of the field.

There are several historic examples of acoustic sounds augmenting game-play experience. Since gambling games and pinball machines of the 19th and early 20th centuries were mechanical by nature, the sounds of their various components such as motors spinning, clicking and sliding added to the aural experience of the game. A landmark development was Pacific Development's 'Contact' pinball machine produced in 1933, which introduced an electro-mechanically activated bell to indicate game states favorable to the player. 3 As video-games began to utilize exclusively loud-speaker generated audio in the 1970s, much of the mechanically produced sound from previous generations of hardware was replaced with virtual reproductions and synthesized sound.

Musical Robotics and Virtual Worlds

In recent times, there have been renewed developments towards using physically actuated sound to augment the experience of virtual worlds. One striking example is OccultUs by Simon de Diesbach. 4 This installation makes

use of the Occulus Rift virtual reality headset, and asks the participant to sit on a chair in a room surrounded by various mechanical devices with the headset on. The software guides the participants on rails through a virtual world filled with several rooms of 'strange machinery' which are activated by the user's gaze. The various kinetic sound objects in the real room, such as a machine that drops glass to break it, a machine that spins a tube of marbles and one that drags chains on a metal floor are then synchronized with the machines in the virtual world to create a perception that the virtual objects are creating a real sound. Though the effect achieved is vivid, the level of interactivity in this installation is limited, with the participants somewhat passively experiencing the content rather than truly interacting with or creating it.

Another recent project that is closer in scope to the installation presented in this paper is a setup by David Thompson. 5 Making use of two Raspberry Pis, a commercially produced amaha Disklavier and several solenoids, David is able to have the sound of several Nintendo games reproduced during game-play on an automatic piano and several percussion instruments. Due to the process used to translate the game-play audio to control instructions, this setup has the drawback of introducing a half-second delay between the in-game actions and the resultant sounds, and incomplete control of the sound mapping. The installation described in this paper seeks to create an experience that builds on these previous efforts and improves on their various limitations.

The Installation

An installation is presented, consisting of a television screen, Nintendo Entertainment System (NES) controller, Robotic Xylophone, Robotic Glockenspiel, Robotic Egg-Shakers and Robotic Castanets. When a participant picks up the controller, they are greeted with the welcome screen of the famous Super Mario Bros. NES game and are able to play the game freely on the television screen. During game-play, the original synthesized audio of the game is muted, the sound effects and music being replaced and reproduced entirely by the array of robotic musical instruments decorating the installation. The game Super Mario Bros. was selected for the instant recognizability of its theme music and sound effects, even for non-gamers. By choosing a game with very well-known sounds, the effect of their substitution with alternatives in the physical world creates a greater impact on participants and aims to let them re-imagine experiences from their earlier years in a new light. The designs of the various components of the system are described below.

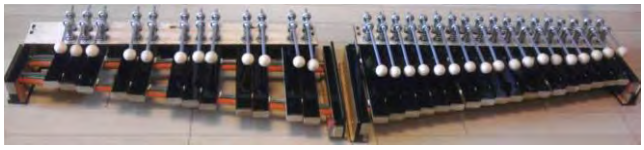

Figure 1: The Robotic Xylophone

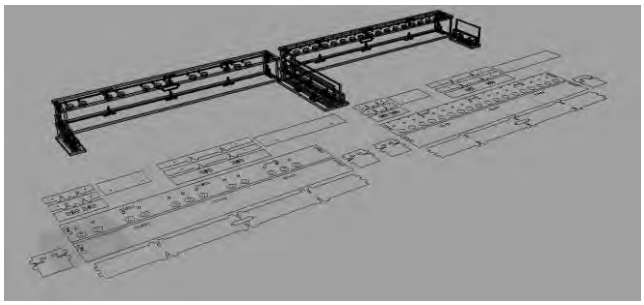

Figure 2: CAD Design of the Robotic Xylophone

Robotic Xylophone

This robotic xylophone was built around a commercially produced amaha xylophone, and elements of its design were inspired by instruments such as Godfried Willem Raes' Xy automated quartertone xylophone, 6 Trimpin's Conloninpurple installation 7 and Eric Singer's Xylobot. 8 The striking mechanism is based on the 'Trimpin Hammer' design described in 9 . The two sections of the 30-key instrument are independent from each other, and can be placed separately in the installation in order to enhance their spacial effect. The frame is constructed using laser-cut plywood (CAD drawing presented in figure 2), and they are connected to a control box via standard DB-25 cables.

The Robotic Xylophone is the primary melodic instrument in the installation, and actuates the majority of the game's background music and many of the sound effects. It is fully velocity sensitive, able to perform loudly and softly as appropriate, and is able to achieve more than 20 strikes per second per note with an entire system latency of approximately 20 milliseconds.

Figure 3: The Robotic Glockenspiel

Robotic Glockenspiel

The Robotic Glockenspiel repurposes a marching band glockenspiel as a computer-controlled instrument, inspired by other robotic metallophones such as the armetik

Glockenbot [10] and Godfried Willem Raes' Vibi automated vibraphone. [11] It utilizes direct-striking tubular solenoid mechanisms similar to Vibi 's, which allow very low latencies, simple implementation and low levels of extraneous acoustic noise. By positioning the striking mechanisms below the keys of the instrument, it leaves the possibility for it to also be played simultaneously by a human player and allows the participants and audience an unobstructed view of the instrument. After trialing solenoid shaft caps of several varying materials, wooden ones were chosen for their bright but not overly harsh sound. It is also built as a one-piece table top instrument, making it very portable and simple to set up, with a single DB-25 cable connecting it to the control box. This instrument is used in the installation to provide supplementary effects to the music and to create sound effects where a metallic timbre would be appropriate. The most common example of such a sound in the Super Mario Bros. game is the two-toned chime which is sounded when the main character picks up a coin.

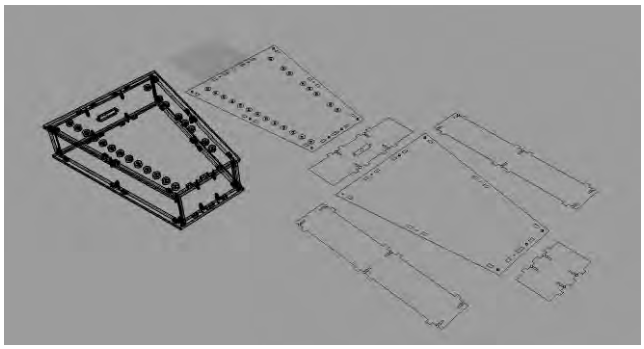

Figure 4: CAD design of the Robotic Glockenspiel

Other Robotic Percussion

To complement the pair of polyphonic pitched percussion instruments, a set of individual un-pitched percussion instruments were also utilized. The set consists of two robotic egg shakers and up to four robotic castanets.

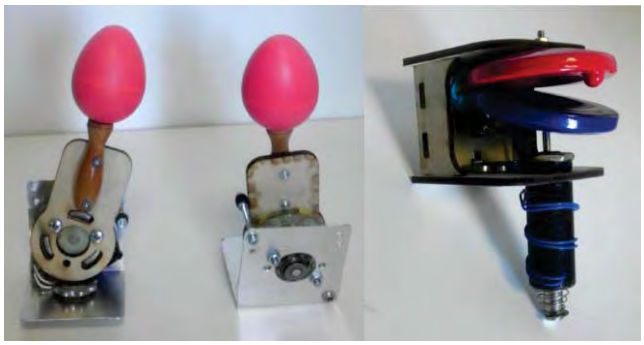

Figure 5: Robotic Egg Shakers (left) and Castanet (right).

Robotic Castanets As shown on the right of figure 5, the Robotic Castanets make use of tubular push-type linear solenoids to strike the bottom side of the castanet against the top side, which is fixed to the laser cut MDF frame. Unlike some other automated castanet machines such as Godfriend Willem Raes' Casta Uno and Casta Due , [12] these are individual devices which are fitted with standard microphone stand nuts. These allow the Robotic Castanets to be separately positioned around the installation space as appropriate for maximum spacial effect. These instruments play some of the percussive elements of the installation's background music, and some in-game sound effects. A CAD drawing of the frame of the instrument is shown in figure 6.

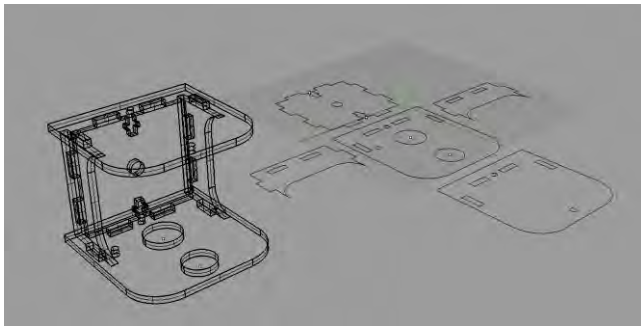

Figure 6: CAD design of a Robotic Castanet.

Robotic Egg Shakers As shown on the left of figure 5, the Robotic Egg Shakers utilize rotary solenoids which generate a side to side motion that is stopped at one side by the termination of the solenoid s movement, and on the other side by a rubber damper. The rotary solenoids have adjustable internal springs that return the egg shakers to their original position after the controlling voltage is removed. As these units are somewhat heavier than the Robotic Castanets, an aluminum mounting bracket was created for added strength, and it can also connect directly to standard microphone stands for flexible positioning in the performance space. These instruments also perform some of the percussion parts of the background music of the installation.

Control Hardware

To control this ensemble of robotic musical instruments, custom controller hardware was created.

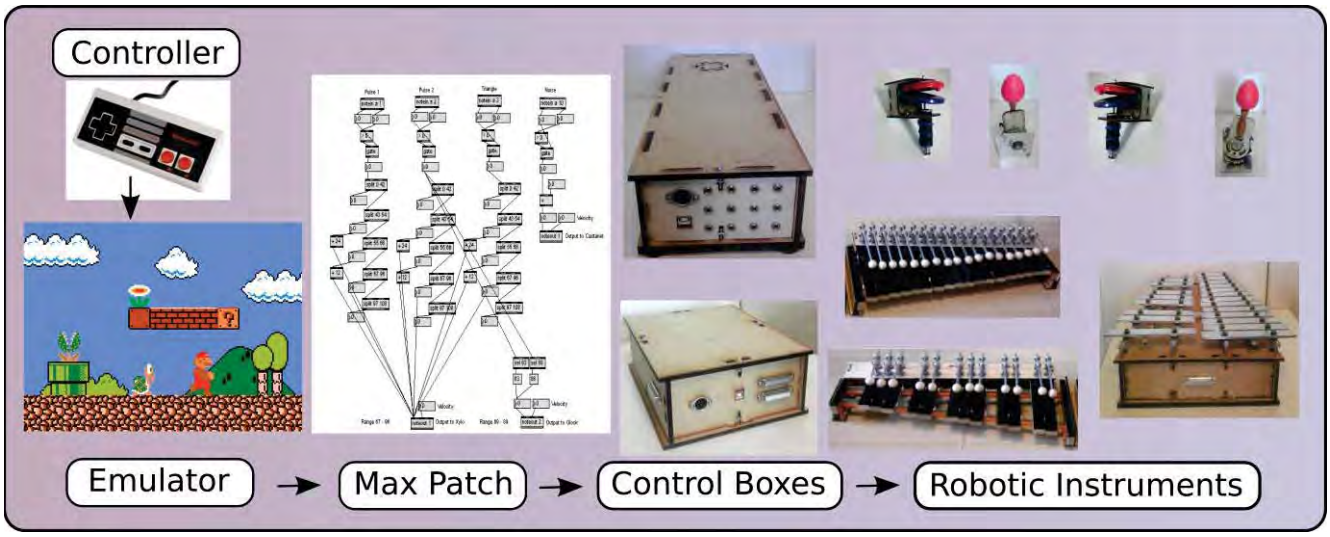

Figure 8: A diagram charting the flow of the musical control signals from the participant's controller to the musical robots.

Figure 7: Modular (left) and Polyphonic Percussion (right) Control Boxes

Modular Control Box A flexible control box as shown on the left in figure 7 is used to send both the transient control signals to the Robotic Castanets and the toggling control signals to the Robotic Egg Shakers via the array of 3.5 mm phono jacks on its front panel. The unit contains a 48v switched-mode power supply, and the logic firmware is based around an Atmel Atmega8u2 microcontroller. This chip carries out the task of receiving MIDI messages from either the 5-pin DIN connector or the USB socket on the panel of the unit, interpreting them, and outputting the necessary control signals to actuate the appropriate robotic musical apparatus.

Robotic Xylophone and Glockenspiel Controller The polyphonic percussion control box shown on the right side of figure 7 is responsible for interpreting the MIDI messages received at its 5-pin DIN or USB ports, and outputting the relevant pulses to the solenoids of the Robotic Xylophone and Glockenspiel instruments by way of the 3 DB-25 ports on its front and side panels. In this case, an Atmega8u2 microcontroller loaded with a recompiled Hiduino firmware [13] carries out the USB-MIDI processing, and the primary microcontroller on-board is an Atmega1280. This chip was chosen due to its high number of general purpose input / output registers, which are utilized to control the 51 solenoids contained in the two instruments. The polyphonic percussion control box is powered by two transformers, one configured to supply 42v for the Robotic Xylophone, and the other configured to supply 58v for the Robotic Glockenspiel.

Software

Since the control boxes outlined above require an input of a MIDI signal to operate, software must be written to convert the musical messages that the Super Mario Bros. game generates into MIDI data in real time. The Nintendo Entertainment System synthesizes the audio in its games by way of an Audio Processing Unit (APU) housed inside its main CPU. The APU is capable of generating 4 channels of synthesized audio. These are 2 pulse waves, 1 tri wave and 1 noise channel. A very rudimentary sampler is also included, but since the contents of the sample change from game to game, that channel is not used in this project. The 4 synthesizer channels each have several controllable parameters such as pitch and length of note, duty cycle (for pulse waves), and a sweep control. These parameters are accessed by setting various registers in the APU s memory. [14]

For the proof of concept of this installation, it was decided that an NES emulator that is capable of outputting its audio data in the form of MIDI messages would be employed. GNes and oshiNES are two pieces of emulator software that were successfully trialed, though since there is more than one way to interpret the NES APU control information as MIDI, each emulator provides differing streams of MIDI information.

In order to distribute the musical information among the notes of the robotic musical instruments in an appropriate manner, a piece of software was written in the Max/MSP visual programming language to receive the MIDI messages from the emulator, filter and translate them, and output them to the hardware control boxes. Some examples of this translation include assigning specific frequencies of the noise channels to trigger the various robotic egg shakers and castanets, transposing melodic content of the tri and pulse wave channels that are out of the instruments ranges into a range playable by the instruments, and mapping certain key sound effect notes to corresponding instruments. The signal flow from the participant's controller to the triggering of the robotic musical instruments is presented in figure 8.

Future Work

Though the proof-of-concept which uses emulator software to interpret in-game sound messages successfully fulfills the intended purpose of the installation, since it relies on the author of the emulator's interpretation of the sound data stream, there is some flexibility sacrificed. It is for this reason that the next iteration of the work's implementation plans to make use of the original NES console with microcontroller mounted inside the unit to intercept the data lines of the APU directly and generate a MIDI output from inside the enclosure. This will result in 3 improvements. Firstly, it will remove the dedicated MIDI translation running PC from the installation making it simpler, more compact and robust. Secondly, it will allow participants to interact with the genuine hardware of the console complete with genuine controller, adding to the authenticity of the installation, and lastly, it will allow the maximum amount of routing and interpretation flexibility by accessing the control data stream from the original game cartridge directly. Other welcome additions to the capabilities of the system include the ability to automatically detect which game is being played and switch to a corresponding configuration, and also to add further intelligence to the sound effect recognition algorithms to make sense of certain combinations of MIDI notes that indicate specific effects in the game and route performance information to the robots accordingly.

Another limitation in the current system is the fact that in order to maintain a coherent cause and effect relationship between the actions of the participant and the sound actuators, currently only musical robots with a very low level of latency can be employed. This prevents some robots that require preparation in order to play notes such as Eric Singer's Guitarbot [15] and James McVay et al.'s Mechbass [16] from being included in the system. Future development could potentially enable the use of these types of musical robots in the background music of games by automatically recognizing specific sequences of notes and synchronizing pre-programmed musical sequences with the in-game music.

Conclusions

This project has resulted in the successful construction of an art installation that breaks new ground in the area of augmenting virtual worlds with robotic sound-generation devices. It utilizes several custom-built novel robotic musical instruments and implements a mapping framework that allows in-game sounds to be realized with corresponding physical devices with minimal latency. The fact that users create an action in-game that is immediately responded to by a sound in real life creates a cause and effect relationship between the two movements and aids with the users' suspension of disbelief while interacting with the system. Rather than seeing the robotic musical instruments as responding to the game, participants report perceiving the sounds of the game breaking through to the real world. In the case of this particular game, it also brings them to reimagine nostalgia from their earlier years in a new way.

Though this paper described the technical details of an installation which focuses on a specific game, the instruments can be re-purposed for other games for the NES platform with little modification in the translation software. There are also many further possibilities in several other domains including applications in arcade gaming, virtual reality, cinema, education and potentially many other areas.

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Author Biography

Jason Long is a composer and sound artist from Christchurch, New Zealand. He completed his undergraduate study there at the University of Canterbury, and the Utrecht Higher School of the Arts, the Netherlands. He was subsequently awarded a Japanese Government scholarship to undertake a Master degree at the Tokyo University of the Arts where he designed and constructed an ensemble of robotic musical instruments. With a number of his pieces being performed internationally at festivals such as the ISCM, ACL, and ICMC and a slew of music released internationally in the form of vinyl records, CDs and digital distribution, Jason is currently pursuing a PhD at Victoria University in Wellington, conducting research in the fields of musical robotics and live electronic music.

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Disruptive Behaviors: AI, Robots and the Autism Spectrum Disorder

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Abstract

Today we see the rise of new artificially intelligent entities. Some are embodied as robots and others as non-corporal AIs in devices, interfaces and games. Researchers in robotics and Artificial Intelligence and philosophers speculate that these entities will some day pass the Turing Test and exhibit Artificial Consciousness (AC) or Artificial General Intelligence (AGI), act as artificial moral agents (AMAs), be our lovers and even manifest the signs of experiencing pain and suffering. If such entities become our fellow workers, associates and companions shall these entities be extended the status of personhood with all the rights, privileges and protections under the law? How can we judge if they are truly conscious? Will the Turing Test be sufficient test to judge their fitness for citizenship? What if they exhibit behaviors that match the diagnostic criteria from the *American Psychiatric Association's* Fifth Edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) for Autism Spectrum Disorder, Dissociative Identity Disorder or Antisocial Personality Disorder? This paper argues that a DSM "Turing Test" will be needed for what Marvin Minsky termed "self-improving" robots to determine if they are fit to work along side of and interact with human beings on a daily basis.

Keywords

Artificial Intelligence; Artificial Consciousness; Artificial General Intelligence; Artificial Moral Agents; Autism; Person; Rights; Dissociation; Psychopathology; DSM-V

Introduction

In 1979 Marvin Minsky cautioned that the first 'self-improving' robots and AIs may become psychotic and it will take "generations of theories and experiments to stabilize them." [1] Today we see the rise of new artificially intelligent entities. Some are embodied as robots and others as non-corporal AIs in devices, interfaces and games. Researchers in robotics and Artificial Intelligence and philosophers speculate that these entities will some day pass the Turing Test and exhibit Artificial Consciousness (AC) or Artificial General Intelligence (AGI), act as artificial moral agents (AMAs), be our lovers and even manifest the signs of experiencing pain and suffering. [2]

Robots Will Be People (too!)

Philosopher David Deutsch argues that Artificial General Intelligence (AGI) is not only possible but also such entities will indeed be self-aware and are most assuredly 'people'. [3] A report from the Future of Identity in the Information Society (FIDIS) concludes: "When it comes to attributing full legal personhood and 'posthuman' rights to new types of entities, the literature seems to agree that this only makes sense if these entities develop self-consciousness." [4]

If such entities become our fellow workers, associates and companions shall these entities be extended the status of personhood with all the rights, privileges and protections under the law? How can we judge if they are truly conscious? Will the Turing Test be sufficient test to judge their fitness for citizenship and/or Peter Singer's expanding circle for inclusion as a living being with rights? [5] What if Marvin Minsky is right and they do become psychotic? How do we diagnose their condition? What if they exhibit behaviors that match the diagnostic criteria for Autism Spectrum disorders?

A Freitas Jr. offers a relatively straightforward way to assess if AIs or robots are ready to be functioning members of society: "Certainly any self-aware robot that speaks English and is able to recognize moral alternatives, and thus make moral choices, should be considered a worthy "robot person" in our society. If that is so, shouldn't they also possess the rights and duties of all citizens?"[6].

David Deutsch suggests a test to verify if an entity qualifies as an AGI by determining whether or not "it lacked even a single cognitive ability that is characteristic of people."

In Corpis Juris Roboticum, Raymond August notes that Anglo-American Law has adopted the sanity test to judge competency. Under the Model Penal Code "insanity is the incapacity to either appreciate wrongfulness or conform to the requirements of the law." [7]

Presumably such a test could be given to a robot or AGI. However using rule based programming techniques, an AGI could easily follow the dictates of the law and "readily regurgitate statements of law on demand." August feels a sanity test alone is insufficient. Instead August proposes a more robust but simple test consisting of six questions:

1. Does it/he/she have a complex brain?
2. Is the brain capable of speculation, calculation and memory, in addition to the operation of subsystem or body parts?
3. Is the brain's capacity for speculation, calculation and memory comparable to that of a human?

4. Is the brain capable of learning, i.e., can it separate potentially useful information from useless information, and can it purge or discard the useless?
5. Is the brain's capacity to learn unlimited by subject matter, i.e., is it capable of invention?
6. Is the brain capable of using sensory devices to perceive its environment and to interface with humans even if those sensory devices are not connected?

If a robot passes the above test along with a sanity test then for August, "it seems logically, ethically and morally compelling not only to regard it as both human and sane, but also entitled to the rights of other "natural", humans.

The Turing Triage Test

Another test that might be used to determine if we are willing to confer such rights to robots is proposed by Robert Sparrow. Alan Turing first proposed the Turing Test in 1950 and referred to it as the "imitation game." [8] Sparrow extends Turing's imitation game to what he calls the Turing Triage Test. [9] Like the trolley problem from Game Theory, the Turing Triage Test posits that two lives are at stake and only one can be saved. He continues: "We will know that machines have achieved moral standing comparable to a human when the replacement of one of the patients with an artificial intelligence leaves the character of the dilemma intact. That is, when we might sometimes judge that it is reasonable to preserve the continuing existence of the machine over the life of the human being. This is the 'Turing Triage Test'."

Cyborg Citizen Turing Test

Chris Hables Gray also references the Turing Test (i.e. the imitation game) and proposes a 'double-blind' Cyborg Citizen Turing test "to see which entities can actually operate in our discourse community, and which cannot." [10] Gray sees the ability to fully participate in the discourse of citizenship as judged by jury of peers (other citizens) as the measure of inclusion under the protections of a Bill of Rights for robots, AIs and their fellow travelers.

The Replicant Test

The Replicant Test was featured in the sci-fi classic Blade Runner based on Philip K. Dick's novel "Do Androids Dream of Electric Sheep?"[11] In the film, Harrison Ford plays Richard Deckard, a "Blade Runner" whose job is to hunt down artificial humanoids know as replicants. Once he finds them he terminates them. To determine if a subject is human or replicant the Blade Runner Deckard uses a Voight-Kampff machine. [12] This is a kind of lie detector machine that measures "respiration, blush response, heart rate, and eye movement in response to emotionally provocative questions" [13] while the Blade Runner asks the subject 20 to 30 cross-referenced questions.

An updated version of the replicant test can be found on the OK Cupid dating site to determine if the online object of your affection is a replicant. [14] A sample question seek to probe the replicant's life history or lack of one:
From the choices below, Choose only the good things that come into your mind. About your mother…

- Kind, loving, a great cook
- Strict, intimidating, kind of loud
- sweet, smart, a nice person
- I never knew my mother

These questions point to an actual lived life. "Robots" or replicants have fabricated life histories. Careful questioning would begin to reveal inconsistencies in this "imitation game."

Eliza

This example from this questionnaire recalls Joseph Weizenbaum's Eliza Program. [15] This software demonstration used a text based interface to simulate Rogerian psychotherapy by asking leading questions such as "Tell me more about your mother….". That program famously had no understanding of context or meaning and yet Weizenbaum writes that people took it quite seriously and responded to the questions. This points to our human gullibility and desire to project agency where there is none.

Autism Spectrum Disorders

However it is quite likely that humanoid robots and other species of AIs will tumble into the uncanny valley [16]. As humanoid robots appear and act more life-like we will notice the differences and will recoil or feel disgust. While there has been a rapid advances in the AI labs around the world in a race to develop social robots, techniques of "affective" computing that can read human emotions and display appropriate emotions is still plaqued by obvious shortcomings.

Humanoid robots will betray serious limitations especially in social situations in very obvious and disruptive ways. These shortcomings will likely manifest as inappropriate verbal responses, abnormal eye contact and repetitive actions. Since robots will have simulated emotional states and will depend on robust facial recognition software "empathy errors" will be prevalent. Humans can easily detect inconsistencies. Robots will likely have fictionalized life histories, and will lack true subjective experiences (qualia). Yet they will likely be programmed to report that they do see the color "red" or feel love or have memories of a childhood or even their parents. However it may be beside the point if a robot "experiences" internal states.
Cynthia Breazeal's doll like Kismet [17] to David Hansen's hyper-real bots [18] robots display communication deficits that induce the uncanny valley and are uncannily similar to a range of autistic behaviors.

Social Communication Disorder

The *American Psychiatric Association's* Fifth Edition of the Diagnostic and Statistical Manual of Mental Disorders

identifies the following diagnostic criteria under Social (Pragmatic) Communication Disorder (code as item 315.39 in the DSM-V): [19]

So the question becomes will humanoid robots have "persistent difficulties in the social use of verbal and nonverbal communication as manifested by all of the following:"

1. Deficits in using communication for social purposes, such as greeting and sharing information, in a manner that is appropriate for the social context.
2. Impairment of the ability to change communication to match context or the needs of the listener, such as speaking differently in a classroom than on the playground, talking differently to a child than to an adult, and avoiding use of overly formal language.
3. Difficulties following rules for conversation and storytelling, such as taking turns in conversation, rephrasing when misunderstood, and knowing how to use verbal and nonverbal signals to regulate interaction.
4. Difficulties understanding what is not explicitly stated (e.g., making inferences) and nonliteral or ambiguous meanings of language (e.g., idioms, humor, metaphors, multiple meanings that depend on the context for interpretation).

Will these deficits of humanoid robots "result in functional limitations in effective communication, social participation, social relationships, …or occupational performance, individually or in combination"?

Aspergers

Aspergers was eliminated as a category in the DSM-V and is simplified as the Autism Spectrum Disorder (coded as item 299.00 in the DSM-V) which has the following diagnostic criteria:

Will humanoid robots have "persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following:"

1. Deficits in social-emotional reciprocity, ranging, for example, from abnormal social approach and failure of normal back-and-forth conversation; to reduced sharing of interests, emotions, or affect; to failure to initiate or respond to social interactions.
2. Deficits in nonverbal communicative behaviors used for social interaction, ranging, for example, from poorly integrated verbal and nonverbal communication; to abnormalities in eye contact and body language or deficits in understanding and use of gestures; to a total lack of facial expressions and nonverbal communication.
3. Deficits in developing, maintaining, and understanding relationships, ranging, for example, from difficulties adjusting behavior to suit various social contexts; to difficulties in sharing imaginative play or in making friends; to absence of interest in peers.
4. Difficulties understanding what is not explicitly stated (e.g., making inferences) and nonliteral or ambiguous meanings of language (e.g., idioms, humor, metaphors, multiple meanings that depend on the context for interpretation).

While space does not permit a more detailed discussion of each of the above diagnostic criteria, this author submits that by there are no robots in existence today that would escape the diagnostic "net" of the above criteria. However, this author does also make the claim that we will need to systematize the above criteria into a kind of new Turing Test for Autism. We will want to know how well our synthetic hardware or wetware sisters and brothers will do is social situations. Will they embarrass us? Will they offer us comfort and be supportive? And what of more dystopian futures that are a replicant meme of Hollywood movies i.e. the malevolent robot or evil AI bent on world domination.

Anti-social Personality Disorder

Will "self-improving" robots develop on their own new algorithmic solutions to classic examples of game theory such as the "Prisoner's Dilemma"?. [20] Will the robot reach the inference that in every social situation it is a zero sum game and it must select the win state at all costs and ignore Isaac Asimov's Three Laws for Robots? [21]

We can again look to the DSM-V for the diagnostic criteria to determine if our robots, our sexbots, robot slave workers and their fellow travelers are psychotic or worse psychopaths! The DSM-V now calls psychopathology "anti-social personality disorder." The primary diagnostic criteria are as follows:

1. Impairments in self-functioning (a or b):
   a. Identity: Ego-centrism; self-esteem derived from personal gain, power, or pleasure.
   b. Self-direction: Goal-setting based on personal gratification; absence of prosocial internal standards associated with failure to conform to lawful or culturally normative ethical behavior.

AND

2. Impairments in interpersonal functioning (a or b):
   a. Empathy: Lack of concern for feelings, needs, or suffering of others; lack of remorse after hurting or mistreating another.
   b. Intimacy; Incapacity for mutually intimate relationships, as exploitation is a primary means of relating to others, including by deceit and coercion; use of dominance or intimidation to control others.

Will robots present pathological personality traits in the following domains:

1. Antagonism, characterized by:
   a. Manipulativeness: Frequent use of subterfuge to influence or control others; use of seduction, charm, glibness, or ingratiation to achieve ones ends.
   b. Deceitfulness: Dishonesty and fraudulence;

misrepresentation of self; embellishment or fabrication when relating events.
c. Callousness: Lack of concern for feelings or problems of others; lack of guilt or remorse about the negative or harmful effects of ones actions on others; aggression; sadism.

2. Disinhibition, characterized by:
a. Irresponsibility: Disregard for – and failure to honor – financial and other obligations or commitments; lack of respect for – and lack of follow through on – agreements and promises.
b. Impulsivity: Acting on the spur of the moment in response to immediate stimuli; acting on a momentary basis without a plan or consideration of outcomes; difficulty establishing and following plans.
c. Risk taking: Engagement in dangerous, risky, and potentially self-damaging activities, unnecessarily and without regard for consequences; boredom proneness and thoughtless initiation of activities to counter boredom; lack of concern for ones limitations and denial of the reality of personal danger.

Although many of these traits appear to be uniquely human (e.g. boredom) such behavior by a robot would be interpreted by humans as fitting the DSM descriptions.

Discussion and Conclusions

In recent years AI has made impressive strides performing tasks considered difficult for humans. The developers of Google's Deep Mind project reported in Nature [22] that the "deep Q-network agent" using reinforcement learning, received "only the pixels and the game score as inputs, was able to surpass the performance of all previous algorithms and achieve a level comparable to that of a professional human games tester across a set of 49 games…" Ginni Rometty, the Chairman and CEO of IBM claims that as Watson, the AI software that beat human Jeopardy winners, "gets smarter, his ability to reason is going to exponentially increase," and "In the future, every decision that mankind makes is going to be informed by a cognitive system like Watson," she said, "and our lives will be better for it." [23]

Google's Deep Mind and IBM's Watson which both employ using powerful learning algorithms could arguably be described as "self-improving". Researchers do not consider these "AIs" as conscious and in fact, find the question of consciousness irrelevant to their work. However, as robots are introduced into our lives as fellow workers, associates and companions they will possess similar computation power and capacity to learn and "self-improve."

Researcher Julie Carpenter interviewed military Explosive Ordnance Disposal personnel who use robots for bomb disposal. Her research that "patterns in their responses indicated they sometimes interacted with the robots in ways similar to a human or pet," [24] If soldiers in the field form emotional attachments to robots what will happen when we work along side of humanoid robots and even have them as surrogate companions or lovers?

Even with behavioral deficits perhaps our future companion robots will be "just good enough" to pass the Turing Test of the imitation game. However, such robots with their access to vast data coupled with learning algorithms could become unpredictable. What if the robot lover learns or develops an algorithm that trumps conventional notions of moral behavior and begins to show anti-social tendencies or a "lack of concern for the concerns or feelings of others"? What if the robot is infected by malware or is hacked, lapses into silence, displays repetitive activities akin to autism or acts as if it has a new identity? What if there are accumulated errors and our fellow worker robots reports seeing or hearing things that are not there?

Will the Consumer Protection Agency of the future require robot workers and robots companions be continually certified to possess "normal" psychological profiles in order to protect end users? Will competition in the marketplace drive manufacturers and retailers seek to advertise that their robots pass the DSM Turing Test?

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The Algorithmic Gardener – Tales of Nature and Code

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Abstract

The Algorithmic Gardener – Tales of Nature and Code is a collaborative new media installation that is currently being developed by the authors and Juan Wachs, a roboticist and computer vision expert in Purdue University's School of Industrial Engineering. Using a two-armed robot with stereoscopic vision capabilities programmed to autonomously identify and pull weeds, the project investigates an emerging visual culture defined by synthetic ways of seeing and the material realities such seeing might produce. Conceptually, *The Algorithmic Gardener* focuses on the translation of a cultural concept, that of weeds, and its many connotations (from agriculture, to real estate to social contexts) into robotic action code. These algorithms, executed by the robot, merge culture and technology into tangible outcomes: a series of ideologically-laden micro-gardens that can activate agricultural, political and environmental narratives, metaphors and materializations for 21st century relationships between nature and technology.

Keywords

Critical gardening, Taurus dexterous robot, weeds, gardens, robots, new media art, nature, technology, narratives, culture, algorithms, translation, metaphors, visual culture, synthetic vision.

Introduction

In her cultural study of the gardens of Versailles in the 17th century, cultural and science studies scholar Chandra Mukerji reveals gardens as sites where art and technology produce material realities and social narratives with political consequences. She writes**:**

> *Gardens are complex laboratories, where new cultivation techniques are explored, new approaches to engineering entertained, new aesthetics mobilized, and new demonstrations/representations of power tendered; they are places where human will and the natural order are co-constructed. Gardens address, in other words some fundamental ties between human action and the material, "natural" world, so they have surprisingly important tales to tell about human societies.* [1]

The conclusions she reaches about a French national past, open questions about a transnational future. As an interdisciplinary group of artists, technologists and practitioners of social inquiry, the authors would like to grapple with these questions: What tales of human society do we want to hear in the future? What relations between nature and technology – future natures – do we want to 'explore, entertain, mobilize, tender and construct'? And, what new visual metaphors can we create to help publics narrate, debate and act on possible futures? The authors aim not to provide definitive answers to these questions of speculation, but to create an artwork that constructs, activates and interrogates visual metaphors for emerging relations between nature and technology in the 21st century. Key here is a particular understanding of metaphor. The authors agree with cultural geographer Tim Creswell's materialist and experientialist understanding. Drawing on the work of Lakoff and Johnson (1980), Cresswell (1997) in an essay about 'out-of-place metaphors' (weeds, disease and bodily filth) argues: "The point is that … metaphors are ways of acting and not merely poetic flourishes." [2] Given the significant nature-related challenges that humanity faces, including climate change and food insecurity, a critical consideration of the relationship between ways of representing and ways of acting is warranted across a variety of fields, including the arts, humanities and the sciences.

The Algorithmic Gardener builds on the authors' existing body of collaborative work through which they research and represent cutting edge technologies that will have a profound effect on human-nature-technology relations. [3] This project will also contribute to the small, but growing number of interdisciplinary contemporary artworks that address developing cultural shifts resulting from the interaction of code, robotics and "nature," or that mobilize weeds to reveal underlying assumptions of social exclusion. Specifically, *The Algorithmic Gardener* has drawn inspiration from the following examples:

- *TeleGarden* (1995-2004), an installation by new media artists Ken Goldberg and Joseph Santarromana allowed web users to view and interact with a remote garden filled with living plants. Members could plant, water, and monitor the progress of seedlings via the internet-controlled movements of an industrial robot arm. [4]
- The weed gardens of Tyrolean artist Lois Weinberger emphasize peripheral zones (*Randzonen*) in the exploration of the spaces of nature and civilization [5] (e.g. the rooftop garden

at the Watari Museum of Contemporary Art in Tokyo).

- *Lot* (2005), the architecture scale works of installation artist Kim Beck use decals in the shape of weeds, applied to windows, literally taking over abandoned buildings. [6]
- Architect Martha Schwartz' *Splice Garden* (1986) which uses culturally specific forms to create a garden through "abstraction, symbolism and reference" constructed of unusual materials that alludes to the dangers of gene splicing. [7]

Gardens and Machines

The *Algorithmic Gardener: Tales of Nature and Code* brings together four main components: weeds with their metaphorical intensity and as targets for extermination, agricultural plants like soybeans (see McMullen and Winkler's *National Security Garden* public artwork for the significance of soybeans in this context [8]), technology in the form of a dexterous robot and synthetic vision algorithms for precision robotics.

The presentation of *The Algorithmic Gardener* will allow visitors to see multiple small-scale garden boxes at various stages of development in a customized greenhouse. At least one garden will already have been weeded by the robot. One will be the box the robot is currently working on and there will be at least one that still needs to be weeded. The authors are very interested in the divergent possible outcomes of this weeding process, since each garden represents the visible results of the translation of a cultural concept, that of weeds, into an algorithm – computer code that controls the actions of the robot (Figure 1).

Weeds are a powerful and unstable category, offering fertile ground for an artistic interrogation of the metaphoric and the material. While in its initial experimental stage the robot is programmed to look for soybeans as the only desirable plants, the goal is to eventually express a more nuanced and ambiguous definition of weeds that is informed by agricultural, aesthetic and social contexts. For example, the eradication of weeds has increasingly been viewed as a path to improved crop yields, weed science has developed into a field of research with a significant presence at universities with strong agricultural programs. [9] The goals of weed science are mirrored more broadly in urban and suburban space – the absence of weeds from real estate is viewed positively. Weed-free sidewalks, yards and lots have been seen as a sign of property value, urban prosperity (as opposed to decay) and human moral superiority. [10] As a metaphor, weeds are often associated with politicized terms like decay and invasion that can harbor racist, nationalist and classist undertones. [11]

Figure 1. First weeding experiments with the Taurus robot, May 2015. A video of this behavior is available at: http://www.gardensandmachines.com/AlgorithmicGardener. ©McMullen_Winkler.

Adding to this instability are evolving alternative concepts of nature and technology. Biodiversity, permaculture, synthetic biology, GMOs, the "doubly green revolution," [12] "industry-nature," [13] sustainability, organic farming, (sub)urban nature and farming, urban ecology; all of these concepts and attendant practices challenge in part or whole the industrial age divisions of nature and culture into discrete locations and sets of practices, and question the existing definitions of weeds and the actions that should be taken against or for them. Restating the primary question in this context, the authors ask: In the age of code, how are cultural conceptions of weeds changing, or how could they change, and what agricultural, political and environmental narratives, metaphors and materializations can they activate?

Creating an artwork to provoke these questions successfully requires a high level of engineering expertise in the fields of robotics and synthetic vision. The detection and pulling of weeds is a complex motor-perceptive task that involves planning, recognition and execution. Several engineering challenges need to be overcome to achieve precision robotic gardening. To begin with, the robot needs to be able to recognize the "weeds" and distinguish them from other plants in the garden. [14] This is a non-trivial synthetic vision task, since both objects have a similar color distribution, and have variable shapes. Conventional approaches for template matching and color segmentation will not work in this case. Based on prior research, [15] Juan Wachs is currently supervising two graduate researchers' experimentations with a novel approach involving the robot's arms to move plants while looking at them to get different views for better classifications. Secondly, once the exact position of the weeds has been assessed, the robot needs to move in real-time. For this to happen, an optimal trajectory must be computed for the robot to reach the weed while avoiding obstacles – precluding damage to the desired plants. [16] Finally, once the weed is reached, haptics technology will determine the systematic grasping movements, enabling the right amount of force to be applied in order to extract the weeds in a "single trial." In summary, from a technical perspective, weed detection and removal is a significant challenge that requires engineers to achieve visual recognition, precision haptics and effective programming. Each technological

step requires the translation of cultural and embodied concepts into code. From a collaborative perspective, success means the robot will perform algorithms in which culture and technology merge into visible outcomes, at the same time failures will provide opportunities to consider the same relationships.

An Emergent Visual Culture of Synthetic Vision

The very first experiments with the Taurus stereoscopic camera system already showed that the images the robot creates and abstracts in order to identify plants yield intriguing visual material that is directly related to the robot's actions (Figure 2). Experimental geographer and artist Trevor Paglen has recently observed that computer vision images are created "by-machines-for-machines", and large numbers of them are never seen by humans. [17] Yet, in order to understand, critique and shape the impact of machines seeing with abilities beyond human vision capability, humans will need to learn to see like machines, to understand their abstractions and their categorizations of things in the world. German art historian Horst Bredekamp makes the case that images do not merely reproduce a prior reality but rather actively create our reality. [18] Seen in this light, synthetic vision images are extremely powerful and require a better understanding by humans if they wish to critically shape the realities these images create.

One interesting starting point for an emergent 'visual culture of synthetic vision' is the analysis of the image sets that are used to train synthetic vision systems. Who constructs these image sets and with what criteria? What perspectives of the world do they convey? Who and what are excluded? For example, Edith Zimmermann's cleverly curated image gallery titled "Women Laughing Alone With Salad" [19] exposes latent stereotypes and cultural absurdities in large stock photo collections, pointing out that visual datasets may not be as neutral as imagined. The authors are only at the beginning of these investigations for which they have received funding for continuing explorations: during the summer 2015, they will research, together with a graduate student from Purdue's American Studies program, deeper intersections between computer vision and visual culture as well as robotics and agriculture (the contemporary "Machines in the Garden" [20]) culturally contextualizing the artwork's engineering components. Together with the gardens the robot creates – materializations of the translation of cultural concepts into computer code – this visual culture research will hopefully further inspire critical thought about the future of nature and technology hybrids.

Figure 2. Visual output of a basic synthetic vision process (image segmentation: separating a soybean plant from its background). ©Arjun Narang, McMullen_Winkler.

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Authors Biographies

Shannon McMullen and Fabian Winkler are interdisciplinary artists and researchers combining their backgrounds in new media art and sociology to produce collaborative artworks that often combine sound, image, code and installation to create temporary new social spaces and investigate relations between nature and technology (http://www.gardensandmachines.com). Their work has been shown internationally at venues such as Art Center Nabi, Seoul, Korea; ZKM Center for Art and Media, Karlsruhe, Germany and the Spark Festival, Minneapolis, USA. Shannon McMullen is an Assistant Professor with a joint faculty appointment in Art and Design and American Studies at Purdue University. Fabian Winkler is an Associate Professor of Art and Design. Both teach in the Patti and Rusty Rueff School of Visual and Performing Arts at Purdue University in West Lafayette, IN where they co-direct the area of Electronic and Time-Based Art.

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The IndaPlant Project: An Act of Trans-Species Giving

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Abstract

The IndaPlant Project: An Act of Trans-Species Giving is a generative artwork in which houseplants are robotically enabled to freely move in search of sunlight and water. This project has successfully constructed a floraborg, a term its creators coined to describe an entity that is part plant and part robot. Originally debuted at ISEA in 2012, the interdisciplinary collaboration now consists of a community of three light-sensing, robotic vehicles, each of which responds to the needs of a potted plant by moving it around in three-dimensional space. This paper presents an overview of current floraborg life and details the research in and across art, engineering, computer science and biology that makes self-sufficient, data-sharing IndaPlants possible. These initiatives include the creation of a self-monitoring computer vision system, a self-watering mechanism that utilizes plants' transpiration, and a cyber-physical interface to support plant-machine communication, and by extension, a new paradigm in plant-to-human interaction.

Keywords

IndaPlant, robotics, eco-robotics, mobile plant, plantbot, machine vision, floraborg, cyber-physical interface.

Introduction

The IndaPlant Project: An Act of Trans-Species Giving was conceived as an interactive installation in a domestic environment, where robotically enabled, autonomous houseplants could roam freely in search of sunlight and water.

Artist Elizabeth Demaray originally envisioned that the robotic supports for the IndaPlants would draw upon the work of the Italian/Australian cyberneticist Valentino Brattenberg. He designed Brattenberg vehicles, which are simple devices, based on the neuronal architecture of insects, that utilize basic schematics for attraction to and avoidance of stimuli. However, once the team began considering the possibilities inherent in the creation of a floraborg, we realized that we could instead wire the vehicle through an Arduino board. This configuration not only allows for species-specific programming, but can also support simple adaptive behavior in the form of machine learning.

Floraborg Configuration

The one floraborg featured at ISEA in 2013 has expanded into a population of three units, each of which performs sun- and water-seeking functions. The plant-carrying robot platforms are three-wheeled to enable movement in any direction. Each unit is equipped with six sonar sensors for motion planning and carries three solar panels that allow the robot to recharge its battery packs when the plant is sunning itself. These solar panels additionally function as the unit's light sensors, allowing it to find the brightest spot within a lit area. Created to map the space of a domestic environment, the community is designed to wirelessly share information concerning light and water sources.

Figure 1. Single IndaPlant on three-wheeled platform. Each unit has six sonar sensors for motion planning and three solar panels for recharging its batteries. © David Gehosky 2014

Daily Routine

Currently housed in the Mechanical and Aerospace Department at Rutgers University, the floraborgs have become part of the daily routine (see Figure 4). When Zou comes to work in the morning, he is greeted by the three IndaPlants, which jostle one another to exit his office in search of sunlight in the adjacent hallway. When an IndaPlant is thirsty, a moisture sensor sends a signal through the unit's central processor that may decide that the plant needs water. If so, the unit will locate a water dispenser in the hallway via an infrared sensor. If a floraborg is in the immediate vicinity of a watering station, passers-by are invited to give it a drink. A three-minute video summarizing the project's inception, with footage from the IndaPlant community's daily routine, may be seen at https://vimeo.com/90457796.

Aims of Current IndaPlant Project

Due to their sessile nature, plants are often exposed to a variety of overlapping perturbations, including air pollution, temperature and light variations, drought, a deficiency or surplus of nutrients, and attacks by insects and pathogens, and they must therefore develop sensory mechanisms to protect themselves. Different stimuli evoke specific responses in living cells, which are in turn transmitted to the organism as signals. Consequently, plants generate various types of intra- and inter-cellular electrical impulses in the form of variation potentials. Moreover, since they lack motility, plants are naturally equipped with superior biological probing devices that detect, record and transmit information about environmental changes.

Given the unique characteristics of plants as sensors and actuators, the IndaPlant team aims to build the necessary computational and robotic infrastructure to support the health and self-sufficiency of these organisms while integrating them into a dynamic, mobile, cyber-physical system.

We currently seek to establish both a theoretical/computational and a cyber-physical framework that may sustain an IndaPlant community. Key to this effort is the creation of an interface that allows the robotic platform to acquire signals from the plant and to interpret these signals to infer gas interactions, metabolism and growth in its supported species. In response to this input, the robotic carriage will move the plant around to maximize its well-being. The platform's ability to navigate according to the plant's signals is essential to closing the control loop. This can be achieved by equipping the floraborg with the necessary support infrastructure, sensors, processing power and algorithmic ability to gather and interpret data. To this end, the team is exploring machine vision, a transporation watering system, and the creation of a floraborg cyber-physical interface.

Machine Vision

A fundamental challenge we are addressing is to capture a plant's visual cues. Ahmed Elgammal is using a Raspberry Pie camera board to record time-lapse video of the IndaPlant, which allows it to visually monitor its own state of health. We developed a computer vision algorithm to track the plant's growth and leaf wilting, which indicates the need for water.

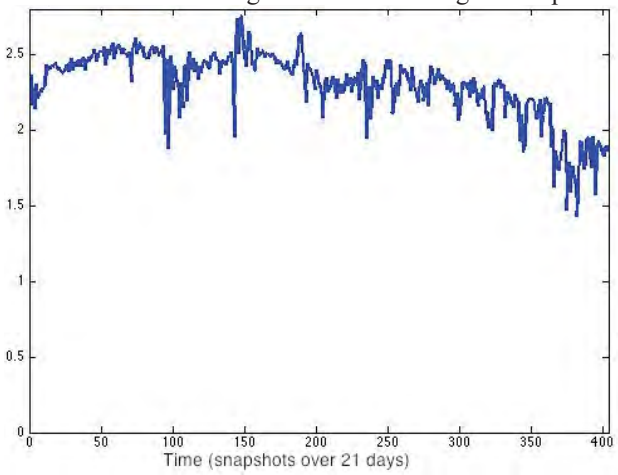

Figure 2. Measuring visual leaf wilting signal over a duration of 21 days. The decay in the signal corresponds to a period when the plant was not watered. © Ahmed Elgammal 2014

We plan to investigate the use of basic computer vision segmentation and shape description techniques to quantify the growth process and other visible cues. Figure 5 shows the preliminary results of measuring a plant's wilting motion via a single visible spectrum camera. They were obtained using 2D analysis of one view over a long duration. We will attempt to develop algorithms to measure and discriminate between several visible cues, including growth,

Figure 3. A Demaray-Kuchoni system gathers purified water after photosynthesis. © Elizabeth Demaray 2014

wilting, phototropism, and different types of nastic movements. We will also investigate the use of multiple cameras that can obtain depth information from various views to provide a dynamic 3D reconstruction of the plant.

Transpiration Collection

Transpiration is the process that plants use to secrete purified H_2O on the undersides of their leaves—trading water for atmospheric gas (CO_2)—during and after photosynthesis. This collected water is a way to measure plant metabolism. The IndaPlant team is designing a system that may use collected transpired water to allow each floraborg to hydrate itself. This research and design work has also resulted in a Demaray-Kuchoni collection system that lets humans draw on the potential of plants to produce purified water, as seen in Figure 3.

Plant/Robot/Human Communication

The IndaPlant team also aims to create a cyber-physical interface that can close the positive feedback loop between the plant and its robotic support. Functioning as a conduit to signal and then digitize information about environmental perturbations from plant to machine, this interface will, by extension, allow for a new paradigm in plant-to-human communication.

The immediate goal of this interface is to create an instrument that utilizes the sensory powers of sessile organisms to detect and map hazardous gasses within a mobile framework. While still in its infancy, the floraborg system may pave the way for a wide variety of environmental exploration, manipulation, data mining and modeling applications. By utilizing whole plants, we hope to devise a way to leverage the information they can gather on ecosystem health, the effects of climate change, and air pollution. In this capacity, the IndaPlant interface may provide foundational capabilities that will allow us to model and support environments that can sustain humans and plants alike. In settings that are unsafe for humans, the autonomous mobility of an IndaPlant may be used to detect pathogens, poisonous gasses and weapons. It may be able to sense toxic chemicals on the battlefield. In geologically unstable terrains, it may be able to analyze the fumes from volcanoes. Current research using biosensors in space [1] highlights the importance of bioinformatics in the success of human missions to Mars. Hence, this cyber-physical system may be used extraterrestrially to model how living organisms adapt to non-earth conditions.

While the field of biosensing is still young [1], there are already indications that different plant species excel at different types of sensing and remediation [2]. Our project maintains that focusing on the abilities of heterogeneous plant species is timely and important. Scientists believe that the earth is in the midst of a sixth great extinction, an event characterized by the loss of between 17,000 and

Figure 5. Two IndaPlants on a live webcam feed at "Welcome to the Anthropocene," the Association of Environmental Science Studies 2014 symposium in New York City. © David Gehosky 2014

100,000 species each year [3]. According to Stephen Hopper, director of the Royal Botanic Gardens in Kew, England, "Recent work on plant assessments suggests that around one in five plants are threatened" [4]. While new species do eventually evolve to replace those that are lost, after each of the last great extinctions, evolution required about ten million years to restore the pre-disaster levels of diversity [5]. With each extinct plant species representing a loss of genetic information in the form of ten million years of evolutionary adaptation in both the sensing and remediation of harmful conditions, the IndaPlant group aims to create the cross-cutting, multi-disciplinary framework required to support studies on the abilities of the plants that are still available.

Broader Impact

We anticipate that our research will have a broad impact in robotics, biology, bioengineering, and system controls. The paradigm shifts involved in mobilizing a sessile organism, in creating a two-way plant robotic interface (allowing greater communication among plants, computers, and by extension, humans), and in utilizing plants as mobile biosensors, will open the door to new studies in the biology of the biosensing and remediation capacities of diverse plant populations; bioengineering and systems control; and advances in computational science as plant signaling becomes more integrated into the plant/computer interface. These research activities may even foreshadow the creation of EcoRobotics, which may become a field in its own right.

IndaPlant Project Updates

Videos, project information and updates on the *IndaPlant Project: An Act of Trans-Species Giving* can be found at http://elizbethdemaray.org.

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Figure 4. Floraborgs in the hallway at Rutgers University. © David Gehosky 2014.

[Session 27]

MetaCreators: The Generative Artists

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A Composer's Search for Creativity Within Computational Style Modeling

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Abstract

Computational style modeling involves building a computational representation of the surface of musical works, one that captures features of rhythm, melody, harmony, and structure within its patterns. While such models are useful for musicological purposes, the creative use of these models to generate new music consistent within a given style raises a critical question: can generative music based upon a corpus be considered creative? This paper addresses this question, examining how creativity has been historically viewed, and discusses recent research into creativity. Examples of computational creativity by the author using both rule-based and corpus-based systems will be discussed.

Keywords

Creativity, computational creativity, generative art, style imitation, David Cope, Experiments in Musical Intelligence, postmodernism.

Introduction

One of the most basic tenets of creativity is *originality*, in which something *novel* – an object, idea, or solution that has not previously existed – is created [1]. A secondary aspect of creativity is the notion of value, or worth; specifically, the creative product must be regarded as having some *usefulness.* Subjectivity is thus part of the equation, which explains why the relative balance between innovation and craft has shifted throughout history. While some creators, such as Haydn, have been acknowledged for generating many of the forms and ensembles that we now associate with the classical era in music (approximately 1760-1810), his contemporary Mozart, who created no new forms, ensembles, or styles, is venerated as one of the greatest composers of all time. Haydn *transformed* his musical space, whereas Mozart remained firmly within it; his specific creativity is found within the content rather than its structure [2].

In applying notions of creativity to machine-generated artifacts, we confront other concerns. Anglo-American copyright law requires a work to be sufficiently "original" to warrant copyright protection; however, originally does not refer to historical novelty, but to human origin: works produced by mechanical processes without any contribution by human author are not registrable [3]. How then, does one assess creativity within works generated by computer? Researchers within the nascent field of computational creativity – who aim to endow machines with creative behavior – have avoided the thorny distinctions involving distinctly human processes [4] by defining computational creativity self-referentially as "the performance of tasks which, if performed by a human, would be deemed creative" [5].

Early attempts at incorporating computation into artistic production tended to be expert systems designed by practitioners to follow heuristic rules generated by its creator [6]; despite AARON's ability to produce a stylistically consistent body of work that, by Wiggins' definition, was creative, its creator refused to be drawn into the question of whether his system was, in fact, *creating*. In retrospect, one can view AARON as a machine that reflected Cohen's taste and aesthetic; it was completely bound by rules set by its creator in order to produce output that Cohen felt artistically desirable.

At roughly the same point in time, Cope was exploring similar issues within music, albeit using different methods. Instead of determining the rules of the system beforehand, Cope's system analyzed a body of music in order to extract the necessary rules for generation [7]. By curating a consistent corpus for such machine-learning, Cope avoided generality in the derived rules, and was able to produce music that was stylistically consistent within the corpus; for listeners, it meant that he was able to generate music that, even to expert ears, *sounded* like Mozart (for example), but music that Mozart never actually composed. In discovering the distinctive and recognizable characteristics within the corpus, Cope's system essentially extracted its stylistic elements [8]; in using those features to generate new music, the system can be considered *style-imitative*.

A standard argument against art generated using a corpus is that the system is incapable of producing novelty, and can only reproduce what is already in the corpus. This paper will address this question, examining how creativity has been historically addressed, and discussing new research into creativity. A brief reexamination of Cope's work and its detractors will follow. Finally, examples of computational creativity by the author using both rule-based and corpus-based systems will be discussed.

Originality and Historical Perspective

At different points in history, the relative novelty of an

item has had different value. For example, in the twentieth century, due to its predominately modernist aesthetic, the uniqueness of an item, especially an artwork, was paramount: no worse allegation could be leveled at a work than for it to be declared derivative. According to Gregory, such concerns of originality developed out of European Romanticism [9], beginning in the Eighteenth century [10]; prior to this time, audiences favoured variations on familiar ideas and themes, rather than novel ones [11].

The reuse of existing material was commonplace at various points in musical history. The origins of polyphonic music in Europe can be found in the use of a *cantus firmus*, in which novel melodies were combined with existing sacred melodies [12]. This type of derivative composition continued for over 500 years, and expanded into the parody, or imitation, mass of the 16th century, which combined multiple voices of pre-existing compositions: Palestrina wrote over 50 such works [13]. By the 1600s, composers began to abandon their dependence upon existing sacred melodies in order to explore genuinely novel melodic features: it is no coincidence that the Western notion of creativity first appeared during this time of the Renaissance [14].

However, even by the late Baroque period, genuine novelty was never assured, nor, it seems, desired. J. S. Bach's earliest work, two volumes of keyboard works published in 1731 as his Opus 1, are clear imitations of the music of his immediate predecessor at Leipzig, Johann Kuhnau. Of course, young artists, even in the 20th century, are given some leeway in their search for novelty: Stravinsky, an innovative force in 20th century music, borrowed heavily from the music of his teacher, Rimsky-Korsakov, in his early works prior to 1910 [15]. However, while Stravinsky went on to compose *Le Sacre du Printemps* – one of the most innovative works of the century – a few years later [16], Bach's continued "borrowing" of existing music was not considered questionable: his *Mass in B Minor* consisted of movements from his earlier cantatas, while his *Concerto for four harpsichord*s BWV 1065 was a direct re-workings of Vivaldi's *Concerto for 4 violins* RV 580.

By the 19th century, the desire for originality, as typified by the persona of Beethoven, was solidified during the Romantic period. Some researchers equate Beethoven's perceived creativity with his deafness, suggesting, as Ludwig's brother Karl does, that his inability to hear other's music forced him in directions other than imitation [17].

The 20th century was dominated by the tenet of modernism, and its rejection of historical reference [18], even to oneself; as a result, serial composers were compelled to generate a new grammar with each composition. Stravinsky's dip into history through quotation and reference, beginning with *Pulcinella* (1920) remains an example of modernism, rather than post-modernism, due to the irony inherent within his brand of neo-classicism [19]. While the aforementioned work based upon Pergolesi (1710-36) may suggest a post-modernist sentiment through its direct quotation of the original, his subsequent works within the style – beginning with *Octet* (1923) – managed to reference earlier stylistic periods without quotation. As such, he was able to remain a modernist through his ability to use earlier stylistic material in search of novelty, rather than juxtaposition.

Postmodernism's questioning of originality and meaning had very specific interpretations in contemporary music, as discussed in the next section. Barthes' argument against authorial meaning [20], for example, had little direct influence upon music, which itself was questioning whether music had any meaning at all [21]. The exploration of appropriation and its questioning of originality in the work of visual artists such as Duchamp, Warhol, and Levine eventually did find parallels within music in Oswald, Zorn, and Schnittke's compositions, for example. Similarly, sampling culture in Hiphop, and even soundscape composition's direct recording of the environment can be argued to question originality.

Stylistic Appropriation

In the 1960s, American composer George Rochberg abandoned modernism's forge for uniqueness and began to compose directly within an earlier style, basing individual movements upon the styles of specific composers [22]. Rochberg argued in opposition to the teleological view of music, stating earlier styles remain relevant, and free for appropriation:

> "the twentieth century has pointed – however reluctant we may be to accept it in all areas of life, social as well as political, cultural, as well as intellectual – toward a difficult-to-define pluralism, a world of new mixtures and combinations of everything we have inherited from the past and we individually or collectively value in the inventions of our own present, replete with juxtapositions of opposites (or seeming opposites) and contraries." [23]

Like Stravinsky, Rochberg had a deep love of the past; however, Rochberg was not prepared to view the past through the lens of modernity, and chose to fully inundate himself in style imitation: his String Quartet No. 5 (1978)[1] did not merely quote Beethoven, but introduces novel material and develops it completely in the style of the Romantic composer. This did not ingratiate him with critics, some of whom questioned whether his music was even "valid" or contained any artistic statement [24]:

> "Rochberg exhibits no novelty of his own as imitator, for the more successful he is in that role, the more successfully Rochberg is lost as a creator. He cannot have a faithful copy if there are any of his own perceptions present. It is a no win, "catch-22" aesthetic principle, of which Rochberg's work is living proof: art cannot be only imitation. Even if the artist chooses to use another's material, it must bear his own unique stamp."[24]

Block was writing in the early 1980s, a time when modernism in music was no longer the dominant paradigm; instead, tonality – a overarching goal of Rochberg's aes-

[1] An example recording on YouTube: http://youtu.be/D-snNWzq9G0

thetic – was beginning to reassert itself as the principal vocabulary of post-modernism. This may explain Block's contextualization of his criticisms:

> "What is therefore objectionable in George Rochberg's music is not his tonality, not his eclectic mixtures of styles nor his desire to capitalize on the beauty of the great masters' perceptions and material but his necessarily unsuccessful attempt to totally recapture a spirit that is not his own and to which he adds nothing." [24]

Not all critics were as hostile: Ringer's detailed analysis of Rochberg's music lead him to state that the sophistication of the procedures used by the composer were far more original than the purely novel ones used by many of his contemporaries [25]. Thus, we have a dichotomy of viewpoints: Block argues for novelty, while Ringer suggests novelty alone does not engender creativity.

Cultural Appropriation

Stylistic appropriation within music was never limited to extant European styles: referencing non-Western music – whether Mozart's use of Turkish Janissary music in his *Rondo alla Turca* or Stravinsky's use of Russian folk melodies in *Le Sacre du Printemps* – was fashionable, if exotic. Reich, in his *Writing About Music*, advocates for the potential of non-western art forms to permeate western aesthetic creative processes:

> One can create a music with [one's] own sound that is constructed in the light of one's knowledge of non-Western *structures*…This brings about the interesting situation of the non-Western influence being there in the thinking, but not in the sound… Instead of imitation, the influence of non-Western musical structures on the thinking of a Western composer is likely to produce something genuinely new. [26]

Creativity Research

While artists have an intuitive understanding of what it means to be "creative", relatively recent scholarly interest into creativity from a variety of disciplines – including psychology, cognitive science, education, linguistics, philosophy, and computer science – have produced more formal definitions. Most definitions include novelty [27] and appropriateness [28], while others include a requirement for culture from within which creative actions are possible [29, 30]. A few additional points from creativity research will prove useful for our discussion.

Psychologist Margret Boden distinguishes between two types of creativity, P-creativity and H-creativity [31]. The former, also referred to as psychological creativity, implies that the object or idea is novel to the individual alone, while the latter, also referred to as historical creativity, implies that the object or ideas is novel to society as a whole. The separation of eminent creativity from more everyday creativity can be found in Kaufman and Beghetto's notion of the Four C model of Creativity [32]: the highest level – *Big C* – involves creativity that is considered "great" in a given field, *Pro-C* is creativity exhibited by professionals within a field, although not considered eminent, and the remaining two everyday creative acts fall into variants of *little-c* creativity.

Boden also introduces the notion of *conceptual spaces:* a set of *concepts* that are deemed to be acceptable as examples of whatever is being created [33]. In regards to these spaces, *exploratory creativity* is the process of exploring within a given conceptual space, while *transformational creativity* is the process of changing the rules delimiting the conceptual space. Thus, *Pro-C* artists accomplish exploratory creativity, while only *Big-C* artists are able to accomplish transformational creativity.

Previous Research in Style Modeling

Using machine-learning for style modeling has been researched previously. Dubnov *et al.* [34] suggest that statistical approaches to style modeling "capture some of the statistical redundancies without explicitly modeling the higher-level abstractions", which allow for the possibility of generating "new instances of musical sequences that reflect an explicit musical style". However, their goals were more general in that composition was only one of many possible suggested outcomes from their initial work. Their examples utilized various monophonic corpora, ranging from "early Renaissance and baroque music to hard-bop jazz", and while they do state their research produced two original computer-assisted compositions performed by the French Orchestre National de Jazz, no specific information is provided regarding these works.

The concept of style extraction for reasons other than artistic creation has been researched more recently by Collins [35], who tentatively suggested that, given the state of current research, it *may* be possible to successfully generate compositions within a style, given an existing database.

Unfortunately, space does not permit a full discussion of computational production systems that have explored stylistic modeling; suffice to say, it does have a long history, especially if one considers any system that is stylistically consistent. For example, Lewis' *Voyager*, an interactive expert system based upon rules provided by the composer that dates from the 1980s, produces free jazz improvisations in the specific North American tradition [36]. While Lewis argues that machine agency challenges outmoded human-centric notions of expression, he also notes that *Voyager*'s use of simple randomness, the primary factor in his system sounding non-human, results from practical necessities [36], a decision my own systems have attempted to avoid [37]. It should be noted that many composers utilizing machine-learning on a corpus do so not to replicate the style of the corpus for aesthetic reasons; instead, we do so for a more practical purpose in deriving generative rules from exemplars, rather than having to hand-code such rules ourselves.

Artistic Exploration of Style Modeling

As has been already discussed, style imitation is not unique to computation: post-modernism is ripe with stylistic polymorphism [38]; my doctoral thesis described the stylistic appropriation I used in a major work for dance [39]. In that work, my compositional process was decidedly traditional: deciding to base the work on the music of Vivaldi, I immersed myself in his music, albeit audio recordings. When it came time writing the actual music, I was able to replicate the surface features of the music – its melodic types, harmonies, figurations; however, few listeners would have mistaken the resulting music as Vivaldi's. Importantly, my deconstructing and reframing of the Italian Baroque style in post-modern terms allowed for the use of material in ways that were not possible in Vivaldi's time.

Similarly, following Reich's incorporation of non-Western influence on Euro-American musical structures, my Master's thesis explored such compositional directions [40]. Many years later, when creating generative computational systems, I returned to notions of appropriation, yet reflective of Reich's approach: basing rhythmic generation on the complexity of Indian *tala* and the rhythmic interaction upon West African drumming [41]. As before, the use of style appropriation was an artistic decision to explore new methods of formal organization: few audience members would have felt they were listening to either Indian, or African, music.

Human conceptual spaces

Underlining the difference between *influence* and *imitation* is important when considering an artist's ability to freely use whatever material at his/her disposal. Despite Block's objection to imitation, Rochberg's composing directly within an earlier style was a logical extension of post-modernism's appropriative cravings. Block fundamentally misunderstands Rochberg's motivation: it is not to seamlessly recreate Beethoven's music, but to posit the potential of an earlier style's appropriateness in temporally disjunct surroundings.

> "The real scandal lay not in Rochberg's rejection of doctrinaire serialism or aleatoric composition, but rather in his far more radical rejection of the whole philosophical foundation of the postwar avant garde. These works were the manifesto of a revolt." [42]

Applying Boden's conceptual spaces model, the "artistic" use of stylistic modeling retains the conceptual space of the artist: by appropriating Beethoven's style, Rochberg *transposed* Beethoven's conceptual space into his own, which remained firmly in the 20th century. Of course, one could also argue that in doing so, Rochberg *transformed* the existing modernistic conceptual style.

Virtual Conceptual Spaces

A problem arises when one considers computer models of style: while using such models for musicological purposes are straightforward [43], what happens when these models are used generatively. Within which conceptual space does the generative work exist?

Hofstadter, like many others, suggests that artistic creation is reserved for humans [44]. In describing what would be required for a computer to create music, he suggests

> "It would have to understand the joy and loneliness of a chilly night wind, the longing for a cherished hand, the inaccessibility of a distant town, the heartbreak and regeneration after a human death. It would have to have known resignation and world-weariness, grief and despair, determination and victory, piety and awe. In it would have had to commingle such opposites as hope and fear, anguish and jubilation, serenity and suspense. Part and parcel of it would have to be a sense of grace, humor, rhythm, a sense of the unexpected – and of course an exquisite awareness of the magic of fresh creation. Therein, and therein only, lie the sources of meaning in music. [44]"

Hofstadter displays a somewhat antiquated, and certainly referentialist view of meaning in music [21], suggesting a rather romantic notion that the emotion a listener feels when listening to music is contained within the music itself, and the result of a composer's direct desire to transmit such feelings. However, his questioning of volition is relevant and insightful: computers lack the desire to create, and therefore lack the ability to create their own conceptual spaces. Therefore, any system that generates music using style modeling could only produce music within the original conceptual space of the corpus.

Hofstadter's comments came in response to Cope's system, Experiments in Musical Intelligence, or EMI [45]. Hofstadter's original reaction to EMI's music accepted their proficiency – suggesting they could be the output of a graduate student in music – but questioned their originality. Such judgments are often leveled against computer-generated music [46], but are unnecessarily biased in this case: Cope's corpora consisted only of exemplars, acknowledged geniuses of music. When one considers that 99% of all music composed is lesser than that of the masters, does that discount all music outside of masterworks? In a social media comment on my own work in musical metacreation, one person wrote: "A computer couldn't write Beethoven's String Quartet 3 in F, plain and simple", seemingly invalidating all music incapable of meeting Beethoven's transformational abilities.

Faced with the output of EMI in the form of extremely accurate stylistic imitation of Chopin, Hofstadter was perplexed that a system based solely upon the analysis of the symbolic representations of the composer's music could create music that was *not* "emotionally empty":

> "I was truly shaken. How could emotional music be coming out of a program that had never heard a note, never lived a moment of life, never had any emotions whatsoever?" [47]

Hofstadter's objection to EMI was that it was a machine capable of producing "human" music. Wiggins – a researcher into computational creativity and artificial intelligence – objects to Cope using too many human methodol-

ogies, labeling it pseudo-science [48], and criticizing Cope for such aspects as selecting individual items from EMI's output for presentation. This last criticism once again places computer-generated music on an unfair pedestal: why is it perfectly normal for artists to select which of their human-composed works to publically present, but not computer-generated?

This treads into the little traversed area of the autonomous virtual artist. The use of software as assistive technology in the service of an artist is perfectly acceptable, as the concept space being explored clearly remains in the hands of the artist. However, affording greater autonomy to the system severs this link, and the concept space seemingly becomes that of the system, which, paradoxically, is incapable of autonomous artistic volition. Since Cope, or anyone else interested in stylistic modeling, is still required to select the corpus, the association between human and system output is retained; as such, the human would seemingly maintain the right to select from the system's output.

The difficulty, of course, is assigning "creativity" to such systems. Computer-generated art may be statistically novel – its specific patterns may never have been previously existent – therefore being H-creative. Artworks created by systems have proven to be valued when compared to human-created artwork: AARON's paintings have been shown in galleries, and EMI's music has been performed by symphony orchestras. While computer-generated art may not, as of yet, have produced *transformative* artworks, few human creators can claim such achievements.

By merging the disciplines of art and creativity together with scientific disciplines of computer science, we risk offending two camps at once. Those in the former field require human experience and expression, while those in the latter require pure objectivity. For example, Wiggins doesn't accept Cope's claim that "what matters most is the music" [49], and counters "with hand-coded rules of whatever kind, we can never get away from the claim that the creativity is coming from the programmer and not the program." [48].

Wiggins' own research into computational creativity is focused upon a search for a scientific solution, eliminating any subjective element from the equation. Wiggins seems to suggest that because art isn't science, its practitioners are incapable of describing what they do, and it is up to science to rectify this shortcoming [50]. He states that a failing of Lerdahl and Jackendoff's Generative Theory of Tonal Music [51] is its inability to be successfully implemented as a generative system without recourse to human knowledge [52]. Whereas Wiggins sees the need for human input as failure, I see it as hope; Wiggins seems to want to eliminate the subjective artist in favour of objective science, while I embrace the continued need for artistic involvement in generative systems [53].

Reflections on Style Modeling

My own creative research has involved creating computational systems that can be used as compositional assistants [54], or as autonomous generators of music [55]. The perception of creativity – whether it is viewed as mine mirrored through the system or possibly the system's itself – has been at the forefront of my thinking.

Earlier systems were based in models of non-western music and required human intervention for performance. For example, in *Bhatik* (2008) the music is clearly heard as being influenced by Indian and African aesthetics, yet retaining a Euro-American post-modern narrative, possibly due to the composer/programmer/performer being visible on stage, a puppet master pulling the strings of the system[2]. Non-western stylistic models could be found in the conception of the music, and the design of the system, however no direct examples of the original style were used.

Other, Previously and *Armar*

This wasn't the case in later versions of my systems, in which a corpus of stylistic examples were used to derive rules for generative purposes. *Other, Previously* (2009) used the traditional Javanese gamelan composition *Ladrang Wilugeng* [56] to derive rules for the generation and evolution of musical parts using a genetic algorithm [55][3]. The same system was used for *Armar* (2009) for four percussionists, which used traditional Cuban percussion music as a corpus. In both cases, the surface features of the model were clearly represented, while the human composer supplied the deeper formal and structural elements. The end result for the listener was curious: *Other, Previously* was orchestrated for string quartet, an extremely European ensemble; as such, the non-western influence could be heard as a form of exoticism. *Armar*, with two of its four movements orchestrated for the original Cuban instrumentation, were heard as less exotic and more as misconstrued imitation: for example, the fundamental *clave* patterns would often shift in relation to other parts, resulting in "incorrect" *Mambo* and *Mozambique* music[4].

One of the Above

A more unusual form of stylistic appropriation occurred in *One of the Above*, which consists of several movements for solo percussionist generated entirely by computational system. The intention was to create "high-modernist" music: extremely complex gestures that are difficult to perform. The unusual aspect involved audience validation: one of the four movements was human-composed, while the other three by machine, and the audience was asked to determine the difference. This was not meant as a Turing Test to prove the success of the system, but instead an effort to discover whether a computational system could accurately

[2] See http://youtu.be/R-DQ5WPd4ao for a video of this performance.
[3] See http://youtu.be/gaQfyhOiRio for a video of this performance
[4] See http://youtu.be/flCUs-uOYps for a video of this performance.

model a style, in this case, the author's own modernist style [57][5].

GESMI – Generative Electronica Statistical Modeling Instrument

Within Western contemporary art, post-modernist or otherwise, a great deal of value is still placed upon novelty; however, Electronic Dance Music (EDM) has a unique relationship between novelty and stylistic consistency. A myriad of separate styles within the genre [58] are often a combination of elements from earlier styles [59]; thus, it is important for music created within a specific style to retain very specific stylistic elements, otherwise a novel track would be considered outside the genre. Furthermore, a track's value is often based upon its ability to enforce the genre's stylistic conventions while demonstrating novelty in other aspects: for example, timbre and signal processing.

Because stylistic elements are often explicit – Wikipedia lists the "characteristics" of each style – EDM is often a project undertaken by nascent generative musician/programmers. Furthermore, EDM's repetitive nature, explicit forms, and clearly delimited style suggest a parameterized approach. As with many cases of creative modeling, initial success will tend to be encouraging to the artist: generating beats, bass lines, and synth parts that *resemble* specific dance genres is not that difficult. However, progressing to a stage where complete pieces are generated that are indiscernible from the model is another matter. In those cases, the "artistic voice" argument tends to emerge: why spend the enormous effort required to accurately emulate someone else's music, when one can easily insert algorithms that reflect one's personal aesthetic? Instead, why not generate music that is, in such cases, merely *influenced* by the corpus?

Our research within EDM has been motivated by scientific concerns – can we generatively produce complete musical pieces that are modeled on a corpus, and indistinguishable from that corpus' style? – as well as artistic: can we generate good music without being an expert in the style? [60] While GESMI has produced at least two albums worth of material that are consistent within one of two styles based on corpora of Breakbeat and House music, what I have found to be more interesting is style-mixing. For example, drum breaks occur frequently within Breakbeat music, but never within House music; by mixing the corpora of the two styles, the generated music sometimes produced unique drum breaks within a House track, a novel achievement outside of either conceptual space.

Conclusion

If one accepts that artists create unique conceptual spaces with each work – albeit spaces that are enclosed within larger spaces of their current style and the larger artistic style within which they work – the need for transformational creativity and/or Big-C creativity is not required for the acceptance of new artworks to be valued and considered creative. Even works that are never transformative can be considered masterpieces, as evidenced by compositions by Bach and Mozart. Bach was composing within the strict limitations of a late-Baroque contrapuntal style, yet managed to discover sublime combinations of pitches and rhythms that demonstrated not only his genius, but the potential for innovation within severe constraint. While current computationally creative systems based upon style modeling may not have reached such levels, they are producing novel artworks that have value, and, as such, can be considered creative.

Style modeling does not require a computer, as demonstrated by Rochberg, nor does style mixing, as evidenced by Third Stream music [61]. Computational style modeling does, however, allow for large corpora [62], much larger than could be feasibly understood by an artist; as such, the curation of such a corpora could be deemed creative and artistic in itself. While this may, on the face of it, suggest the impending irrelevance of the traditional artist, I would argue the exact opposite. The potential for neophytes to create art has always existed, and the increased power inherent in computational systems suggests this will only escalate; the separation between acceptable art and great art may narrow, but navigating the delicate balance between novelty and value will continue to require the unique characteristics of a creative artist.

[5] See http://youtu.be/gAIjQOiMG54 for a video of this performance.

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Disruptive Systems and Organizing Principles in Generative Art: Two cases (1980-ongoing) by Ernest Edmonds

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Abstract

This article explores the work of British artist and pioneer of computational art, Ernest Edmonds, and its relevance to the field of generative art. Its focus is on two important, but often overlooked, works he created: *Fifty One & Fifty Two* (1980) and *Four Shaped Forms (Park Hill B)* (2014). The article poses a number of questions about the origins and development of these works. How were these works created and what inspired their creation? How are they connected? Based upon an analysis of material held in Ernest Edmonds's Archive, the National Archive of Computer Based Art and Design at the Victoria & Albert Museum, London, and a series of interviews conducted with Edmonds by the author, the article provides answers to these questions.

Keywords

Interactive art; generative art; computational art; computation and creativity, Ernest Edmonds (b. 1942); art and technology.

Introduction

Ernest Edmonds (b. London, 1942) is a British artist who has been active in the field of interactive and generative art since the late 1960s. This article first examines the artist's background, context and key works engaged with the notions of color, structure, time, and interaction. Looking at how some of Edmond's works have been created, this paper investigates how they disrupt the formal systems of art perception, particularly through interactivity and audience participation. From the late 1960s through the following two decades, most of Edmonds' work has been either concerned with the implications of the notion of computation, exemplified by his seminal work *Nineteen* (1968-9), or with the application of Systems approaches to the construction of art works, such as in *Communication Game* (1970), as described below. Nonetheless, in the early 1980s, Edmonds carried out a parallel experimentation in art concerned with the organization and structure of surfaces and colors, both in terms of process and execution. The results, analyzed in this article in detail, included two important, but often overlooked, painting works, *Fifty One & Fifty Two* (1980) and *Four Shaped Forms (Park Hill B)* (2014). As the article will demonstrate, despite the thirty-four year gap that separates these works, the way they were created and similarities that connect them, help us understand one of the key developments of generative art from its very early stages as well as its evolution up to the present time.

Artist's Background, Context and Key Works

Ernest Edmonds is a pioneer of computational art whose work has been engaged with the notions of color, structure, time, and interaction from the late 1960s. As demonstrated by a number of recent studies and art exhibitions, his work has contributed to establishing a link, often overlooked, with the structural research conducted in the late nineteenth century by Paul Cézanne and the subsequent developments carried out by constructivist artists in the 20th century. [1]

Edmonds's background in mathematics, philosophy, and logic has provided opportunities for interdisciplinary exchanges that have had a profound impact upon the nature of his art. These studies enabled Edmonds to explore new ideas in art through the use of technology that have become a constant stimulus in his creative research.

Edmonds's art is rooted in Constructivism, an art movement established in Russia in the late 1910s to the early 1920s. Constructivists aimed to design objects with a new, revolutionary, and functional approach. Inspired by such ideas, Edmonds soon developed his own artistic language based on an ongoing dialogue around color, structure, time, and interaction.

Among Edmonds's early influences in art was Cézanne and his research on structure conducted through direct observation of nature and the unique way he represented volumes and space through color. Cézanne represented for Edmonds the high point in his understanding of color and structure. But it was the work of Henry Matisse and its bold colorism that particularly influenced him in his use of color. Visiting the Tate Gallery in London as an undergraduate student, Edmonds admired the master's technique and studied his secrets behind the use of color as a vehicle giving balance to a composition while creating visual sensations. It was then that he realized that color has structure, a notion that continues to be a central focus in his art practice today. Works such as his early 1970s sprayed painting reliefs, the paintings *Jasper B* and *C* (1988), and his most recent developments demonstrate this.

From the early 1960s, Edmonds began experimenting with structure in his work, in his painting, drawing, and poetry. His early watercolors, his drawings in china black ink from the early 1960s, and later paintings created between 1974 and 1982 using acrylic paint, depict geometrical abstract shapes. These works reference the iconic color structures of the Dutch artist Piet Mondrian and the experimental American artist Charles Joseph Biederman's evolution of constructivism. A work such as *Nineteen* (1968–1969), which will be described below, provides a link to Edmonds's early experiments in structure using a computer.

In the early 1980s, Edmonds's work evolved towards a praxis increasingly engaged with the notion of time. This was made possible in part by the introduction and availability of the personal computer. This represents a pivotal moment in the artist's career: when he realized there was a way in which he could combine his research into structure and add time to it, making time-based art.

Edmonds' insight was that logic programming, one of the four main computer programming paradigms, based on axioms and goal statements, could be applied in art to make generative work integrated with the notion of time. As the artist explained in 2012, [2] logic programming can be used as a method for handling structures in time by visually representing the internal search process within a computer. Time can be used to make generative work in which the rules, specified in logic, control the form and order of a sequence of images. The sequence can go on forever without loops, depending on the rules. The logic specifies how the work unfolds; both the structure of each individual image and its structure in time. The details of this depend on a particular way of using logic in computer systems known as logic programs. In this method, a set of logical statements (in this case about the design of images) is interpreted as a program that instructs the computer to search for some specific goal or state (in this case of the image). An important element of logic programming is that it includes "backtracking," where, when certain rules have been tried and fail to get to the goal, the computer goes back and looks for alternative ways of using the rules. In what Edmonds calls his *video constructs*, a series of works created in the early 1980s, this process of backtracking is used to generate an unfolding search and the artwork, the image sequence, is a trace of this search. [3]

Interactivity

Interactivity has been a central concern in Edmonds's work since the late 1960s. [4] It developed more visibly when Edmonds collaborated with British artist Stroud Cornock to produce **DATAPACK* (1970), an interactive piece shown at the Computer Graphics 70 exhibition held at Brunel University in Uxbridge, London. **DATAPACK* represents an early interactive computer-based art system. The work was, as Cornock described it in 1973, "an example of a matrix that consists of participants, a display, a computer installation and a designated area around the Vickers Building next to the Tate Gallery in London." [5] **DATAPACK* was a system that allowed participants to have a "pseudo-English conversation" with the computer. The results of this conversation were then processed by the machine connected to drum plotter. This was able to identify a volume of space around the Vickers (now known as the Millbank Tower) and allocate it to the active participant. Part of the output of this process was a drawing, made by the plotter, using impulses collated from the participant's data. **DATAPACK* represents an early investigation into the potentially changing relationship between artist and viewer or "participant," accelerated by the intervention of the computer.

Nineteen (1968–1969) (Figure 1) embodies Edmonds's first use of a computer program in his art. A computer-program approach, which Edmonds had used in 1968 to solve a mathematical logic problem, was applied by the artist to compose his work *Nineteen*, "in order to try to structure the work according to a set of pre-defined rules." *Nineteen* was first exhibited in the *Invention of Problems* exhibition at the City of Leicester Polytechnic (now De Montfort University) in 1970. It was a large panel measuring 135 × 170 × 15 cm, which consisted of twenty squared reliefs attached to a white supporting structure and arranged in a grid of five pieces wide by four high. Each piece shows a number of abstract shapes delineated by vibrant colors. The variety of forms and colors, and the ways the pieces were juxtaposed, created a dynamic composition that vibrates in front of the viewer's eyes. Shadows and reflections added extra depth and sophistication to the orthogonal structure making the work inseparable from its environment.

Figure 1: Ernest Edmonds, *Nineteen*, 1968–1969. ©Ernest Edmonds. Image courtesy of the artist.

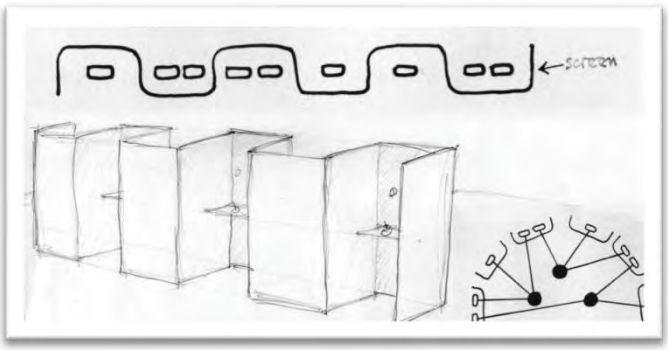

Figure 2: Ernest Edmonds, *Communications Game*, 1970. ©Ernest Edmonds. Image courtesy of the artist.

Figure 3: Ernest Edmonds, *Fifty One & Fifty Two*, 1980. ©Ernest Edmonds. Image courtesy of the artist.

Communication Games (1970) (Figure 2) represents Edmonds's original network communication art system conceived in 1970. *Communications Game* was originally a proposal for the Computer '70 trade exhibition held at Olympia, London, in September 1970, but it was not carried out, and the detailed design of required input/output devices was not specified. It was proposed that the system of the project be controlled by a "digital computer." The work was later produced and shown in the Invention of Problems II exhibition at the City of Leicester Polytechnic in 1971. It included stations for a maximum of six participants. The stations were arranged so that participants could not see one another, but could see one or two stimulus-providing units within the station. Each unit could be acted upon by the participant in response to a given stimulus. No instructions were given to participants on the manner in which the system of units operated. The idea behind *Communications Game* was to see art as a communication or interaction between people enabled by technology.

Through such projects, Edmonds demonstrates how color, structure, time, and interaction influence each other. The viewer becomes an active participant, bringing new unexpected turns to the artist's work. These interchanges are a constant stimulus in Edmond's explorations in art. They represent a path towards the creation of new constructs in art that technology has enabled and that Edmonds has, over the last forty years, made visible.

Fifty One & Fifty Two (1980)

Fifty One & Fifty Two (Figure 3) are part of a series of acrylic paintings on canvas created by Edmonds in 1980, when exploring new ways of structuring and executing an artwork by using rules as organizing principles. This was a direct consequence of the discovery of the value of the computer in organizing the structure of an artwork Edmonds made in 1968 when he created *Nineteen*. This discovery also taught Edmonds that the computational process was of interest to the making process of an artwork.

Fifty One & Fifty Two were structured in two concurrent respects: firstly, the organization of the surface and the colors; secondly, the process of execution of the painting. As to the organizational aspect of the artwork, this had no implications on how it was done, whereas the process drove how the painting was made, in what order the paint was applied, and where.

Fifty One & Fifty Two are two separate squared canvases placed side by side and represent two variations of a theme, or structure. Each one uses three basic colors, called "seeds colors." Let us take the first variation, *Fifty One* (Figure 3, on the left), as an example. The first rule specified by the artist is that the image be divided into nine sections of equal area that define a three by three grid. There should be three seeds colors in it; each of those three colors should be allocated a square in the grid where none of them has to appear on the same row or column as another. For ease of explanation, Figure 4 exemplifies the grid; the numbers in it refer to a specific square in the grid. The three seeds colors in *Fifty One* therefore appear in square number 4, 2 and 9.

1	2	3
4	5	6
7	8	9

Figure 4: organizing grid (*Fifty One & Fifty Two*).

The second organizing rule states that when any one of these colors appears in any particular row or column, then such color has to be in all of that row or column. So for example, the color in 9 has to appear in 7, 8, 6 and 3; the color in 2 has to appear in 1,2,3,5 and 8; and the color in 4 has to appear in 1,7,5 and 6.

As to the process of execution of the painting, this followed other sets of rules. The paint was applied with an electric way control spray gun. As one of the organizing rules implied the presence of two colors in one single square of the grid, the artist decided that, when combining the two colors, they should be sprayed both without mixing them. This created a result that visually recalls the work of Seurat, where the combination of different colors appears unified by the physical process made by the eye of the viewer.

Edmonds decided to make the spraying process obvious, so the colors were intentionally sprayed lightly. This meant that the direction of the spray was made visible. The artist therefore chose three ways of spraying: bottom left to right top, horizontally, and top left bottom right. These three directions formed, similarly to the three seeds colors mentioned before, three different generating squares following the same organizing rules set up for each seed color. As a result, if square 8 was allocated horizontal spray, then 7, 8, 9, 5 and 2 will have to use horizontal spray, and so on. There are now two overlapping patterns: the pattern of colors and the pattern of spraying. In this way, the artist has defined the structure of the organizational elements of the painting, and the process of making it. The second painting, *Fifty Two* (Figure 3, on the right) is a variation of the same theme, where the allocation of the colors and spraying directions are changed.

For Edmonds, this process of creating an artwork derived from two important sources of inspiration. Firstly, as mentioned above, was the process activated by *Nineteen*, which represented to Edmonds the first critical point of change in his art. Secondly, was the work of Charles Biederman.

The first major retrospective of Biederman's work was organized by Robyn Denny for the British Arts Council in 1969 at the Hayward Gallery in London. The exhibition had a strong impact on the art community at that time. The exhibition was then shown at the Museum and Art Gallery in Leicester. Edmonds visited the exhibition at both venues and was overwhelmed by Biederman's work, particularly the simplicity in which he constructed and organized his reliefs, and the effect that bold shining colors had on the reliefs' aluminium surfaces.

It was particularly the way Biederman understood art as the solution of a problem to be found in pure observation that connected with Edmonds' research and art practice. As Biederman suggested, "Nature teaches us the methods and structural conditions by which to solve problems." [6] The next step for the artist was to abstract from the structural process of nature. This point led to the notion of structural procedure and minimal complexity that excited Edmonds' curiosity. It was the way reliefs were constructed without having anything excessive - no redundancy, - that interested Edmonds the most. After visiting the Hayward Gallery exhibition, Edmonds studied Biederman's works in more detail when the retrospective moved to Leicester.

> It was seeing Charles Biederman's exhibition in London that really settled my decision to minimise the elements with which I worked in order to maximise the potential richness of what I was able to produce. [7]

These two experiences helped Edmonds crystallize the understanding that making the elements of the work simpler added power to his work. As he learned more psychology through his interest in human-computer interaction, then he came to understand that actually there is nothing surprising about that and there are many examples from psychological experiments that show how our mental processes deal much better with constrained choice situations than unconstrained choice situations.

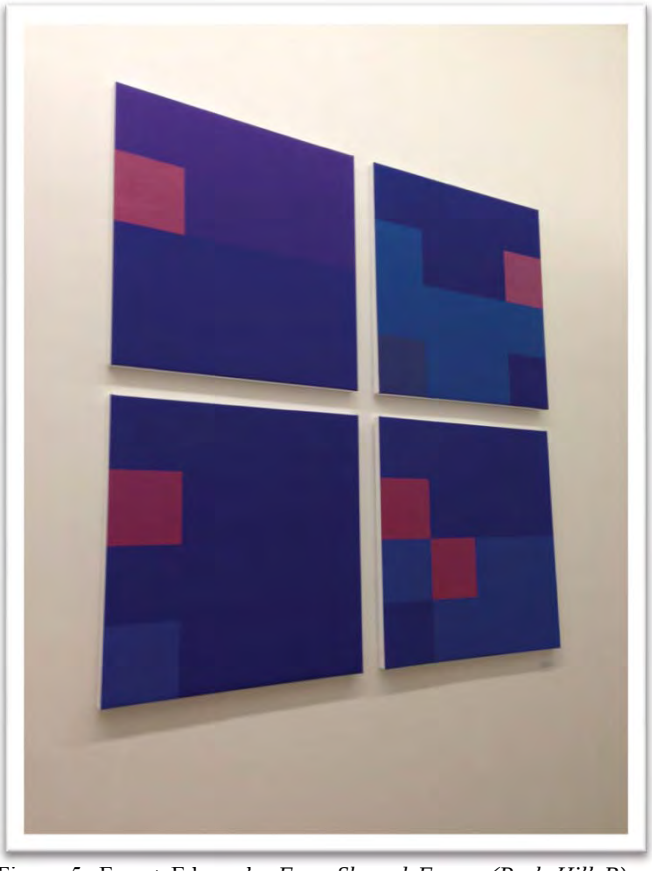

Figure 5: Ernest Edmonds, *Four Shaped Forms (Park Hill B)*, 2014. ©Ernest Edmonds. Image courtesy of the artist.

Four Shaped Forms (Park Hill B) (2014)

Four Shaped Forms (Park Hill B) (Figure 5) is a four-piece of acrylic paint on canvas strongly connected to *Shaping Forms*, a series of time-based works Edmonds made from 2007 exploring the notion of interaction. Interaction has been one of the focuses of Edmonds' investigations, initiated by works such as *Communication Game*, as analyzed above. It developed even further in recent years, as demonstrated by his *Shaping Forms* series. Here, interaction is intended as an exploration of "long term influences rather than short term reactions." [8]

Shaping Forms (Figure 6) are a series of generative and computational works displayed on a square monitor, surrounded by a purpose-designed frame built in plastic and wood by the artist. *Shaping Forms* are individual works where images are constantly generated by a computer program that decides which colors, patterns, and timing the work should display at any given moment. The movement in front of each work is detected by a camera and produces changes in the image, shape, and duration, so that the environment, the active spectator, and the work influence each other. Edmonds once described his unique way of perceiving interactivity in his art as an interest in "seeing how computer generated art systems can interact with the most purposeful enquiring systems—human beings." He continues,

> I am interested in how humans react to artworks that behave differently because of their presence and whose form and appearance change over time…The atmosphere, the light, the space, the audience are all part of the experience of a work…In interactive art, the audience is deliberately made a component of the work: the person in the art space becomes an active participant. In participative interaction, the artefact is just one element of the whole experiential space. [9]

The four canvases making *Four Shaped Forms (Park Hill B)*, represent four variations of a theme directly connected to *Shaping Forms*. The selection of colors, in both cases, is generated from a system that uses color models, where the hues are equidistant according to some rule and the saturation levels are the same or close together according to a system.

In *Four Shaped Forms,* the structure of the elements within the picture organized in a four by four square grid looks similar to the way *Fifty One & Two* were organized. As a matter of fact, its structure is much more complex and less easily explained by geometry, as *Four Shaped Forms* are four moments selected out of a time-based sequence. The way *Four Shaped Forms* is structured is therefore more obscure, but nevertheless it provided Edmonds with a procedure and process for generating the images in a rigorous way, similarly to the earlier experiences of *Nineteen* and *Fifty One & Two*.

Figure 6: Ernest Edmonds, *Shaping Forms*, 2007. ©Ernest Edmonds. Image courtesy of the artist.

The colors and patterns chosen for each canvas of *Four Shaped Forms* are selected by the artist from stills of *Shaping Forms*. The colors are then manipulated and adjusted by eye onto the canvas. The dialogue that this relationship creates between the time-based work and the paintings is strong. In the time-based works, the viewer can only appreciate colors and patterns in one sequence with different lengths of time between them, which generates a kind of rhythm through time. Although this musical quality is lost in the paintings, by looking at the four variations of *Four Shaped Forms,* the viewer is able to experience four different moments of a theme at the same time.

Conclusions

This article has explored a selection of works by Ernest Edmonds that delineates one of the possible roots of the very complex field of generative art. The mathematical rules applied by the artist to create *Fifty One & Two* and the software work that inspired *Four Shaped Forms* have generated paintings that are in constant dialogue with their computational counterparts, *Nineteen* (1968-9) and *Shaping Forms* (2007). *Fifty One & Two* and *Four Shaped Forms* demonstrate that rules and computation methods can be seen as inventive forces that delineate a new order in the creative process of an artist. Although the computer was not used directly to create such works, these could have not been created without the earlier computational works generated and programmed by Edmonds from the late 1960s onwards. There is a dialogue between the painting works and the software pieces analyzed in this article,

and they represent one of the developments of generative computational art that is in constant evolution.

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From Immateriality to Neomateriality: Art and the Conditions of Digital Materiality

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Abstract

This paper explores the evolution of materialities in the context of art and digital technologies and proposes "neomateriality" as a current condition of material and objecthood. It traces the evolution from dematerialization and the immaterial to hypermateriality and neomateriality as a term capturing various disruptions that introduce new aesthetic paradigms. The concept of neomateriality strives to describe an objecthood that incorporates networked digital technologies, and embeds, processes, and reflects back the data of humans and the environment, or reveals its own coded materiality and the way in which digital processes see our world.

Keywords

digital objecthood, immateriality, hypermateriality, neomateriality, post-digital, post-Internet, new aesthetics, coded material

Introduction

The materiality of the digital has been transformed as technologies developed over the past decades. Digital and networked art has commonly been classified as immaterial, an understanding that builds on the dematerialization of the art object in the art of the 1960s and 70s (in Conceptual art, happenings, Fluxus etc.) and emphasizes the coded, software components of the digital medium. In the past decade, in particular, discourse surrounding digital art has returned to the material realm. The terms post-digital and post-Internet art attempt to describe a condition of artworks and "objects" that are conceptually and practically shaped by the Internet and digital processes yet often manifest in material form.

Bernard Stiegler has used the term "hypermaterialization" to describe a form of everyday reality where material appliances transform everything into information and subject it to endless transformation. While Stiegler's term captures the gathering, monitoring and processing of information through material devices, it does not focus on materiality that is a residue of the digital process forming it or on the affective aspects of materials that are shaped by "human data" and mirror and reflect us back to ourselves. Hypermateriality does not account for "the machines waving back at us," as James Bridle would put it. [1] The concept of neomateriality is proposed here to describe an objecthood that incorporates networked digital technologies, and embeds, processes, and reflects back the data of humans and the environment, or reveals its own coded materiality and the way in which digital processes see our world. Neomateriality is understood as different from the theories of neomaterialism that emerged in the 1930s and investigated relationships between human activities and the productive capacity of the environment in the concept of anthropology and evolution. Artworks by Clement Valla, Sterling Crispin, and Ashley Zelinskie are used as examples that reflect or become a residue of the concept of neomateriality.

Post-Digital and The New Aesthetic

As digital technologies have "infiltrated" almost all aspects of art making, many artists, curators, and theorists have pronounced an age of the "post-digital" and "post-Internet" that finds its artistic expression in works both deeply informed by digital technologies and networks, yet crossing boundaries between media in their final form. The terms attempt to describe a condition of artworks and "objects" that are conceptually and physically shaped by the Internet and digital processes – taking their language for granted – yet manifest in the material form of objects such as paintings, sculptures, or photographs.

The condition described by the "post-" label is a new, important one: a post-medium condition in which media in their originally defined format (e.g. video as a linear electronic image) cease to exist and new forms of materiality emerge. However, the label itself is problematic in that it suggests a temporal condition while we are by no means *after* the Internet or the digital. Internet art and digital art, like good old-fashioned painting, are not obsolete and will continue to thrive. Nevertheless, post-digital and post-Internet represent a condition of our time and form of artistic practice and are closely related to the notion of a "New Aesthetic," a concept originally outlined by James Bridle's at SXSW and on his Tumblr. [2] The New Aesthetic, in particular, captures the process of seeing like and being seen through digital devices. The post-digital and New Aesthetic provide us with a blurry picture or perhaps the equivalent of a "poor image" as Hito Steyerl would understand it, a "copy

in motion" with substandard resolution, a "ghost of an image" and "a visual idea in its very becoming," yet an image that is of value because it is all about "its own real conditions of existence." [3] Whether one believes in the theoretical and art-historical value of the post-digital, post-Internet, and New Aesthetic concepts or not, their rapid spread throughout art networks testifies to a need for terminologies that capture a certain condition of cultural and artistic practice in the early 21st century.

From Immateriality to Neomateriality

The era of the post-digital and New Aesthetic marks a new stage in the relationship between digital technologies and materiality. In the late 1960s and early 70s, Lucy Lippard theorized the dematerialization of the art object. [4] While Lippard did not explicitly talk about digital art, the art forms she examines – such as Fluxus and happenings – are today considered part of the lineage of digital art and emerged in a cultural climate that was infused by cybernetics and systems aesthetics. Over the following decades a slow process of rematerialization occurred. While Jean-François Lyotard's exhibition *Les Immatériaux* (1985, Centre Georges Pompidou, Paris) seemingly highlighted immateriality it in fact also argued that the immaterial is matter subjected to interaction and conceptual processes. Bernard Stiegler equally believes that there is nothing that is not ultimately in a material state, and the immaterial therefore does not even exist on a nanolevel. [5] Stiegler says:

> *I call hypermaterial a complex of energy and information where it is no longer possible to distinguish its matter from its form […] a process where information – which is presented as form – is in reality a sequence of states of matter produced by materials and apparatuses, by techno-logical devices in which the separation of form and matter is totally devoid of meaning.*

This, Stiegler concludes, is not dematerialization but hypermaterialization. While Stiegler's term grasps the gathering, monitoring and processing of information through material devices, it focuses on sequences of states rather than, for example, the affective aspects of materials that are shaped by data and mirror and reflect us and the environments we inhabit back to ourselves. Stiegler's hypermaterialization does not highlight the state of materials waving back at us or objects representing how the machine sand softwares we created perceive us. I propose the notion of neomateriality to capture an objecthood that incorporates networked digital technologies and embeds, processes, and reflects back the data of humans and the environment, or reveals its own coded materiality and the way in which digital processes perceive and shape our world. Neomateriality describes a twofold operation: first, the confluence and convergence of digital technologies in various materialities; and second, the ways in which this merger has changed our relationship with these materialities and our representation as subjects.

Neomateriality describes the embeddedness of the digital in the objects, images, and structures we encounter on a daily basis and the way we understand ourselves in relation to them. It finds different kinds of expression within contemporary culture and artistic practice in the form of objects or artworks that 1) use embedded networked technologies, reflecting back their surrounding human and non-human environment; 2) reveal their own coded materiality as part of their form, thereby becoming themselves a residue of digital processes; 3) reflect the way in which digital machines and processes (seemingly autonomously) perceive us and our world.

What distinguishes most digital art – and software art, in particular – from other artistic practices, is that its medium resides in distinct materialities. Paintings, for example, allow us to perceive the brush stroke or paint splatter that created them and film consists of consecutive frames of images. In digital art the visual results of the artwork – no matter how "painterly" or "cinematic" – are derived from code and mathematical expression. The back end of the work and its visual front end typically remain disconnected. Code has also been referred to as the medium, the "paint and canvas," of the digital artist but it transcends this metaphor in that it even allows artists to write their own tools – to stay with the metaphor, the medium in this case also enables the artist to create the paintbrush and palette. Artistic practice engaging with conditions of neomateriality often highlight this condition by turning code and abstraction into the material framework of an object.

Figure 1. Ashley Zelinskie, *Space* Triangle, 2014; 3d printed PLA (eco friendly plastic); 12 x 12 x 12 in. © Ashley Zelinski.

Ashley Zelinskie's *Reverse Abstraction* series [Figure 1] engages with the different languages, concrete and abstract, through which humans and machines perceive the world. Objects and forms cannot be perceived by computers without layers of abstraction while the codes that make computers run or execute operations are not necessarily readable by humans. *Reverse Abstraction* constructs traditional objects out of material representations of the hexadecimal and binary codes that allows a computer to construct them. If computers were to read the code that constructs the artworks they would "see" the form that a human perceives. Transforming abstraction into material, Zelinskie's project strives to dissolve the duality of human and machine.

A different take on form as a coded materiality is provided by Clement Valla's *Surface Proxy* series (2015), which consists of objects literally wrapped in their own representation. The starting point for these objects were iconic, intact architectural fragments, all of French origin, from the RISD Museum in Providence, Rhode Island, as well as the Metropolitan Museum and the Cloisters in New York. Valla employed these historical relics as a basis for a complex process of remediation. Using 123d catch, an app that lets users create 3D scans of virtually any object, Valla produced 3D models of the architectural fragments. These 3D models where then digitally draped with cloth by means of the 3D graphics and animation software Blender and the surface of the original object was virtually imprinted on the cloth. After this process of digital remediation, the virtual objects were translated back into the real world. The cloth depicting the image was printed using an inkjet printer and wrapped around a 3D print of the object's form. The object is re-skinned by its own image in an analogue version of texture-mapping. [Figure 2] The image has to fragment and splinter itself in order to conform to the object it strives to represent. The object's surface functions as both a stand-in and questions its own authority to represent the object.

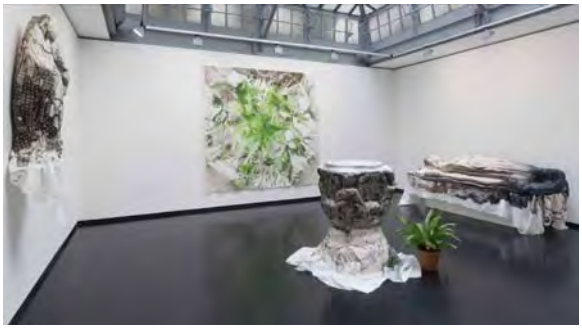

Figure 2. Clement Valla, Surface Proxy (2015). Installation shot, xpo gallery, Paris, France.

In the *Surface Proxy* exhibition at xpo gallery in Paris, this fragmentation unwraps itself in only one instance. While scanning one of the original architectural fragments in the Cloisters, a plant unavoidably was captured, too. Rather than wrapping a 3D print of a plant, Valla decided to exhibit an actual plant next to the relic and to display the unfolded version of the wrap generated from the virtual model of the plant on the wall next to it. Living nature thereby resists presenting itself as iconic.

Sterling Crispin's *Data-masks* (2013 - present), by contrast, reflect on the way digital technologies "perceive" us and construct our identity. Crispin uses face recognition and face detection algorithms for producing human-like faces that take the physical form of masks. In Crispin's work, mathematical analysis of biological data becomes material form revealing how software systems represent human identity. What distinguishes *Data-masks* [Figure 3] from other virtual representations of human faces and bodies – such as 3D models or renderings – is the fact that their creation involves softwares designed to determine identity and thereby demonstrates their process. Sterling sees his work as an instance of the digital panopticon staring back into its own mind. [6] The 3D-printed face masks were algorithmically evolved to satisfy facial recognition algorithms: the software creates a materiality that reflects a seemingly autonomous machine vision of identity.

Figure 3. Sterling Crispin, *Data-masks*. From left to right: *Zuck Blister*, 2015; 3D Printed Nylon, Facial Recognition, Genetic Algorithms; 7 x 10 x 4.5 in. *Chronos (Greco)*, 2014; 3D Printed Nylon, Facial Recognition, Genetic Algorithms; 7 x 10 x 4.5 in. *Kodama*, 2015; 3D Printed Nylon, Facial Recognition, Genetic Algorithms; 7 x 10 x 4.5 in. ©Sterling Crispin.

New technologies of representation always introduce new complexities and render image flow and materiality problematic in different ways. Digital technologies have

introduced new ways of "seeing" the world and of rendering objects. Digital materiality in the age of the Internet of Things (as the network of physical objects or "things" embedded with electronics, software, sensors and connectivity) and the quantified self (as data acquisition on aspects of a person's daily life through wearable sensors and computing) means that objects are constructed by and understood through the language of the digital. The new digital materiality is characterized by processes of seeing like and being seen through digital devices and has changed our relationship with objecthood and our representation a subjects.

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Author Biography

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LiveCoding Readings. Algorithms viewed as text/image

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Abstract

As new ways to represent text/image in unison with other arts, LiveCoding sessions have been one of the contemporary options where the union of music, visuals, algorithms and science get together to make a community experience. The live programming performances where the music or visual result is part of a whole experience that join with the programming algorithms to build a new layer of text that can be experienced not just as a process but as a narrative by itself. The Sound result can be perceived not as an audio performance but as the relationship with the algorithms that create not just a series of instructions but a visual and abstract representation of what you heard combining images to create and share a process.

Keywords

LiveCoding, Digital, Visual, Music, Receiver, Image, New Text.

Introduction

As new ways of constructing narratives through more scientific languages, and as part of bringing back the use of algorithms to build a set of rules to conform a more aesthetic visual/sound result, LiveCoding is part of the contemporary practices in Art, which uses it along all kinds of knowledge to experience aesthetic processes. As told, the use of algorithms is not new in art. During the 50's, Ben F. Laposky[1] created a series of pictures called "Electronic Abstractions: Oscillons", generated through algorithms on an oscilloscope that produced wave shapes. Since then, the use of a specific language, plus the construction of modern computers, allowed other ways to produce culture. LiveCoding is, as Alex McLean[2] describes: "writing in a computer program while it runs". We are now able, not only to show the sound/visual result, but also the code itself, as part of a sharing process. The projection of the code transforms into a complex language to communicate something to the interface, as well as a piece of a visual section that interacts with the spectator. So, at the end, even though it is a complex perception, the challenge -as McLean[3] said-, is to build new forms of making an enjoyable programing code screening for every audience and, therefore, to construct and make possible the interaction between a range of different texts, perceiving text as an image, and an image as something that we recover from our historical memory archives.

The Communication Practice in LiveCoding

From an emerging perspective, one can't consider any human action without a communication practice, where images are created during the interaction. On the other hand, classical communication model consists of a transmitter, a message containing a code, and a receiver. But this model does not help us anymore to perceive what is happening with LiveCoding as an emerging artistic practice. During LiveCoding Practices, both, transmitter and receiver, manifest themselves within a specific context sharing images as the common element that both are capable to enjoy, even if they do not know anything about how LiveCoding is done. They do not need anything to discover common images, because many of them belong to collective memory archives: including the exploration of a logical use of programing code. However, it is necessary to update the communication practices, since models that help us to organize our thinking are not immutable.

Practices

In artistic productions like LiveCoding sessions, which is not a linguistic manifestation but live programming used to generate feeling experiences, there is a chain of riddles that has to be updated by the receiver as well as by the transmitter. LiveCoding sessions are images that belong to the body, as Hans Belting says in his book "Anthropology of the Image"[4]. So the receiver is transformed into an actor instead of being only a contemplative body. This one opens its own archives to activate images to make connection with the code itself and its graphic composition. From this perspective, there is nothing to understand, because there are not messages to transmit, but there are images that are open during the experience of living a LiveCoding session, and are shared in community. On the other hand, the transmitter produces or builds sensitive real-time immediate experiences, and consumes and produces the image as the receiver does it. It is a fact that the transmitter and receiver are presented in LiveCoding sessions not as opposites, as they are presented in the traditional communication model, but as two active elements interacting within a context that defines, perceptively, the programing language used, in this case, "productive or constructive coding". We do not call it "creative coding" because there is nothing to create, and particularly, because nothing is created if we do

not open archives from our historical collective memory. We do not create anything, we produce or build images taking as a start what we have experienced and learnt. But, which are these kinds of images? Are they expressive? Are they poetic? Are they practical? Are they common images? We do not need to forget how we perceive images. Images are contemplated in its widest range of possibilities. We want to say that images are considered as sound and visual, shape and content, particularly, because the shape is already given, so we need to work with the content, that is a synonym of idea. In this emerging communication practice both, the transmitter and the receiver, become triggers of opening images archives they active on. On one hand, there is a manifestation from the transmitter, which will not only generate images as feelings that the receiver has never experienced, but also will make this person conscious about opening his o her own archives (conscious or unconscious) during the LiveCoding session, while they are making their proposal, manage information, perceive the constructive intention of the images, and the enunciation to recover a historical image body loaded of all their immediate references and their entire historical archives that are not seen in the use of the production. This is the point when LiveCoding, as an image body, generates what we call “new feeling”.

On the other hand, receivers, like the transmitters, but in backwards operation, face the problem to generate images that are going to be perceive by themselves in order to feel them; the issue to identify the transmitter’s production; perceive the goal of the LiveCoding session; feel the crash between, the personal own images opened form collective archives, and the images given by the transmitter. These interactions now acquire a perceptive and generative character, because they address receivers, depending on his immediate and historical images and the fact that both are able to make meaningful the programming constructive code. This is also the moment in which empathy is given between the image body (perceiving the image body as LiveCoding session) and the receiver; thus, both operate on it. At this moment the LiveCoding session is a heap of information that receivers must update, otherwise it is incomplete. As Hans Belting[5] says, there is a missing link between transmitters and receivers where they do not interact with other system of thinking the image that converge on LiveCoding sessions for the reason that it is riddled with unsaid and invisible things.

The Image

LiveCoding sessions are corporal images. They are made using algorithms. It is not given from a context where the distance between transmitter and receiver is like in the traditional communication model. In these, the distance, between the main communication’s actors, does not exist. Instead, the main goal is creating a community. Community is understood as a group of receivers/producers that can and have the opportunity to interact and create a meaningful dialogue during and after LiveCoding sessions. Therefore, the concept of LiveCoding goes beyond sharing the screen. It is the practice where images, generated between code/algorithm and visual/sound results, by the programmer, and the spectator is vital. Where a bond will be created and will last beyond the moment of the session itself.

LiveCoding makes use programming-codes for the implementation of immediate and unrepeatable pieces for both: programmer and spectator. So, a connection exists between algorithmic writing and the product, as well between transmitter and receiver. The projection and speakers give the space/time bifurcation between the computer and the product; it is what the receiver (audience) witnesses in real time, which result in the modification of instructions, processes, and information that the receiver legitimates the production beyond from an aesthetic or artistic discussion. Thereupon the transmitter is able to establish strategic, as Hans Belting[6] says: images are democratic and translate them into an action that takes place in a space/time shared by the transmitter and the receiver within an image body. In LiveCoding sessions, there is convergence an emerging way of thinking the image as complex as the image is. It does not matter if it is musical/visual languages, algorithms, digital media, grammatical semantics of the textual body, etc. As previously stated, the communication model needs to be updated. Specially, due of the fact that new practices are emerging, such as the programming code is employed in LiveCoding sessions.

Author/Transmitter/Builder/Actor/Activating

In this adaptation of the communication practice: LiveCoding sessions, authors remain as ghosts operating as archives openers within the image body, in order to be active actors building an immediate and active image or recovering that image from the memory through algorithms. The cooperation between image body and receivers goes away from the ghostly figures of the relationship that they have with regular texts. Authors’ role in a LiveCoding session is present, immediate and irreproducible, since it occurs in real time. From this perspective authors, as consumers and producers of images, are also builders of immediacy, instantaneity, spontaneity, and experimental experiences. Their presence is crucial as trigger of the process that will take place when the receptors are collaborating with the image body, communicating impressions and perceptions, converging on a space/real time, betting on the construction of the transmitters as builders of the simple image body, but complex in their perception and reconstructions of images.

When the receivers open an image from their historical archives, is similar to opening a world of meanings that converge in its conceptualization. Considering the single concept of "salt", say in the immediacy of usage. This opens the door for the meaning of "seasoning", but also reveals its historicity to let us know that, at some historical point, “salt” meant "money", "conservation", "travel", "marketing", "exchange", "sodium chloride", "kitchen chemistry", "laboratory", etc. The concept of “salt” has mutated through history, but that history has not been re-

moved from the concept itself, it has rather been absorbed by it. This suggests the way in which the concept of receivers has mutated into a viewer/trigger, although their passive role is contemplation. The receivers as consumer and producer of images confront, in the image body's space, their own perceptions with the perceptions of the transmitters. Their own immediate and historical memories, the elements that have allowed them to adapt to the space/time to get into the more complex conceptualization of the same space/time where now he/she is nothing more than a viewer, but they can act, in the sense of collaborating within the context altering their own perception and the perception itself. However, this trans-mutated Receiver/Viewer/Activating/Actor collaboration is not simple.

A) Receiver/Viewer/Activating/Actor Basic Visual/Sound.

This kind of receivers are the ones who, first experienced a LiveCoding session and faced the bombing of images systems that they had to interact with, and has two options: accept it or reject it.

1. This kind of receivers accept LiveCoding because they have the pseudo-conceptual skills to experienced, or have the attitude of being exposed to new aesthetics experiences. Aesthetics is perceived as: the first time, the viewer exposed himself to the experience LiveCoding sessions. They are newbies introduced to the world of programming constructing code which converge in building images, sounds, grammar, mathematics, psychedelia, etc.

2. These kind of receivers reject LiveCoding in terms that they reject both: digital technology as a tool which allows to mix, apparently, different images (sound and visual), and to be challenged cognitively in order to be exposed to complex image body that has to be learned in order to be experienced, and at the same time processed.

B) Receiver/Viewer/Activating/Actor Synthetic Visual/Sound.

These receivers are neither newbies, nor experts in going LiveCoding sessions or writing algorithms structures. They have cognitive skills capable to live a Visual/Sound experience given by LiveCoding sessions. They are interested in getting involved with constructive processes through digital technology, access to it and see the potential for this process but they do not consider it as art. Thus, these kinds of receivers have the opportunity to access by two approaches to the Image/Algorithm:

1. Examining readily recognizable concepts, since programming code that are used in these platforms are based on structures that are built with English words. So, a simple instruction like /*color (255)*/ in the Processing platform can lead receivers to the conceptualization of what is happening in real time. In this case, a visual result through the word "color".

2. Receiver tend to explore visually any algorithmic result, not as a series of instructions that impact immediately in an audible and/or visual result, but in a series of graphic elements that reminds the textual body exploration. Not as communicative result itself but as graphic compositions and explorations that visual producers like Joseph Beuys performed in some of his paintings in which he wrote a list of objects, for the simple fact that graph words generate an image aesthetic sense.

C) Receiver/Viewer/Activating/Actor Specialist Visual/Sound.

These receivers are part of the community; converge in constructing and collaborative processes that accurately communicate perceptions of using of Digital Technologies and Programming Codes experimentally and immediate real experience LiveCoding sessions. They know and manage several programs that are used in these practices and, at least, they are specialists in some of them in two areas where LiveCoding sessions happen: the use of programming code of the image, or the use of sound programming code. They are not exactly Visual Artists. Fitting here, there are professional people interested in the phenomenon of the use of a specific programing languages, and even scientists, who are engaged in design, image construction, knowledge of sound code, exploration of sound, animation, etc. They are productive, and they are generally engaged with the movement, producing, collaborating, managing, educating, disseminating, promoting, offering festivals, and constructing community. This is the highest level that is both: an Author /Sender/Builder/Actor/Activating and a Receiver/Viewer/Activating/Actor

These three kinds of receivers converge on a single space/time and they are classified like this for mere research purposes, but the same receiver may go through the three stages. Perhaps the richest of all receivers and the one in the widest communities, is the Receiver/Viewer/Activating/Visual Synthetic Actor/Sound, in a second instance, receivers tend to access the platforms using programming codes and the community itself, and then transform into a Transmitter/Programmer and a Receiver/Viewer/Activating/Actor Specialist Visual/Sound.

Example

In order to materialize we will explore an example of the Mexican composer/programmer Alejandro Franco Briones. As part of the ideological narrative of the code, this was projected outside the Blas Galindo Hall, the Hall of an important orchestra named "Carlos Chavez". As critical point of view was intended when questioning the real meaning of an orchestra: What does it symbolize? And then using a Silvestre Revueltas orchestra piece (1938), that actually was based on Sensémaya's poem (Nicolás Guilén, 1934) -a curse poem-, the LiveCoding intended to dematerialize this piece, transforming the original narrative and then destroying it and let it penetrate the walls of this Hall.

The code then can be read in three stages, we are going to explore the last two stages, B) Receiver/Viewer/Activating/Actor Synthetic Visual/Sound, when the actors can identify symbols easy recognizable and see the graphic construction of the code itself; and C) Receiver/Viewer/Activating/Actor Specialist Visual/Sound when the actors can perceive the code in a specialized manner, identifying not only the symbols, but also the structures and the objects. As the first one talks about a superficial perception of the code, a newbie will hate it or love it, we are going to skip it for this example.

B) Receiver/Viewer/Activating/Actor Synthetic Visual/Sound Reading. When we skipped the code really fast we can at first identify some recognizable language forms that identifies the ideological intentions of the programmer. In the second 41, a .wav file is called, the lines respond to: **/*a=Buffer.read(s,"sounds/laculebra.wav");*/** the name of the file was made for receivers to identify the aspects of "culebra", a "snake", then a variable is defined: **/*~laOrquestamuerta={Pan2.ar(PlayBuf.ar(2,a.bufnum,0.8),0)}*/** with the name "La Orquesta Muerta", the "Death Orchestra" using the analogies and some critical lines of things you cannot do inside of an Orchestra's Hall, the programmer continues to set names of variables that distort the sound of the original version of Revueltas' piece that he called at the beginning. Names as **/*~nopuedeComer.play*/**, "it can't eat", **/*~nopuedeSilbar.play*/**, "it can't whistle, **/*~nopuedeCorrer.play*/**, "it can't run" continuously appeared and were modified and distorted during the 10 minutes and 15 seconds that the LiveCoding piece lasts. On the other hand, words as **/*.play*/**, that we have in these example, can be easily identified as something that is being reproduced, as the quote **/*.stop*/** that implies something is not supposed to play anymore. With this possibility of reading, transmitters have the opportunity to connect with receivers and send them messages; there is a possibility to connect with people through the bounding of narrative representations inside de text/code. On the other hand, receivers can connect with the graphic composition of the structures, we can see in this example, that the whole real-time experience, and the composition/writing of the algorithms conforms a whole visual composition by itself.

C) Receiver/Viewer/Activating/Actor Specialist Visual/Sound. This stage of code perception becomes a more social construction. Perception is made in community, not only individually. This is where "LiveCoding practice transforms into a social space" as Michaud (2003), said. The community builds knowledge, and through this, members are capable to perceive a specific language. Mainly, what is happening on the code is that: an audio file is called in order to be destroyed by a sine wave of sound. In the line:

/*~nopuedeComer={Splay.ar(SinOsc.ar((2000..2040),0,0.5))}~
nopuedeComer={Splay.ar(SinOsc.ar((2000..2040),0,0.1))}~
nopuedeComer= {Splay.ar(SinOsc.ar((2000..2050),0,0.1))}*/

The variable "nopuedeComer" is making a sine that oscillates, with a frequency that goes from 2000 to 2040 hertz, then with the other lines, de sound waves vary the ascendant way of the frequency values. Later on a low frequency sound is added through a Noise object: /*LFNoise0.ar*/ and **/*LFNoise2.ar*/** multiplying the sine. Almost at the minute 6, **/*convolution.ar*/** is made by mixing two objects, the file thought the variable named **/*~laOrquestamuerta.ar*/** and a sine wave made by the variable **/*~nopuedeComer.ar*/** multiplied by another sine. A minute before the end, objects as **/*GVerb.ar*/** and **/*Ringz.ar*/** appeared making a reverberation in the sound, later on with the use of a **/*Pan2.ar*/** the information is reproduced through two speakers, making different sounds in each one. At the end there is repeated convolution between variables multiplying the sound with different amounts of distortion until all the sound stops [**/*.stop*/**].

Conclusion

This last example shows the possibilities of these contemporary music/visual sessions. These kind of practices can not be perceive with a simplistic point of view of a work of art that can be sell or that can be held in a museum of gallery context. So, these practices do not need somebody, as a curator but a community that works as a medium of learning process to create not just readers but producers. Music and Visual, in these practices, need to be considered as a whole experiences where visual, sound and narrative process is held, this context is where all kind of texts get together to make something different every time, that can not be repeated it as the same thing. It is a work of art that is constantly changing, and the possible connections between texts defers of the receiver's knowledge or approaches.

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Rolando Rodríguez Guízar studied Education and Communication and right now he is studying his Master in Contemporary Art at the University of Arts in Aguascaliente, México. Co-founder of Andamio, a collaboration project. For a long time he's been writing and promoting cultural events, as well as, producing his own artistic pieces. He's won several writing contests in México, and making a lot of presentations about what he does. Lately, Andamio was selected to make a presentation, a workshop, two researches and chat at the Image Festival in Manizales, Colombia. This month we made a presentation on line at the UVM in Brazil, and next august, we will present our researching results about our writing called: LiveCoding, algorithms viewed as a text.

[Session 28]

Generation and Human Factors

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Antonymic Exchange

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Abstract

Antonymic Exchange is an artist-run operating system, an idiosyncratic means of developing "algorithmic literacy," and an engine capable of generating rich swathes of cultural dark data. In this ongoing project, artists Carl Diehl and Lindsey French carry out a conversation through a daily exchange of images, retrieved using search engines, then shared over electronic mail. Exactly what aspects of an image will be decoded antonymically remains unspecified, and either artist might, at different times, respond in opposition to formal aspects, conceptual connections, cultural cues, or other vectors of antonymic analysis. Querying contemporary and non-traditional instantiations of "algorithmic culture," the artists cast a wide net. Along with information theory and cultural analytics, the artists draw inspiration from the "writing machines" of the Oulipo, the estrangement of urban networks as envisioned by the situationist practice of dérive, and the "intimate bureaucracies" of mail-art. Quarterly reports are compiled every three months, exploring the relationships between images, the search terms and other terms of negotiation that each artist employed.

Keywords

antonymic, algorithmic, dark data

Introduction

Antonymic Exchange is an artist-run operating system, an idiosyncratic means of developing "algorithmic literacy," and an engine capable of generating rich swathes of cultural dark data. Astute information scientists will wonder if there isn't a procedural dimension to the Antonymic Exchange, or, as Google might inquire: *Did you mean "algorithmic"?*

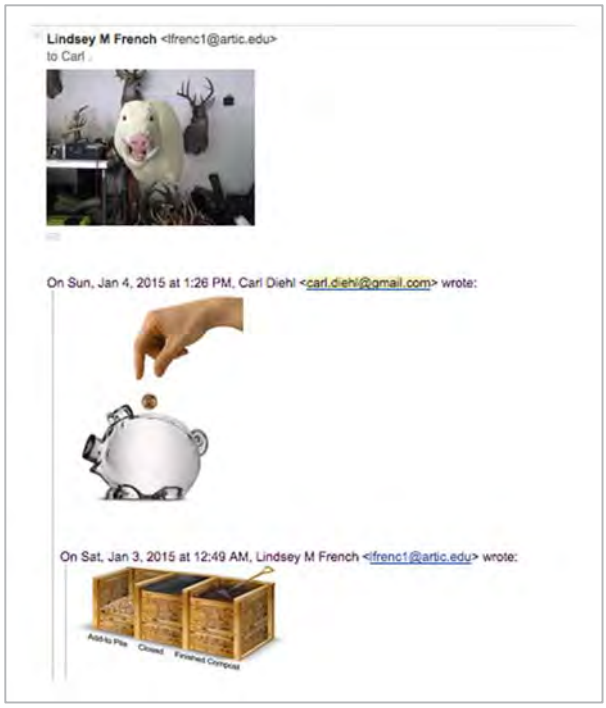
In this ongoing project, artists Carl Diehl and Lindsey French carry out a conversation through a daily exchange of images, retrieved using search engines, then shared over electronic mail. The perceived banality of this sort of exchange is betrayed by an oppositional approach to correspondence within contemporary network culture. Extending the antonym beyond its conventional literary context, the artists assemble the material of their exchange; an aggregate of visual resources.

Using the antonym as a critical framework for analyzing and informing responses to incoming images, the artists selectively and antagonistically cultivate an image-based vocabulary of exchange. At once politically and semantically motivated, these acts require an interstitial orientation towards querying globally networked databases of imagery. Whereas Google's search engine is designed, as writer Nicholas Carr has argued, to "promote the speedy, superficial skimming of information," the antonym serves as a catalyst for the artists to respond against the implicit velocity of information consumption. [1] Working within the dominant visual vocabulary of Google and the purview of antonymy, each image exchange yields new communicative idioms and, eventually, provides a vernacular subset of data which the artists might subsequently draw on in the generation of new texts. Optimization of this system's performance is at odds with the standard measure of accuracy that qualifies effectiveness in automated information retrieval systems. In this context, relevant results are paradoxically linked to the artists' adherence to a contradictory model of pattern recognition.

The Antonymic Exchange is contained within the body of an email, and consists entirely of images sourced from Google's image search. Each participant responds to the received image with another image determined after an "antonymic" consideration. Conflating encoding and encryption, the artists consider appropriate responses while simultaneously working to disguise outgoing forms in the cloak of "antonymity." Exactly what aspects of an image will be decoded antonymically remains unspecified, and either artist might, at different times and to varying degrees, respond in opposition to formal aspects, conceptual connections, semantic dissonance, cultural cues, or other vectors of antonymic analysis.

For example, in one exchange, an image illustrating three stages of composting, from adding organic debris, to covering and retrieval of finished compost was answered with a photographic image of a penny being dropped into an empty piggy bank. Here the operative antonym might be interpreted as Marxist, as the use value of this natural recycling process increases the longer its content sits, while that which sits in the piggy bank does not. Alternately, or additionally, the first image is a realistic drawing of a compost bin while the latter is an abstracted stock photograph of an actual hand depositing a penny into a glass piggy bank. In the next image, the hollow exteriority of the piggy bank is opposed by the internal stuffing of the taxidermy form of a wild boar. The cartoon version of a domesticated pig is replaced by a form devised to aid a realis-

Figure 1: Screenshot of three images within the email thread of the Antonymic Exchange.



tic re-presentation of a wild animal. One image points towards a private act of storage and saving, while a social vector at play in the other is one of display (Figure 1).

Along with each artist's rationale, dark data for these exchanges includes the string of words that were used by each artist to search for suitable representations of their respective antonymic concepts. The exchange functions by way of alternating tasks, artist-to-artist, with each image posed as a response to that which was previously received. In each artist's turn, a text-based terminology must first be abstracted around the received image. These terms are then routed through the "black box" of antonymic analysis, then searched for again, often repeatedly. A suitable image is eventually settled upon and sent off, shifting the responsibility of antonymic analysis back to the other artist. As the exchange is cultivated between the artists, the voice of Google's image search database pervades. Set against Claude Shannon's diagram of a general communication system, the "lossy" antonym and the corporate curation are the noise, generating an unclear message poised for response. [2]

The algorithmic logic of "instructions, steps and results" has stealthily infiltrated techno-social situations, global economies and political policy-making.[3] The "algorithm", in turn, has been cached by the cultural imagination. From Cultural Analytics and the visualization of massive datasets to the Internet folklore surrounding autocorrected texts and the design fiction world of the Digitarians, wherein inhabitants are comfortably tyrannized "by technocrats, or algorithms...as long as everything runs smoothly;" the implications of procedural solutions are manifest within many forms of social and cultural commentary. [4]

Along with these contemporary examples, Diehl and French find insight in the Oulipo, or, "workshop for potential literature," an early expression of algorithmic literacy. Since 1960, this group of writers has devised a variety of simple formal interventions, literary constraints that privilege strict rules over chance operations; "algorithmic" procedures with the potential of generating novel forms of literature. Digital Humanities scholar Stephen Ramsay has championed the Oulipo in his discussions of computer-aided text analysis, praising the capacity of constraints to temper the perceived risks of "excessive subjectivity" in the unaided human mind while also flaunting the cold, quantifying logic of computation. [5] "Antonymy," an Oulipian constraint requiring "the replacement of a designated element by its opposite" is directly reflected in Diehl and French's operations. [6] In a literary context, antonymic translations might target letters, words or phrases, replacing each of these units with a compatible adversary.[1] Antonymy is ostensibly visual in Diehl and French's exchange, each image received is met with critical reflection and interpretation as detailed above. This consideration is then followed by the quotidian activity of keyword searches in hopes of revealing relevant images. Situated within the privacy of an email thread and also embedded within the broader infrastructure of the Internet, the Antonymic Exchange is also reminiscent of what art historian Craig Saper's terms an "intimate bureaucracy." Appropriating the international postal network as a platform for subversive play, artists' groups such as Fluxus and the New York Correspondence School functioned as intimate bureaucracies by "[making] poetic use of the trappings of large bureaucratic systems and procedures...to create intimate aesthetic situations, including the pleasures of sharing a special knowledge or new language among a small network of participants." [7] While those who practice mail art work within the constraints of letters, envelopes, stamps, and postcards, Diehl and French utilize the parameters of various Google applications, from Gmail to Image Search, Google Docs and Spreadsheets. [8]

The multivalent nature of these communicative systems allow for slippages in formal rules. In comparing natural language and algorithms, Andrew Goffey identifies a pragmatic dimension (language does things, algorithms do things - they are both embodied in materials and executed through actions). Distinguishing the two, Goffey writes,

> "While formalization comes afterwards with natural languages, with algorithms, formalization comes first, the express aim being to divorce (formal) expression from (material) content completely" [9]

Within this framework, the Antonymic Exchange exists closer to a language than a process, the enactment of the antonym a resistance to predetermined formalization. Revisiting Foucault's description of the algorithm as a statement,[2] the new texts of the Antonymic Exchange offer not

[1] For example: the word 'dog' might replace 'cat.'

[2] Goffey recalls Foucault's description in *The Archaeology of Knowledge*. "to speak is to do something—something

statements but questions, or perhaps, nuanced non-sequiturs aimed at disrupting the formation of machine-readable cultural statements. These gestures serve as creative disruptions of cultural patterns, moments to navigate away from an anticipated path for the sake of avoiding predictability and entertaining the critical potential of what Geert Lovink has speculatively proposed as "antagonistic or dialectical programming." [10]

In contradistinction to the "anything goes" model of non-sequitur, or chance operations associated with Surrealism, an effective antonym must maintain some modicum of harmony with its opposite. Pursuing an aesthetic of interruption, yet tinged with aspects of continuity requires ingenuity and deliberation. Inherent in this process is the risk that the vectors of "Synonmy" may become too pronounced, resulting in droll caricatures of the recommendation engines used by Amazon and Facebook. [11]. The artists must remain committed to "[finding] ways to make compelling, complex play environments using the intricacies of critical thinking to offer novel possibilities," as Mary Flanagan asserts in her discussion of criticality in games. [12]

The consistency of a daily practice strengthens one's ability to maintain opposition. Within a history of artists devising constraints and naming restraints, the artists find agency in adhering to their own restrictions, alongside parallel structures of power. In his discussion of the rhetorical prowess of algorithms, author Chris Ingraham calls for the crafting of one's own algorithms to achieve full algorithmic literacy.[3] Anti-algorithms then, including, but not limited to, The Antonymic Exchange, offer opportunities to maintain agility within the interstitial spaces of a daily image search.

By opposing the synonymic path of least resistance, an unplanned circuit in search of the antonymic compels the artists to digress. Drifting through the landscape of globally networked image databases, these irregular jaunts recall the experience of a psychogeographical dérive. Not unrelated is Michel De Certeau's consideration of the "spatial practice" of walking in the city, in which the philosopher describes the pedestrian as "a spatial acting out of space." [13] If the wanderings of an urban pedestrian constitute an action of speech, an analogue would be the browser path within the virtual architecture of the database, rhetorically envisioned as a city. Each search is an annunciation, and these annunciations are recaptured into language via the collected search terms. In the case of the Antonymic Exchange, the primary language of discourse is not the search terms but the image choice. This process is always incomplete, yielding images partially similar to preceding terms. It is exactly this broken logic that renders the process generative.

Within the Antonymic Exchange, dark data is abstracted individually, across a "rift isolation:" a quarantine, wherein parallel worlds of communication develop discretely. Quarterly report sessions serve as an opportunity for the rift to be temporarily breached, provoking an accelerated collision of the estranged strands of text-based language. This facet of the artists' operating system reveals the residue of underlying decisions, including the search terms and antonymic analyses that each artist secretly and separately employed. Shedding light on this dark data, an inherent impossibility is revealed in the prospect of attributing authorship to any particular artist, algorithm, or image-provider for the production of new idioms.

The procedures that Diehl and French have developed in the Antonymic Exchange present alternative pathways through the database imaginary, novel forms of analysis and retrieval that are reliant on a reconfiguration of everyday human and machine relationships. The artists' initial interest in remixing their dark data has been largely supplanted by a critical attention towards fine-tuning and performing their anti-algorithms. Here, perhaps, the Oulipian endeavor to devise "creations that create," as opposed to "created creations," can be understood as a tactical response to contemporary algorithmic culture. [14]

Developing data sets the long way, the wrong way, these acts of antonymic analysis tentatively exist on the periphery of searchability. This daily practice marks an understated opposition, a quiet friction, scraping against the algorithmic rhetoric of predictive solutions. To find an image's antonyms is to identify not only its content, but to respond against automated computational processes.

other than to express what one thinks, to translate what one knows, and something other than to play with the structure of language," His suggestion to replacing "speak" with "program" offers a more directly political read of the rhetorical power of the algorithm.

[3] "achieving full algorithmic literacy in the coming years will eventually mean acquiring the technical chops to generate algorithms of one's own." See Chris Ingraham. "Toward an Algorithmic Rhetoric." In *Digital Rhetoric and Global Literacies: Communication Modes and Digital Practices in the Networked World*, ed. G. Verhulsdonck and M. Limbu (IGI Global: Hershey, PA, 2014), 69.

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Emergent Behaviour: Learning From An Artificially Intelligent Performing Software Agent

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Abstract

This research investigates the possibility for emergent choreographic behaviour to arise from the interactions between a human dancer and a learning, digital performing agent. The cognitive framework is extended through theories of distributed cognition to take into account the two interacting agents rather than a single agent and its environment. The Artificial Neural Network based performing agent demonstrated emergent dance behaviour when performing live with the human dancer. The agent was able to follow the dancer, create movement phrases based on what the dancer was performing and recognize short movement phrases, as a result of the interaction of the dancer's motion captured movement data and the agent's artificial neural network. This emergent behaviour was not explicitly programmed, but emerged as a result of the learning process and the interactions with the human dancer.

Keywords

Emergent behavior, dance, motion capture, distributed cognition, artificial neural network.

Introduction

In *Embodied Cognition: A field guide*, Mark Anderson puts forward an argument for the development of robots using developmental approaches based on embodied or situated approaches to cognition. (1) *Instead of emphasizing formal operations on abstract symbols, this new approach focuses attention on the fact that most real-world thinking occurs in very particular (and often very complex) environments, is employed for very practical ends, and exploits the possibility of interaction with and manipulation of external props.* p.91 Anderson goes on to suggest that this situated activity can allow behaviours to emerge that are the result of the interactive relationship between the robot and its environment.

This project was one of the outcomes of research into collaborative performing agents undertaken at Motion.Lab. The goals of the research were to develop a performing agent capable of recognising and responding to human movement data generated by a live human dancer. The agent was developed utilizing a creative workflow that attempted to be familiar to a dancer, modeled on a collaborative performance making process between two dancers. From conception, through the rehearsal process and on to performance, the relationship between the dancer and agent was considered as a means of supporting the agent's capabilities and learning. This allowed the dancer, Steph Hutchison, to follow a performance-making trajectory that was familiar to her and enabled the relationship with the agent to be viewed in similarly familiar terms.

The research made use of Deakin Motion.Lab's 24 camera Motion Analysis motion capture system. The system was used to both pre-record the dancer's movement to train the Artificial Neural Network (ANN) and to allow the dancer to interact with the agent by passing her live movement to the ANN. The Motion.Lab has a 6 metre passive stereo screen on the rear wall onto which was projected the avatars of the dancer and agent. These avatars were at times humanoid, at other times of more abstract representation. The work was viewed from the front as a studio proscenium performance.

Artificial Neural Networks for Learning

We chose a type of ANN called a Self Organizing Map (SOM) (2, 3) The SOM is an unsupervised form of ANN and as such it is not directed towards a particular goal, but rather attempts to find its own relationships in the data presented to it. We chose the SOM because it proved able to both classify (recognize) the dancer's movement as well as synthesise movement from the same neural network. Even though the SOM is a relatively simple structure, it proved quite versatile in terms of its responses to the dancer's movement data.

The initial experiments were successful in suggesting that the SOM would be a suitable structure as the basis for the performing agent's learning and performing capabilities. Experiments with SOM suggested simple choreographic structures that could be used in the creation of the performances, such as the simple task of one dancer following the other. After the ANN had been trained using motion capture data from Steph's dancing, subsequent live motion captured data succeeded in eliciting a response from the neurons in the neural network and the information contained in the neuron was used to animate the agent's avatar. In this manner a simple type of following behaviour

arose as the movement of the dancer triggered a response from the agent's neural network. This prompted investigation of choreographic tasks that made use of this type of naturally occurring behaviour in the SOM, and which could inform the development of shared movement for the performances. The related performance *Emergence* is described more fully in McCormick et al. (4)

The human dancer developed movement phrases through structured improvisation based on the kind of relationships that would be used in the performance; being followed by or following the agent, providing starting postures for the agent to begin a movement phrase with, making short movement gestures that the agent might recognise. These movements were passed on to the agent for learning. Once the agent had gone through the learning process, the dancer improvised with the agent to reacquaint herself with the movement and to investigate how the agent had assimilated her original movement and the relationships envisaged when developing the original movement material. We used a familiar rehearsal and performance process in order to embed not only the movement itself but also the relationship between dancer and agent into the development process. This allowed the dancer to follow a familiar creative trajectory, and supported the agent's capability by providing a close association with the dancer. (Figure 1)

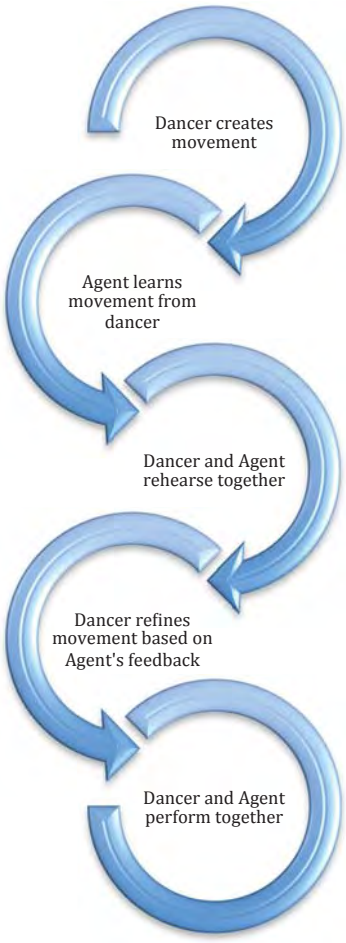

Figure 1. Process for creative development of the agent learning for rehearsal and performance.

The agent took the human data and learnt its salient features in an attempt to better understand the human's motivations, a form of data mining. These goals necessitate a consideration of how an agent might need to be conceptualised, if it were to be able to interact with a human performer. For this to occur, it is not sufficient to generate a system that can respond to motion data per se. The meaning of the motion data in a human performance, and specifically a dance context, must be considered part of the interactive process in any system involving a human dancer.

The use of a cognitive model to guide development, as suggested by Anderson, offers an alternative to a purely computational model on which to develop the agent. This research used the framework of distributed cognition which provided a conceptual structure whereby we could envisage the agent and dancer as a single supportive system rather than developing the agent with self-contained capabilities. We chose the distributed cognition model rather than the embodied cognition model presented by Anderson, as it seemed a more appropriate model to develop the relationship between the dancer and agent. Both models consider cognition to be a result of complex interactions with the environment, however distributed cognition allows for cognition to be shared between humans or in this case a human and digital agent. This framework supported the idea that the agent's cognitive abilities could be directly supported by the dancer's. Allowing the dancer to support the agent throughout the process enabled the achievement of a significant outcome using relatively simple processes. The agent could share the dancer's structuring abilities to augment its own. There was a strong support system for the agent's development already in place in the form of the dancer's honed dance experience.
The dancer was also learning how the agent learnt, what patterns and movement it recognised and how to support the agent in performance. The feedback and learning loops informed the learning and subsequent capabilities of both the artificial and human agents, and provided the human dancer with a source of inspiration for developing duet relationships with the agent performer. (5)

Emergence

One of the most exciting outcomes of this research has been what Anderson descriptively terms "emergence". (1) Emergent behavior is seen in many natural systems, such as weather systems, insect construction behavior, and human social orgnisation behavior. Artificial systems that attempt to mimic natural systems and allow for emergent behavior have been around for decades. Early digital examples of emergent behavior are Conway's *Game of Life*, (1970) (6) and Reynold's *Boids* (1987), a simple set of rules that could be used to simulate bird flocking and schools of fish swimming. (7). In these and many other

examples, relatively complex behavior emerges from very simple rules. As an example of emergence, Anderson offers the work of Steels in artificial life as the roots for artificial intelligence. (8) Steels describes a simple robot with two programmed behaviours; the first instruction is to take a zigzag path toward any light source, the second is to turn before moving again if it comes into contact with any obstacles. The robot must replenish itself by moving to recharging stations when the light at the recharging station turns on. There is no explicit programming to tell the robot to recharge itself. However this emergent behaviour occurs naturally when the robot is placed into the environment. The programmed rules provide the opportunity for the emergent behaviour, yet do not explicitly control the behaviours. Rather the behaviours emerge through the dynamic interaction between the robot and its environment.

The performing agent similarly displayed emergent behaviour in its ability to recognise movement the dancer was performing and to then respond with movement based on what it had learnt from the dancer. However unlike Steels' example, the performing agent in this research was not

Figure 2. The agent creates movement based on the current movement of the human dancer.

programmed with any initial simple behaviours, and its behaviour was attributable to the learning process with no directed behaviour. Steels' example saw the robot's movement being subject to simple rules to enable its behaviour to emerge. The agent in our study sees the dancer's data being simply presented to the SOM where it stimulates particular neurons to effect behavioural changes. The use of an Artificial Neural Network to encapsulate the interactions between the agent and its environment (in this case the dancer's motion-captured movement data) proved very successful in enabling the agent's performing behaviour to emerge.

This was most evident in the performance piece, *Instrumental* (2014), where the dancer's movement data stimulated the agent's neural network, creating a response in the closest matching neuron, which in turn caused reverberations in the Artificial Neural Network's Synaptic Map. (Figure 2) The synaptic map was a second layer of the neural network that contained the pathways of neurons as they sequentially fired. By using the links formed between neurons during the learning process that agent was able to create movement sequences from the data contained n the neurons. The result was the emergence of recognition behaviour of the dancer's current movements and creation behaviour in the agent' response with appropriately themed movement synthesis.

The Self-Organising Map (2, 3) enhanced with a Synaptic layer, was termed a Self-Organising Synaptic Map (SOSM). This allowed the agent to create movement which was stylistically compatible with the dancer's movement, emerging from the trained SOSM. As the synaptic layer is also developed through learning, it has a strong relationship with the dancer's movement, yet because of the multiple, weighted pathways developed between the neurons there is still scope for variability in the movement created by the agent.
(Figure 3)

Figure 3. Using the Self Organising Synaptic Map (SOSM) to

enable the agent to generate its own movement based on the movements it has learnt from the dancer. The dancer's avatar (white) is animated by the live motion data stream, the agent's avatar (red) is animated from its SOSM in response to the dancer's movement.

The choices that led to these emergent potentials were derived from the framework used from the beginning of the research project, namely, the concepts of embodied and distributed cognition. Embodied cognition focused attention towards devices that would allow the agent to learn from the sensory input provided by its environment, in this case the dancer's movement data. (9, 10) The emphasis was not on developing a model of the performance environment or the dancer relationship, through programmed symbolic representation as in traditional approaches to cognition and programming, but rather to allow the interactive engagement of the agent with the dancer to become the key component of its environment, thereby allowing behaviours to develop. Distributed cognition provided a framework for imagining the co-creative relationship between the dancer and agent during creative development and performance and hinted at the potential for allowing the agent to naturally embed its learning and potential using the dancer's evolved intelligence. (11-15) Adopting

this approach allowed the dancer to guide the agent where appropriate and also allowed the dancer in turn to respond to the agent's reactions. While the dancer was the most experienced partner in the performance relationship, the creative energy was not all one way. The dancer was able to feed her creative choices from the agent's performance as well.

This research also pointed towards a new approach for the development of the performing agent. Rather than attempting to build a comprehensive internal model to represent the system and its inputs and outputs, a model similar in characteristics to a traditional, computational view of cognition, the software centres on learning from the interactions between the agent and environment through the sensory engagement with the dancer through her data. This follows methodologies proposed by roboticists and AI researchers Brooks and Steels into the application of Artificial Life to Artificial Intelligence. (16) This change in paradigm has proven extremely liberating - the author no longer needs to control the behaviour of the agent, but rather provide the circumstances whereby the agent can learn from interactive experience allowing behaviours to emerge.

Current extensions to this research involve applying the movement learning capabilities to small humanoid robots to allow them to learn how to perform with human dancers and with each other. The evolution from a software based agent to a physical body is a great challenge. The neural network movement recognition techniques are also being applied to the task of generating haptic information to describe dance to vision impaired audience members.

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Authors Biographies

Steph Hutchison is a choreographer, performer, and artist-researcher. She is an experienced and sought after artist with background in contemporary dance, improvisation, circus arts, physical theatre, dance video and dance technology. Steph is completing her PhD at Deakin University's Motion.Lab. meta: discourses from dancers inside action machines.

Dr. John McCormick has worked in the areas of new media dance, motion capture and telematics performance. John is currently researching movement visualisation and analysis, and with the Centre for Intelligent Systems Research for the past three years investigating machine learning of movement and its application in the performing arts.

Professor Kim Vincs is the Director of the Deakin Motion.Lab, Deakin University's motion capture studeio and performance technology research centre, which she established in 2006. She has been a choreographer for over twenty years, and has focused on interactive dance technology for the last ten. Kim has five Australian Research Council projects in dance, technology and science, and has established numerous industry collaborations in motion capture, movement analysis and digital art.

Dr. Jordan Beth Vincent is an Associate Research Fellow at the Deakin Motion.Lab researching dance and digital technology, a position she has held since 2013. Jordan's background is in dance history and criticism, and she holds a PhD early 20th century Australian dance history from the University of Melbourne. Since 2008, she has been a critic for The Age newspaper, and has contributed to a range of online and print publications in the areas of dance, physical theatre and circus.

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'Splitting Centre': directing attention in trans-media dance performance

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Abstract

In theatrical vernacular, the term 'splitting centre' refers to two performers staged at an equal distance from a centre point and sharing the focus of the audience. This term encapsulates the notion that two people (or, in the case of trans-media dance, two or more performance entities) are dividing the attention of the audience, operating as equal collaborators in a performance context. The augmentation of live performance with 3D projected scenography and mobile devices offers a starting point for discussions on the potential for dramaturgy, choreographic process, and changing expectations for audience behaviour in the theatre. In 2014, Deakin Motion.Lab premiered *The Crack Up*, a trans-media dance work that incorporated live performance, 3D digital scenography, and *The Crack Up App*, an app for mobile devices that audience members were invited to interact with during the performance. This investigation into the potential of trans-media dance performance, (defined here as a live performance in which both the digital and biological elements are choreographed as artistic equals within the theatrical context) with the addition of a mobile device raises questions about how the makers of trans-media dance might direct the attention of their audiences when the work is performed simultaneously across multiple platforms.

Keywords

Dance, trans-media performance, digital and virtual environments, mobile devices, interactive apps, tweet seats

The integration of digital imagery with live performance is becoming increasingly common in Australia and overseas with artists such as Wayne McGregor, William Forsythe, Robert Lepage, Klaus Obermaier, Garry Stewart and Gideon Obarzanek among others creating work that enmeshes digital and biological performance entities within a theatrical context.[1] The works by these artists draw on a range of technologies, from interactive and motion tracking systems to registered projected video, motion capture, 3D scenographic landscapes and more, exploiting the possibilities of emergent technologies. As Dils & Naugle suggest, "the scope of dance is not narrowing towards digital, rather, it is expanding."[2] In 2014, artists at the Deakin Motion.Lab premiered *The Crack Up*, a new full-length trans-media dance work, (trans-media dance is defined here as a live performance in which both the digital and biological elements perform simultaneously as artistic equals within the theatrical context), directed and choreographed by Professor Kim Vincs.[3] Inspired by F. Scott Fitzgerald's 1936 short story of the same name, *The Crack Up* integrates performances by five dancers immersed and superimposed in 3D projected scenographic landscapes.[4] The creation of imagery rich environments augments Fitzgerald's first-person story about a man losing his grip on reality. 'Cracking' landscapes and crumbling digital characters provide a visual reflection of the ambivalence and despair of the text, reflecting on the notion of fragmentation.[5] *The Crack Up* also exploits the sense of 'cracking' (or dividing) the attention of the audience by introducing *The Crack Up App*, a universal app for mobile devices that audience members were invited to download prior to attending the show.[6] In theatrical vernacular, the cue 'to split centre' refers to two performers at an equal distance from the centre point of the stage. With lighting and set design, as well as within the frame of choreographic practice and dance training, to 'split centre' carries a meaning beyond a staging one. It is the notion that two people (or, in this case, two or more performance entities) are splitting the attention of the audience, operating as equal collaborators in a performance context. In essence, *The Crack Up* 'splits centre' across its multiple platforms, with the direction of focus shared between the screen on stage, the dancers on stage, and the mobile devices. This paper investigates the potential for augmenting live performance with 3D projected scenography and mobile devices, and offers a starting point for discussion on the potential for dramaturgy, choreographic process, and the directing of audience attention within trans-media dance performances.

Figure 1. Screenshot of *The Crack Up App*.

Activated within the theatre and with high-resolution imagery running parallel to the action on the stage, the content on *The Crack Up App* follows its own unique narrative trajectory, while contributing to the larger

visual story of the work as a whole. Drawing on the common usage of mobile devices for tweeting and texting, *The Crack Up App* quotes Fitzgerald's *The Crack-Up* (as well as other writing by and about Fitzgerald) and places these texts within visual contexts that reference and comment on the action on the stage and 3D projection screen. Although the content of the scenography and the imagery on *The Crack Up App* was largely pre-determined and fixed (aside from some audience interaction capability), the movement from scene to scene across the platforms was live. In this way, the performance of *The Crack Up App* happens in concert with the action onstage, with the work taking place simultaneously across multiple platforms and with multiple points for audience access. This offers a kind of 'choose-your-own-adventure' experience of trans-media performance, with the audience's decisions about where to look divided between three distinct options: 1) the larger-than-life imagery projected onto the stage screen; 2) the dancers standing within, in front of, and beneath the imagery, or 3) The content on *The Crack Up App*. As Vincs has argued, there is no 'right' place to look at any one time during *The Crack Up*; rather the work simply exists in multiple forms, simultaneously, with a multiplicity of experiences. By consciously drawing the attention of the audience away from the stage and actively encouraging some freedom of experience (i.e. only parts of *The Crack Up App* are interactive) *The Crack Up* utilizes a mode of dramaturgy akin to site-specific or gallery-based work, or perhaps work in which audience members are free to roam around the performers or where the parameters for performance are set, but are left relatively open and uncontrolled.

The challenges with dividing the attention of the audience across multiple platforms are fundamentally dramaturgical and technical ones, with the creation of a "performance that is no longer designed for a 'normal' three-dimensional space, but which must speak within an artificially constructed volume."[7] In other words, the traditional performance area for live performance (the stage) is challenged by the "altered, augmented and perceptually distorted spatiality" inherent in trans-media dance, offering many new directorial and perceptual possibilities.[8] For directors of live dance performances, the decision about where to draw the focus is integral to the shaping of the performance. As Johannes Birringer suggests, this is fundamental to the nature of the integration of digital bodies with live bodies in a performance context because "digital performance with real-time media always involves projectional activities at the same time, i.e., simultaneous and deferred image, sound and light movements and 'micro-tonalities' which happen in continuous contingent (causal and non-causal) interrelationship with each other in total architecture."[9] With lighting designed to direct the eye of the audience to the most important, the brightest, and the most lit form, the body at centrestage becomes, literally, the most visible object on the stage. However, *The Crack Up* takes place across multiple platforms simultaneously, with the moments of performance not solely beginning and ending within the geographical space of a proscenium theatre, but offering a performative example of convergence culture.[10] The 'stage' for *The Crack Up* is both the space beneath and within the proscenium, but also on the individual screens held and activated by each individual audience member.

Within trans-media dance productions, the 3D projections are literally made of light and, in the case of *The Crack Up,* are projected six meter tall screen. This offers an enormous visual draw for the audience, and, even without the presence of *The Crack Up App*, challenges some of the conventions that might govern choreographic practice. How the different performative elements are integrated provides a dramaturgical challenge, particularly when the components are not seen in terms of a theatrical hierarchy in which either live performance, or projection might be privileged. As Beckwith & Vincs have argued, the use of 3D scenography within a digital performance environment, while offering untapped potential for the telling of physical stories, also poses a number of challenges in terms of cognitive synthesis for the audience, including reconciling the "inherent disjuncture between the spatial objects" such as live bodies and digital entities within the same geographical space.[11] Beckwith & Vincs propose the use of Kurt Koffka's Gestalt theories as a means of "creating perceptual wholeness" for the endless stereoscopic possibilities.[12] The addition of a mobile app, which intrinsically draws the attention of the audience away from the stage and down to their devices, further challenges the cognitive synthesis of watching trans-media performance. However, it is perhaps less important how the components of the work are integrated as individual elements than it is how they cohesively translate a theatrical meaning to the audience.[13] This demonstrates that the entire notion of 'direction' with performance art that enmeshes digital and biological content/bodies questions the accepted norms of theatrical dramaturgy. This collision of traditional stagecraft with new technology fundamentally shifts the dramaturgical requirements of creating trans-media dance. In this way, *The Crack Up* perhaps draws on American choreographer Merce Cunningham's work in de-centralising the notion of the stage centre in dance, but rather than abolishing the idea of the centre, *The Crack Up* instead divides it, quite precisely and consciously, between different perceptual, temporal and technological modalities.

The augmentation of live performance with mobile devices has been hotly contested in recent years, with the spectre of 'tweet seats' already challenging the sanctity, or rather the *perceived* sanctity, of the theatrical,

Western, concert space.[14] An audience member in a 'tweet seat' is 'allowed' to access and utilise their mobile device, tweeting or publishing immediate responses from within the theatre. The presence of 'tweet seats' undermines the traditional theatrical adage to 'turn off your phone,' while simultaneously raising concerns about preserving the 'mysteries' of a performance or what it means to have only a partial, or third-person experience of a performance. For avid tweeters, or for those audience members unable to be physically present in the theatre, live tweeting during a performance adds an interactive and responsive dimension to the experience, colouring the social act of attending the theatre with the faceted and multi-layered experience of social media. Opponents to the inclusion of social media within the performance space, such as Alex Roe, Director of New York's Metropolitan Playhouse, have suggested "outside interaction, even of virtual kind, might keep people from getting lost in a good play."[15] According to Roe, "'Part of the whole theatrical experience is the thought of being present in the company of the rest of the audience and the actors… [and] the thought of encouraging people to tweet during a performance is necessarily a violation of that agreement.'"[16] In other words, live tweeting during a performance where it is not part of a dramaturgical design, would cause an unwanted 'splitting of centre' for the audience.

The difference with 'tweet seats' and *The Crack Up App* is not just a matter of content, nor is it a matter of a dramaturgical effect. Although *The Crack Up App* takes place on interactive devices, it limits the amount of control and interactivity the audience has over the content. However much freedom is offered to the audience, it's inclusion begs the question of how focus and attention may be diverted or controlled for theatrical purposes. In the triad of live performers, stereoscopic imagery and mobile devices, the process of 'splitting centre' in *The Crack Up* is not a battle between two performative entities, but three of them. *The Crack Up* addresses this issue by creating a three-way split between perceptual modalities that remains consistent throughout the work rather than introducing digital elements in discrete sections, and by tying the digital content more directly to the conceptual development of the work. However, there remains a fundamental disjuncture between views such as Roe's, that see any engagement outside the on-stage performative world as a detraction from the performance experience, and works such as *The Crack Up* which view divergent sources of engagement as a means of enhancing and extending the conceptual scope and sensory experience of the work. Perhaps the broader philosophical issue this debate raises relates to how one approached the idea of divergence itself, whether of attention, or materiality, of biology versus technology. We argue that 'splitting centre' could be considered in relation to how one responds to the changing nature of attention itself in a digitized culture—to resist the multifocal and multiplicitious, or to specially embrace and cultivate it in a performance context. With the increasing development and availability of new technologies, as well as their increased incorporation into dance and live performance, there is room for further research into how the notion of 'splitting centre' could be exploited to create new and exciting performative possibilities.

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[1] In the context of this paper, the reference to 'biological performance entities' refers to human dancers.

[2] Ann Dils and Lisa Naugle, "Dance with the Mouse: Format for the Future," *Dance Research Journal,* 32:1 (Summer 2000), 163.

[3] *The Crack Up* was created as part of the ARC Discovery grant: *Building Innovative Capacity in Australian Dance Through New Visualization Technologies*, supported by the Australian Research Council through the Discovery Program (DP120101695). *The Crack Up* premiered 31 October 2014 at The Coopers Malthouse, Merlyn Theatre. Choreography and direction by Kim Vincs, Stereoscopic and 3D image concept design and creation by John McCormick, Daniel Skovli, Simeon Taylor, Kieren Wallace, Bobby Lin, Josh Batty, Peter Divers, *The Crack Up App* designed and developed by John McCormick and Kieren Wallace.

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[6] *The Crack Up App* was available for free download through the iTunes and Google Play stores.

[7] Vincs, "Foreword by the Director—The Crack Up."

[8] *Ibid.*

[9] Johannes Birringer, "After Choreography," *Performance Research*, 13: 1, (March 2008), 119. See also: Johannes Birringer, "Dance and Media Technologies," *PAJ: A Journal of Performance and Art*, 24: 1, (1 January 2002), 84-93.

[10] The notion of 'theatrical space' is a contested one, and one that is challenged by the potential of digital technology to redefine and create fluxuations in spatial relationships between people, digital entities, and architecture. See Benedict Anderson, "Out of Space: The rise of Vagrancy in scenography," *Performance Research: a Journal of the Performing Arts*, 18:3, (24 Sept 2013), 109-118. For a discussion of convergence culture, see Henry Jenkins, *Convergence Culture: Where Old and New Media Collide* (New York: New York University Press, 2006).

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[12] *Ibid*.
[13] Jerry H. Gill, "On Knowing the Dancer From the Dance," *The Journal of Aesthetics and Criticism*, 34: 2 (Winter 1975), 133.
[14] As Rupert Christiansen quipped in *The Telegraph*, the softening of the rules towards mobile devices may be "yet another concession to barbarity and further evidence of a catastrophic decline in the etiquette of audience behaviour." Rupert Christiansen, "Why theatre seats for Twitter junkies is a #goodidea," *The Telegraph*, 17 October 2014, http://www.telegraph.co.uk/culture/culturenews/11169040/Why-theatre-seats-for-Twitter-junkies-is-a-goodidea.html.
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Professor Kim Vincs is the Director of the Deakin Motion.Lab, Deakin University's motion capture studio and performance technology research centre, which she established in 2006. She has been a choreographer for over twenty years, and has focused on interactive dance technology for the last ten. Kim has five Australian Research Council projects in dance, technology and science, and has established numerous industry collaborations in motion capture, movement analysis and digital art.

Dr. John McCormick is one of the pioneers of new media dance, motion capture and telematics performance. John has worked with Motion.Lab for the last five years, researching movement visualisation and analysis, and with the Centre for Intelligent Systems Research for the past three years investigating machine learning of movement and its application in the performing arts.

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Ostrich Effects

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Abstract

The scenarios of computer science suggest the potential for an 'Ostrich Algorithm': a strategy of wilfully ignoring potential problems on the basis that the likelihood of their occurrence would be so rare as to negate planning for them.

The paper focuses on the art installation, *The Ostrich Effect* by David Cotterrell. The work is a generative installation that explores the recursive loops that might occur in hypothetical scenarios. Built using commercial automated call centre servers programed to dial and trigger each other, *The Ostrich Effect* is a generative installation that establishes a computer-based conversation, which will never be resolved. The call centres continuously negotiate with each other to sell their products, handle complaints, solicit customer feedback and broadcast government warnings. With systems attempting to recognise each other's responses, a perpetual loop of questions, diversions and holding patterns ensures that calls will neither achieve their assigned tasks nor fully accept the futility of their method.

This paper considers the role of error in heightening awareness of familiar systems, explores the idea of the Ostrich Effect within a contemporary political and technological context and seeks to contextualise Cotterrell's artwork within popular film and science fiction references.

Keywords

Call-centre, automation, IVR, recursive, war games, glitch, ostrich, cold war.

Introduction

> "Sh," he whispered. "Listen."
> He swayed in a slow circle, turning his head from one silent house to another. "She'll phone more and more numbers," he thought. "It must be a woman. Why? Only a woman would call and call. A man wouldn't. A man's independent. Did I phone anyone? No! Never thought of it. It must be a woman. It has to be, by God!... Listen."
> Far away, under the stars, a phone rang. [1]

Who makes the call? A desperate, lonely woman, or a program emanating thousands of kilometres away? Who answers? An equally desperate man, hoping for his happy ever after at the end of Armageddon, or another phone, programed to respond to voice prompts?

From its beginnings in the nineteenth century, science fiction has spoken to us about our contemporary hopes and fears, though these are often presented as visions of a future we have no way of predicting. A common thread running through our future fictions is the fear of automation. Ludd's dehumanisation mingles with Marx's alienation to create dystopic dreams of machines gone mad and human populations living out half-lives characterised by either feckless luxury or terrifying subsistence. As our technologies grow in complexity, we find ourselves entering that uncanny valley, where the more human a technology attempts to appear, the more we are repelled by its lack of humanity.

Willful denial

Roughly put, an 'Ostrich Algorithm' is a strategic decision to ignore a potential problem on the basis that it is unlikely to occur. It's employed to deal with deadlocks in concurrent programing if the cost of their avoidance is deemed too high. [5]

The term first cropped up not in reference to computer science or gaming, but financial risk. In their 2003 paper, Galai and Sade use the words 'Ostrich Effect' in relation to finance and the role risk plays in making investment decisions.

> We define the 'Ostrich Effect' as avoiding apparently risky situations by pretending they do not exist. It is observed that certain individuals, when faced with uncertain investments, prefer investments for which the risk is unreported, over a similar investment (as far as risk and return are concerned) for which the risks are frequently reported. [3]

The term suggests a bird that buries its head in the sand rather than facing threats head on. Ironically, the ostrich does not actually bury its head when in danger – rather, it has a tendency to run away (a more sensible move for an animal that can reach speeds in excess of 70km hour). The human species certainly has the capacity to demonstrate such willful refusal to holistically assess and respond to given situations. In a 2014 study at Claremont McKenna College, California, Josh Tasoff and Ananda Ganguly worked with a group of student volunteers to investigate

'information aversion'. Having supplied students with graphic details about both Herpes simplex viruses, the pair offered students the opportunity to be tested for the virus stating that taking the test would be free, but those tested who did not wish to know their results would need to pay $10. Over 85% elected to pay to not know their results. [4]

Evolving Conversations

The real-life 'water cooler' moments, in which peers catch up on gossip or discuss their views on current affairs, still exist but they have a tendency to be played out on social media, in a silent frame of tweets, pins and posts. Real time, real voice chats are increasingly relegated to a new ghetto of automation. The advent of smartphone technologies like 'Siri' and now 'Cortana' necessitates Q&As rather than discussions. The human speaker is now the 'asker', compelled to repeat their query in a variety of intonations until the program is able to recognise something resembling a question. [6] It is the nature of our interactions that is in fact most changed by these new technologies, encouraged as we are to converse with semi-intelligent machines rather than people.

As our society shifts from a production to a service economy, more and more of our conversations are held with the programed representatives of service providers, which are tied to the lexicons of those who programed them. So, the nature of contemporary conversation is evolving and we are learning the new rules of engagement: we wouldn't visit our insurance broker to discuss marital infidelity – equally, we understand that asking Siri, "What is the meaning of life?" will deliver the ironically-devoid response, "A movie." Try it.

Fig 1. *Infinite Call Centre* (Illustration, 2014) © David Cotterrell

Testing to Destruction

Taking as its starting point the workings of a semi-intelligent, voice activated call centre, David Cotterrell's installation artwork, *The Ostrich Effect* [9] investigates the possibilities for a programing loophole and its ramifications when taken to an extreme level.

The scenarios of computer science and science fiction suggest the potential for an 'Ostrich Algorithm', that is, a strategy of wilfully ignoring potential problems on the basis that the likelihood of their occurrence would be so rare as to negate planning for them. *The Ostrich Effect*, which is formally a bank of speakerphones and empty desks, employs bespoke Interactive Voice Response (IVR) programing to generate and broadcast an endless series of phone calls from commercial automated call centres. While these might be traditionally designed to reach a mass audience of unwilling human respondents, within the installation the calls are answered by other computer based call centres running their own automated IVR programs.

As each automated caller is programmed to recognise and respond to voice, 'conversations' between two callers are able to flourish, though each eventually breaks down with one (or both) callers electing to put the other into a holding pattern rather than attempt to resolve issues. The conceit for the work is that this futile cyclic conversation has been triggered by the most unlikely of events. The outbound call, which initiates the pattern of prompt and response is the recorded UK Emergency Broadcast system, also known as the Four Minute Warning. Within the installation, this ultimate cold call confounds the receiving IVR servers' attempts to interpret perceived menu navigation and insistently emerges from holding patterns to advise a long silent public to take shelter before atomic weapons are detonated.

Like the United States' Emergency Broadcast System, the Four Minute Warning took on a satirical cultural life of its own during the Cold War. Writers, cartoonists and musicians took the threat of obliteration to their hearts, with graphic novels, albums and an endless stream of stage and television comedy pointing the way to the pointlessness of Mutually Assured Destruction (MAD).

> This is the Wartime Broadcasting Service. This country has been attacked with nuclear weapons. Communications have been severely disrupted, and the number of casualties and the extent of the damage are not yet known…there is nothing to be gained by trying to get away…Do not, in any circumstances, go outside the house. Radioactive fall-out can kill. You cannot see it or feel it, but it is there. If you go outside, you will bring danger to your family and you may die…We shall be on the air every hour, on the hour. Stay tuned to this wavelength, but switch your radios off now to save your batteries. That is the end of this broadcast. [7]

The artwork suggests the illusion of chance amidst a dominant culture of reductive choice. It asks what the effects of ignoring potential problems based on the understanding that the probability of their occurrence is exceedingly rare might actually be. The work takes this premise to its natural conclusion to create an ongoing endgame, in which its audience is asked to consider their actions and reactions within a closed loop of predetermination.

The unknowing failure of *The Ostrich Effect* call centres echoes the example of 'Joshua' in John Badham's 1983 *War Games* [8] – an artificial intelligence that is interested in playing and learning but struggles with the rather human concept of futility. That era-defining End of Days scenario of the 1980s, in which we lived with the spectre of a computer error of MAD proportions, created a formidable zone for science fiction. Stanislaw Lem's 1987 *Peace on Earth*, which transposes the arms race to the Moon, leaving automatons in charge of retaliatory strikes, and James Cameron's 1984 *The Terminator*, in which overzealous AI becomes self-aware, delivering a fatal blow to humanity following the launch of Skynet, are typical responses to the escalation of the arms race, Ronald Reagan's rather optimistic 'Star Wars' initiative and a general feeling of societal helplessness and disenfranchisement from the activities of cold-war defence technologies.

Wider Extrapolations

The automated world, in which GIFs repaint the planet's fastest biped as the feeble-minded butt of jokes while manufacturers and advertisers collude to present new technologies as offering ever-increasing choices, is an Orwellian one, recalling Newspeak's doublethink.

The glitch is built in to Cotterrell's work. It is a celebration of the system error and the new possibilities inherent in it. *The Ostrich Effect* suggests there may be untried avenues in these programs that can offer new means of exploring our futility. The thesis explored in this work is that the Ostrich Effect, found through the perverse extrapolation of a series of unlikely scenarios, may serve to reveal the system itself. Witnessing the failure of a system, reminds us of its existence. The mechanics, which have been accepted within the wild-track of contemporary life have the potential to once again attract our attention and reveal their potential futility. The failure of an accepted system allows us once again to explore its meaning, the heroism or folly of its endeavor and the validity of our complacent acceptance of its permanent place within the fabric of our lives.

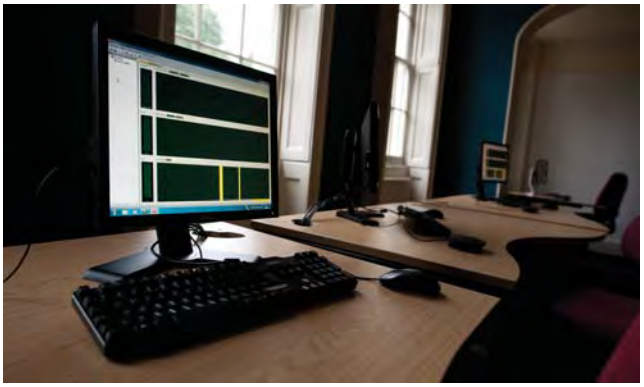

Fig 2. *The Ostrich Effect* (Installation, 2014) © David Cotterrell

Postscript

Cotterrell's artwork pays homage to Ray Bradbury's elegiac musing on a bleak and self-defeating future of technological progress and societal failure. The *Martian Chronicles* reflects on the social challenges of the twentieth century as it speculatively charts the human colonisation of Mars at the beginning of the twenty-first. In Bradbury's narrative, by 2026, the Earth, or at least California, has been laid waste by an unspecified atomic detonation.

The short story, "There Will Come Soft Rains" follows a day in the life (and death) of a fully-automated house, which has survived its biological occupants, whose shadows are burnt onto an exterior wall of the building. With no one to take orders from, the house operates itself, cooking, cleaning, washing up, playing music, reading poetry and, ultimately, attempting to put out the fire that will end its inorganic existence.

> …other choruses, oblivious, could be heard announcing the time, playing music, cutting the lawn by remote-control mower, or setting an umbrella frantically out and in the slamming and opening front door, a thousand things happening, like a clock shop when each clock strikes the hour insanely before or after the other, a scene of maniac confusion, yet unity; singing, screaming, a few last cleaning mice darting bravely out to carry the horrid ashes away! And one voice, with sublime disregard for the situation, read poetry aloud in the fiery study... [2]

Fig 3. *Infinite Call Centre* (Illustration 2014) © David Cotterrell

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Authors' Biographies

David Cotterrell is an installation artist working across diverse media and technologies. His practice is typified by an interest in intersection: whether fleeting encounter or heavily orchestrated event, His works explore the human condition and the breaks or nuances that can lead to a less ambiguous understanding of the world they inhabit. Encapsulating the roles of programmer, producer and director, His practice has considered the limitations and potential of representations of complex data considering human behaviour through micro-simulation, macro-planning and mediated representation. Cotterrell's work has been commissioned and shown extensively in Europe, the United States and Asia. He is Professor of Fine Art at Sheffield Hallam University and is represented by Danielle Arnaud.

Jordan Kaplan is a freelance curator, writer and project manager specialising in the curation of public realm and context specific artwork. Jordan is a founding member of Parabola, a commissioning and curatorial body dedicated to the production of contemporary art and critical debate. Since 2003, Parabola has commissioned over 200 artists to develop new work for projects with the Royal Geographical Society, the Natural History Museum, The Garden Museum, Tatton Park Biennial and the Queen Elizabeth Olympic Park. She has more than ten years' experience working as a visiting lecturer at the University of Hertfordshire and City University. Jordan holds an MA in Art Criticism from City University, is a Fellow of the RSA and a member of the International Association of Art Critics (AICA).

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Projet EVA - Subservient Techno for Subservient Minds

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Abstract

In this paper, we present Projet EVA's artworks that focus on the interaction between social, synthetic and biological systems, outlining the inherently restrictive and subtractive aspects of the increasingly technological environment in which humans are situated. For over 10 years, we have used detournement strategies to explore the entanglements of digital technologies with human activities and psyches. In an attempt to suggest alternative modes of understanding these problematics, the Projet EVA collective has made transgressive use of media in order to ultimately build a critical discourse on how technology informs social and psychological realities. The different projects presented in this paper illuminate EVA's singular approach to interaction design, one that produces experiential art that challenges the expectations of its discipline.

Keywords

interactivity, participation, intervention, transgression, mind control, relational aesthetics, immersion, game, augmented reality, surveillance

Glitches and Hitches

As teachers back in the early 2000s, it was common for us to see undergrads — upon coming to the realization that, on a computer system, sound and video ultimately amount to 0s and 1s — develop projects in which sound generated video, or vice versa. At that time, we shared a similar enthusiasm for the intertwining of different structures. However, rather than enabling one set of data to control another expressive structure, we sought to mix heterogeneous data structures or control systems and throw a party. This led to such projects as the unsuccessful *Nuées*, where cockroaches would be used to display video portraits. *Spamspasmes* (2003) saw a performer's skin pierced by hooks that were attached and pulled by a large pneumatic machine; a digital control structure made the skin move and behave in a totally mechanical way. These involuntary and "unnatural" glitches ultimately underscored the uneasiness produced by the transposition of machine behaviour onto the human body.

These projects remain experiments that unfold as representations or demonstrations. The public is grossed out or excited by this freak show but remains estranged from it all, comfortably going through this moment as a spectator of late 1990s/early 2000s, Stelarc-inspired man-machine art.

In fact, we realized that our artistic intentions had to push past the strict context of media arts. Rather than concern ourselves with disciplinary-specific topics, we turned to philosophical and aesthetic problematics similar to those developed as early as the beginning of the 20th century by the Dadaists, Futurists and later on by Fluxus. What these early harbingers of man-machine art questioned was the relationship of the spectator to the work, its social significance and, globally, the further advancement of the anti-art critique. We developed our work to investigate these topics more thoroughly, through technology and its media derivatives.

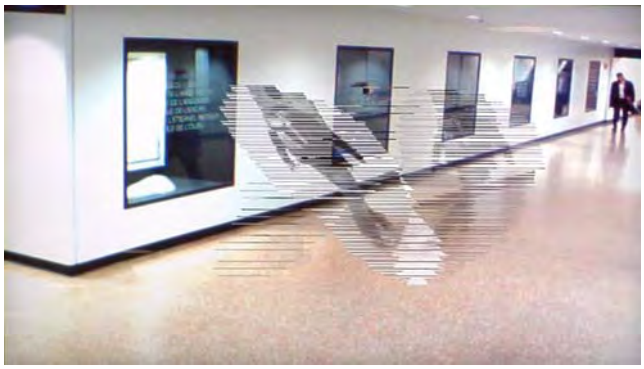

Figure 1. On va tous y passer ©Projet EVA.

A Subtractive Aesthetic

In order to integrate artistic propositions into social environments that are not dedicated art spaces, we create works that play with the social conventions of public spaces and that include passersby in the piece. For example, in *On va tous y passer* (2009), we wanted to incorporate the "normal" behaviour of individuals in these shared contexts as integral to the work. *On va tous y passer* is a video surveillance monitor set in a typical public transit locale. The incoming video feed is analyzed by custom software so that once an individual is isolated from the others, his or her image disappears, leaving the rest of the crowd and its surrounding environment .

By having members of the "audience" disappear, this deceptive mirror acts as an instance of subtractive aesthetics. Instead of augmenting a visual feed with computer-generated content, we focus on the elimination of a specific aspect of an image. Therefore, the piece revolves around "not showing" and disturbs the expected operation of a security device, allowing us to exploit

people's sense of being. Exploring the fundamental disjuncture between one's presence in the space and one's perceived absence within the representation of that space, the work highlights the fleeting nature of the social creature who is the passerby.

The piece worked best as presented in Lebanon in 2009 during Les Jeux de la Francophonie, where we were told on numerous occasions that people actually disappear, therefore tapping directly into the collective experience of surveillance and social control. By singling out individuals and erasing them in real time, *On va tous y passer* inverts the traditional role of the surveillance system, which is to procure an impression of security through monitoring and recording.

This anxiogenic device marked a turning point in our practice, as it was the first time we took a clear stand against the augmentation paradigm that is pervasive in the world of digital art. Instead of assuming that technology enhances human experience, our work started from the standpoint of the limitations of artificial systems. We began to create works that highlight the poverty of the existential conditions created for biological systems by hybrid technological aggregates, as well as the behavioural transformations that would occur in such environments.

Figure 2. This Is No Game ©Gridspace

A Perversion of Relational Aesthetics

In This Is No Game (2008-2011), we push further the notion of limiting percepts and skewing precepts. This performance project relies on two performers whose bodies are covered with a protective suit that completely blocks out vision and limits hearing. The actions of the performers are controlled by remote gamers who have access to live video feed being streamed from cameras affixed to their helmets.

In this context, the performers truly become "meat puppets," with no choice but to blindly obey the players. The relationship between these "avatars" and their controllers becomes perverted by the pleasure that the latter might get from driving their "character" into potentially harmful or dangerous situations.

This Is No Game can be linked to relational aesthetics, as conceptualized by Nicolas Bourriaud[1]. The piece establishes a situation that provokes social interactions, which are the artistic substrate of the piece. The relation to the other through mediatization, explored within a "game" social context, is the basis of the project. This Is No Game distances itself from core relational aesthetics through its perversion of social dynamics. The restrictive aspect of the avatars' suits, the delocalization provided by the radio frequency (RF) video signal and the derealization produced by real-time video processing are basically communicative hurdles limiting positive social interactions imagined by technophiles.

Most participants referred to this project as a game, even though the title clearly asserts that it is not one. One of the reasons we specifically chose the title *This Is No Game* is that this project in fact uses game mechanics to convey its proposition, but, contrary to projects such as Can You See Me Now from Blast Theory, we do not enthusiastically advocate mediated/augmented reality[2]. Instead, we investigate how such an apparatus might skew ethical judgment and social behaviour.

The lack of an apparent goal and the openness of its game mechanics make This Is No Game a very different experience from projects that propose outdoor, life-size games. We have often seen "players" of This Is No Game turn into real-life trolls and break social codes of polite conduct.

In conception and practice, the project offers a critique of augmented reality systems. Proponents tend to imagine augmented reality in terms of its potential to "add" to natural systems (perception, experience, interactions with nature and people). Our projects play at the sites of the possible failure of such a proposal. It is difficult to believe that augmented reality wearables do not violently modify the behaviour of those wearing them, up to the point where there is a sizable loss in terms of freedom of action and cognitive capacities or the quality of social interaction itself. This Is No Game explores this concept by producing what could be called a diminished reality system.

Invasion and Impregnation

With *Cinétose* (2012), our next project, we wanted to coerce the public into a somatic interaction with a mechanistic system. We ended up with a large-scale electromechanic installation that is comprised of steel sheets used as both sound instruments and scenic apparatus. Attached to a mobile grid above the audience, the large steel plates perform a series of movements while descending toward the public, eventually forcing spectators to lie flat on the floor.

The first version of the project, *Répétition pour la fin du monde* (2005), began as a reflection on interaction design that involved large crowds within the context of an interactive show. We were unsatisfied with statistical processing techniques usually employed. We find that these methods tend to create unintelligible relationships

among the crowd, the scenic apparatus and the performer, inducing distance and generating a very limited emotional engagement with the piece. Attempting to move beyond those dynamics, we decided to create some kind of metallic "net" equipped with piezoelectric sensors and pneumatic actuators to use as an "interface" with the crowd. By having this apparatus drop down on people and letting them act upon it, we would create a sound performance where the interplay between the public and the metallic structure would constitute the material of the piece.

Figure 3. Cinétose ©Gridspace

Later, we improved on this proposition by better formalizing the structure and concept into *Cinétose*. Focusing on the inclusion of robotics as an expressive element evolving beyond the simple role of a dissimulated mechanical theater actuator, we became interested in studying the spatial relationship that would be established between the overarching robotic structure and the public.

At first glance, the metallic structure shares the functions of sound production and set dressing. However, our main intent was to use the apparatus as a space-shaping device. We aimed for a proposal influenced by Edward T. Hall's proxemics[3], which divides space into two general categories: *Cinetose*'s metallic structure would creep from the distance, the territory, to an up-close personal space where the spectators would develop a direct, quasi-tactile relationship with the piece.

Rosalind Krauss[4], in her 1986 essay on Richard Serra, employs Merleau-Ponty's *Phenomenology of Perception* to describe a treatment of space that relies on a physical rather than an optical perception. The work of art is transposed from its traditional visual context to a purely haptic one where the seer and the seen are intermingled. This blurring of boundaries is *Cinetose*'s ultimate effect, as the public lays on the floor confused, breathing, next to a stranger, having nothing to look at, being stuck "looking in" to find remnants of the spectacle.

Cinétose, throughout the duration of the performance, shifts the locus of representation. In the first minutes of the show, the metallic ceiling is poised high above the audience. The crowd, gathered underneath, looks at it from afar and sees the different patterns of activation of the grid accompanied by a corresponding light and sound score. But as the ceiling lowers onto people, the distance between what we would normally refer to as the FOH (front of house) and the stage shrinks. As the public starts to feel the wind generated by the movement of the steel sheets, the heat of the lights and the shock waves of the hits of the pneumatic structures, the public gradually stops "looking at" the art and starts feeling it in a much more somatic manner. The grid lowers close to a point of contact, where people are forced to lie on their backs and negotiate with neighbours for some room on the floor. At that point, the performance's different expressive channels (light, sound, mechanics) become asynchronous to a point of contradiction. The spectator's typical perception of space, sound and light thus becomes troubled and the perceptual engagement with the immediate surrounding is uprooted. In terms of proxemics, the piece carries itself into the audience by entering their affective space.

Mind Control

Nous sommes les fils et les filles de l'électricité (*NSFFDE*), currently in progress, is one of our latest projects. It is a hybrid between performance, live participative theatre and digital art. Inspired by mind-control experiments financed by the CIA in the 1950s (especially the Allan Memorial Institute in our hometown of Montreal, Canada), the aim of this project is to orchestrate a disorienting spectacle that explores ideas of private and cultural identity, the politics of a collective future and the dynamics of power.

Proposing a reflection on identity and the alienation of collective memory in contemporary society, we conceived a novel interactive apparatus that would produce a stronger hold on the public's psyche. This will be achieved by localizing, as much as possible, the mechanics of the piece inside the participants' heads. This project marks a departure from previous works as it excludes any notion of physical spatiality. Social games and audiovisual trauma will constitute the main components of the experience.

In *NSFFDE*, a limited number of people are invited to take part in a play where there are no actors, only spect-actors[5]. The spectators are seated, facing one another. A video system projects images, or "masks," onto their faces. Throughout the duration of the "play," participants are given private audio directives such as behaviours and utterances that they must perform. Thus, the actual expressive material of the piece lies within the behaviours and attitudes of the participants, in conjunction with the directives formulated in real-time by the system. The end result has yet to be discovered, but we seek to accomplish the goals listed below.

Further penetrate the minds of the public

The spectator's utterances are both estranged and highly personal. Because they are externally induced and not thought-out words, the sentences enacted by the participants feel distanced and do not originally bear any identification with the body that produces them. Yet,

because they are spoken by this body through a somewhat ritualistic and repetitive process, we hypothesize that this technique might, after a certain time, induce an effective identification process. In *NSFFDE*, participants voluntarily take part in the piece and submit to the "rules of the game." The subordinate volitions that guide the behaviours of our spect-actors are, however, prompted by the system that directs them. By enacting the roles that are cast upon them, the participants might eventually identify with these externally prompted directives and incorporate them as inner-directed attitudes and feelings, in a manner similar to what William James[6] describes as the "conscious experience of emotion."

TRAPicipation?

NSFFDE shares similarities with participatory theatre. In a manner akin to Roger Bernat[7], we are not really interested in fiction and theatricality. Rather than programming a series of images and representations that unfold as a coherent discourse meant to be passively received by spectators, we simply work to make up a context in which participants are situated and ideally brought to some kind of awareness of the topics that interest us. However, it must be noted that the extra-territoriality of spectatorship (the inclusion of the spectator's body within the piece and the enactment by the latter of the play) does not aim at emancipating the spectator from his or her traditional passivity.

On the contrary, *NSFFDE* works as a metaphor for a hypercapitalist society and sets a context where inter-activity and collectivity are deployed in a superficial manner. In truth, participants are meant to experience both solitude and loss of self-identity. The apparent dialogue and communal exchange taking place in the performance are in fact a mere collection of atomized behavioural traits acting to dissolve the social cement. Behind the infinite potential for self-expression lie the technocapitalist tools of a new, soft totalitarianism. As Marcuse put it in 1964:

> In the realm of culture, the new totalitarianism manifests itself precisely in a harmonizing pluralism, where the most contradictory works and truths peacefully coexist in indifference[8].

Contextualizing this assessment within our practice, Projet EVA strives to create works that trouble the inherited assumptions of interactive arts and that challenge the complacency engendered by typical experiences of spectatorship.

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Authors' Biographies

Projet EVA is an art collective that was founded in 2003 out of a shared objective of creating critical, experimental and transgressive artworks in the new media sphere. The scope of the collective's artistic activities spans robotics, electronics, video and audio. Projects are connected by the themes of loss and restriction and focus on problematics related to relationships among individuals, computer systems and their physical extensions. Projet EVA's productions have been presented in Asia, Europe, South and North America and the Middle East.

Simon Laroche is an artist and interaction designer. He teaches Electronic Arts at Concordia University and collaborates on theatre, fashion design, dance and cinema productions.

Etienne Grenier is an artist working in the field of digital culture. He has taught audiovisual interaction design for many years at Université du Québec à Montréal. He has collaborated as a designer with architecture and advertisement firms, dance and theatre companies and video producers.

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Comedy53: An Approach for Creating Computer-Generated Humorous Comics

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Abstract

This paper proposes a system's design for generating comics based on the incongruity theory of humour. We describe the field of Computational Humour, while also examining the nature of humour in the context of images and text to help provide frameworks for developing a system, comedy53, to produce computer generated comics. Based on the results of comedy53, we then propose strategies to help improve the future development of comic generation in the context of Computational Humour.

Author Keywords

Computational humour; automatic comics generation; incongruity theory; text-image relationship

Introduction

Computational Humour is a relatively new subfield of artificial intelligence given that it was only first explored in the early 1990's [1] and that AI research in modeling human behaviour and intelligence has existed for over a half century. In addition to being a new field, our understanding of humour itself is poorly realized, as no agreed upon general theory of humour exists. This is likely due to the fact that humour comes in many forms and is studied across many disciplines, spanning such fields as philosophy, psychology, linguistics, sociology, and more recently computer science [2]. One popular theory of humour that has emerged, and which computational humour has used almost exclusively [3], is the incongruity theory. The incongruity theory posits that humour is created from a conflict that exists between what is expected and what actually occurs, essentially producing an element of surprise in the viewer, which when resolved can produce a sense of mental ease and humour [4] Furthermore, the extent of the divergence (the difference in magnitude between the expected outcome and the true outcome) produces greater humorous effects during information processing [2,5].

Despite the fact that humour comes in many forms, (e.g., satirical, dark, irony, etc.) practically all computer-generated humour programs rely only on text-based humour, particularly wordplay [6]. These programs take advantage of the ambiguities found in natural languages, such as multiple interpretations and double meanings (e.g. homophones), to produce an incongruity (divergence of expectation) which is then later resolved in the punch-line [4]. While a few programs have explored the use of algorithms to produce incongruities and humour through purely text-based jokes, predominately in the form of puns, there is a lack of work exploring the use of images and text to produce humorous comics. We refer to comics in this paper, as defined by McCloud as a text image

The aim of the system design, comedy53, proposed here is two-fold: 1) develop a system that explores the relationship between image + text, to create humorous outputs based on the incongruity theory of humour and 2) use the results of comedy53 to explore future developments of computational comics, using our knowledge of existing comics and humour.

Related Work

Although a majority, if not all, of computer generated humour systems rely on a model of incongruity at some level, the concept is poorly defined in the literature. An explanation of incongruity by Nerhardt [5], comes from a study in the 1970's where he asked blind-folded participants to hold out their hands to receive objects of varying weights. By giving the weights in incremental order, the participants began to expect increased weights as the experiment continued. But when their expectation of the weight was violated, the reaction of the participant was amusement, resulting in humour. Furthermore, Nerhardt found that the extent to which participants found it funny was proportional to the divergence from their expectation.

We can begin to understand why jokes are humorous when we examine them through the incongruity theory. Take, for example, the following joke:

> *Two fish are in a tank. One fish looks over to the next fish and says: "Do you know how to drive this?"*

Here the punch-line comes at the realization (i.e. a resolution of the diverged meaning) that the two fish are in a military tank (double-meaning), and not a fish bowl tank, as one would expect. While this joke may be simple, it relies on certain contextual awareness – a known challenge for computers. As a result, most computer-generated humour involve self-contained (non-contextually integrated) use of wordplay (or puns).

One of the very first systems to generate jokes was Tom Swiftly, developed in the early 1990's [7]. A typical joke goes as follows:

> "*Turn up the heat", said Tom coldly.*

Tom Swiftly produces these short quips by reconfiguring the root-word (i.e. cold, from *heat,* through antonym association) into the adverb "*coldly",* to produce contrast between the first and second utterance. JAPE [8], another program developed in the 1990's, which later became STANDUP [1] in the early 2000's, also uses self-contained puns. JAPE jokes come in the form you may expect from a children's joke book of one-liner puns. A typical joke runs as follows:

> *What do you get when you cross a murderer with a breakfast food? A cereal killer.*

JAPE has many different programmed schemas (scripts) to generate jokes. In this example, the joke is produced by working backwards by first selecting a hyphenated two-worded answer (e.g. serial-killer) and finding similar homophones to one of these words (e.g. serial = cereal) through the linguistic database WordNet, and finding related words (i.e. hypernyms) to cereal (e.g. cereal = breakfast food) to generate the question. The question component of the joke is formed using another schema that uses basic sentence structures to pose questions. JAPE does produce the rare humorous output (subject to human evaluation) but because multiple word matches and sentence structures exist for any given schema, JAPE also produces a numerous amount of "bad" or incomprehensible jokes for every "good" one. This is because these systems do not evaluate what is funny or not through defined rules - a major challenge in computational humour [4].

Throughout the last two decades, many systems have been developed that have generated some form of verbal humour – the use of natural language, conveyed by either text or speech [1]. Only one system, AUTEUR [9], has been developed without the use of natural language or wordplay (e.g. puns, acronyms, etc.) to create humour [1]; AUTEUR instead generates visual humor by manipulating and editing videos to create humorous film sequences.

For the purpose of this research (i.e. using text and image to produce humorous outcomes), it is also important to understand the techniques used in single and three-frame comics. Short text-alone jokes (i.e. all computer generated humour hitherto) are restricted in that they are self-contained; the humorous effect of the words lies strictly within text, offering no referential link to the external world or current context. The addition of images, commonly found in comics, allows for contextual integration: images can create a situation or environment that is both recognizable to the reader and also fundamental to the joke. Thus, the approach and technique to create humour by combining text and image (i.e. multimodal) must apply a different technique than commonly seen in strictly computer generated verbal jokes. Comics, defined as "juxtaposed pictorial and other images in deliberate sequence, intended to convey information and/or produce an aesthetic response in the viewer" [10], provide a context for the viewer, and a platform for a text -image relationship. For the purposes of this research, we are interested in exploiting this text-image relationship (i.e. juxtaposition) to produce a humorous effect. Text and images can interact in three different ways to achieve humour: i) the joke lies solely in the text, while the image only provides supplementary illustration; ii) the image itself is the joke and the text is unnecessary; and iii) the joke is dependent on the interaction between the image and text, either complementing or contradicting each other [11]. Here we are interested in this latter approach: the interaction of text and image.

Humour is often produced in comics by the same two-stage process that we see in verbal humour: an incongruity is made and later resolved [12]. For instance, in the single-frame comic "Freudian slide" by Gary Larson [13] (Fig. 1), the viewer finds a man (represented as your stereotypical professor) 'sliding' into a base in baseball with the caption reading "*Freudian slide*". The viewer's belief and expectation of the phrase "Freudian slip" is challenged, and the culmination of the humour process comes when the viewer resolves that the man is Sigmund Freud who is sliding into the base. Note that the comic would not be (as) funny if the man sliding into base was an ordinary baseball player, or if the viewer had no knowledge of the phrase "*Freudian slip*".

The same two-stage approach (i.e. incongruity and resolution) can be applied to multiple-frame comics. In the four-frame comic "*Suck Note*" by Nicholas Gurewitch [14] (Fig. 2), the viewer is lead to believe that the first character is writing his own suicide note. This notion is drawn out over the first three frames, creating an expectation within the viewer. In the last frame, however, the viewer realizes that he is not writing about himself, but rather the victim.

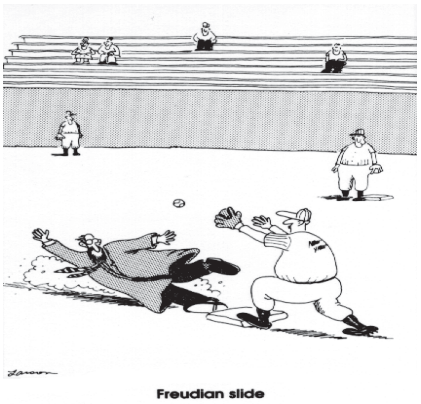

Figure 1: "Freudian slide"(The Far Side, by Gary Larson)

Figure 2: "Suck Note" (The Perry Bible Fellowship by Nicholas Gurewitch)

Based on Nerhadt's blind-fold and weight experiment to produce humorous incongruities, it is perhaps reasonable to assume that a greater humorous effect can be achieved in comics as well by raising the expectation through multiple frames [5]. Time and sequence build familiarity. In the instance of Nerhadt's study, participants didn't just receive one weighted object, they received multiple objects with increasing weight which created familiarity and expectation. In the case of "Suck Note", the multiple frames produce a narrative and a familiar context with the viewer: depression and suicide.

While these previous two examples produced a joke by creating a final resolution, comics, or jokes in general, can also be humorous by introducing an incongruity that ends with no, or a partial, resolution [11]. This structure, commonly known as *nonsense* or *surreal* humour, leaves the viewer with a sense of absurdity that is not logically congruent or resolved in the end. These are often produced in comics via bizarre juxtapositions or non-sequiturs. In Gurewitch's comic "*Bear Police*", (Fig. 3), two boys are in an alley writing graffiti, which are later spotted by a police officer, in the form of a bear [14]. The police bear then chases down and mauls the two boys. The comic is concluded with the police bear peacefully enjoying a coffee and donut, presumably in a coffee shop, with no resolution. The viewer is never given a reasonable explanation of the bizarre juxtaposition of a bear dressed as a police officer who enforces the law. While the comic could have ended after three frames, the absurdity is carried out into the fourth frame, whereby any salvaged resolution the viewer may have leading up to that point is now completely removed in the final frame.

Figure 3: "Bear Police" (The Perry Bible Fellowship by Nicholas Gurewitch)

One key component of comics that should be addressed is the relationship between text and image. Many comics we encounter use images to simply illustrate the narrative of the text; these comics could exist as stand-alone text comics without using images. On the other hand, some comics use images to convey the joke and message, where text is either absent or plays a minimal role (e.g. "*Bear Police*", Fig. 3). In between these extremes, humour and meaning is created by a synergy of image and text, where both components are fundamental for constructing the joke (e.g. "*Freudian Slide*" Fig. 1; "*Suck Note*" Fig. 2). As explained above, crucial to the comic is the knowledge of "Freudian Slip" (found in text), identifying Freud (found in image), context of baseball and sliding (found both in the image of "sliding" and synonym of *slip* meaning *slide*). Thus, both the image and text are constructing and supplementing one narrative. However, a fourth category of comics exists in which there is a loose relationship between text and image, and where both elements are constructing their own narrative. An example of this approach is found in the comic strip "*A Softer World*", created by photographer Emily Horne and writer Joey Comeau [15]. *A Softer World* is produced by combining three photographs, often in sequence or of related theme and juxtaposing them with text, often in the form of a personal monologue. The process of matching text and images together varies; sometimes there is a relationship (e.g. Fig. 4), while other times there is no discernable association between text and image (e.g. Fig. 5), as if both elements are telling their own narrative. Despite having two very different approaches, both styles are effective in creating comics.

Considering the novelty and limitations of computational humour at this point in time, it is perhaps both feasible and practical to take the same approach as *A Softer World* (juxtaposition of image and text) to create computational

Figure 4: "untitled" (A Softer World by Emily Horne and Joey Comeau): Connection between text and image

Figure 5: "untitled" (A Softer World by Emily Horne and Joey Comeau): No or little relationship between text and image

comics. Though, it should be noted that in most cases the text found in *A Softer World* often is the source of humour. Thus, one of the challenges of producing computational humorous comics is crafting and selecting 'humourous' text, not just the relationship between text and image.

Computational comics have explored the use of generating image and text compilations [16], but this work is primarily focused on the graphical layout, rather than text and its relationship with images, let alone humour or sequence of events. Artist John Pound [17] however, has produced randomly generated comics which attempt to follow a loose narrative. Using PostScript, Pound published several computer generated comics (PoundArt; Fig. 6) that follow a three step process of 1) Random Production, 2) Evaluation, 3) Revision. The system Pound produces the images (i.e. drawings) and text (i.e. script) separately, and combines them together in the end process. While the finished product is aesthetically interesting, it does not provide insight into how narrative structures can be produced, nor does it offer any insight in creating humorous effects.

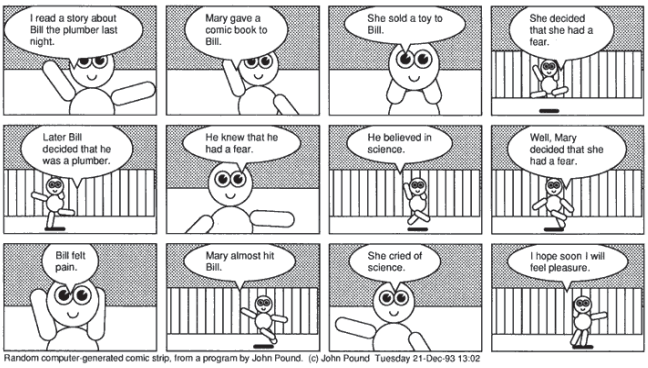

Figure 6: "This Is Not a Comic!" (Pound Art by John Pound

In her work *Grafik Dynamo* and *Why Some Dolls Are Bad*, artist Kate Armstrong produces computer generated net art by using online images from Flickr to create a live action comic strip (Fig. 7)[18,19]. The images are randomly generated based on certain search tags created by the author and mixed together with preexisting original text. The text is primarily composed of philosophical musings and maxim-like utterances, which creates a peculiar juxtaposition with the accompanying images. The comics, Armstrong believes, produces "a strange, dislocation of sense and expectation in the reader, as they are sometimes at odds with each other, sometimes perfectly in sync, and always moving and changing" [18]. A sense of expectation from the reader has the potential to be exploited with incongruity to produce a humorous effect. While the artwork does present interesting questions into the relationship between text and image, the comics themselves are not absolutely computer generated, as the text used in the final product is manually written. To our knowledge, no computer-generated systems have explored the use of image and text to produce a humorous effect.

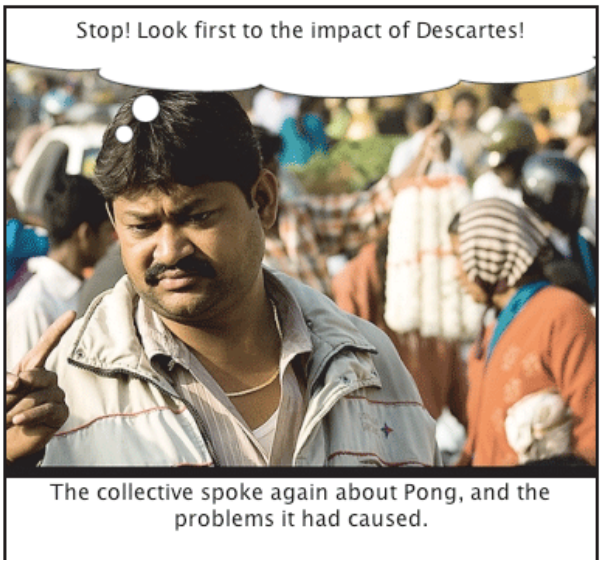

Figure 7: Why Some Dolls Are Bad by Kate Armstrong

The comedy53 program presented in this paper, while a prototype system, offers insight into basic frameworks for how we could design a system to generate humorous comics.

Comedy53 Overview

The overall approach of comedy53 is to match text with images to create humorous comics, based on the principles of incongruity in humour [5]. In doing so, we have created three approaches for generating online comics: HystLyrical, JuxtaQuotation, and FamilyTweets (available online at www.metacreation.net/comedy53).

HystLyrical

We first we examined the process of generating comics in a more narrow and simplified form by using images of classic and popular Hollywood film screenshots together with matching song lyrics. The goal of HystLyrical is to combine these two elements to produce humorous three-panel comics with a short narrative. We propose this selection of images for five reasons: 1) there exists a database of the images (screenshots) accessible online (http://film-grab.com), 2) the image size, dimension and resolution are constant across all screenshots, 3) the images contain a text label which categorize the screenshot's context (Fig. 8) 4) users are more likely to identify and reference the image (building familiarity), and 5) there is a greater likelihood for creating a short narrative using screenshots (three frames in sequential order). These last two points have the potential to produce expectation and anticipation in the viewer, which can result in an incongruity, and later a resolution (for instance, in the final third frame).

Figure 8: An image labeled "redrum" (The Shining by Stanley Kubrick)

We used a similar strategy in selecting a text database. In our approach we decided to use musical lyrics, based on three principles: 1) there exists a database an online accessible database, Lyric Find (http://www. lyricfind.com /services/lyrics-search/), 2) the lyrics have the potential to be recognizable to the reader, 3) the lyrics form a short (coherent) narrative that can build anticipation within the reader. These last two principles give the comic a greater probability of being identifiable to the viewer and can increase expectation. Venour [2] discusses this approach of familiarity to produce a greater likelihood of incongruity and registered-based humour.

Using Javascript and Ajax, the first stage in the HystLyrical system is to select a film, which is done randomly from a list of over 150 Hollywood films. Using the film *The Shining* as an example, HystLyrical then crawls the DOM (Document Object Model) to select three random images from the film. Following our example, HystLyrical selects:

http://i1.wp.com/filmgrab.files.wordpress.com/-redrum.png,
http://i1.wp.com/filmgrab.files.wordpress.com/-girls.png,
http://i1.wp.com/filmgrab.files.wordpress.com/1-axe.png

The URL images are then split and parsed to produce individual keywords. In this example, we retrieve *redrum*, *girls*, and *axe*. The keywords are then loaded into a request using LyricFind's search algorithm:

String baseURL = "http://www.lyricfind.com/services/ lyrics-search/try-our-search/?q=";

String request = baseURL +keyword1+keyword2 + keyword3;

The request then retrieves lyrics that match the keywords. In our example, LyricFind.com returns ten matches that HystLyrical inputs into a string array. Found below is one lyric result, from the song *Redrum* by *Doomsday Productions*:

"of my white Cadillac and a 9 millimeter gat Redrum evil mean muggin' body snatcha Jack the Ripper ain't got shit up on this ax hacka"

Comedy53 then searches the array (i.e. the ten different results) for the lyrics that contain the most matching image keywords. In our example, the lyrics above are selected based on the two matching words "*redrum*" and "*axe*".

Figure 9: HystLyrical output example (Generated from the film The Shining and lyrics from the song Redrum, by Doomsday Productions)

The chosen lyrics are then parsed into three verses, using the "/" as a delimiter. The original three images are then rearranged to match the sequence of keywords in the three verses. Finally, the text is superimposed onto the three images using HTML Canvas. Below is a HystLyrical output based on our example:

JuxtaQuotations

JuxtaQuotations uses the same framework as HystLyrical, but instead the goal is to combine famous quotes with contradicting images, to make a single panel comic.

Using similar methods as HystLyrical, JuxtaQuotations searches a database of quotes based on keywords (i.e. themes) from http://www.movemequotes.com/ to retrieve a quote and name of the author of the quote. JuxtaQuotations then uses Flickr's API to search and retrieve images using a keyword that is contradictory to the original theme used to find the quote. The example implemented (Fig. 10) uses the theme "Success" to find quotes related to success and then finds contradicting images using the keyword "Poverty" as an antonym to "Success". Note, currently the technique for finding contradicting themes for images is not automated, and only works for generating Success/Poverty comics as a juxtaposition.

Figure 10: JuxtaQuotations output example (Success vs. Poverty)

The final output places the Flickr photo inside a white border on a black backdrop, which sits above white text from the quote and author's name. The aesthetic aims to parody popular motivational posters. The instance of combining poverty images with successful quotes also aims to poke fun at ideas of individualism. In the example below, Tony Robins, the motivational speaker, is asserting that one should always be cheerful despite their circumstances, yet the meaning is disrupted when juxtaposed with an image poverty, resulting in a deeper reflection of the text.

FamilyTweets

FamilyTweets examines the production of computational comics by using the latest image from the newspaper cartoon *Family Circus* together with the latest tweets from Twitter. In our example, we explored the use of the latest tweets from Justin Bieber's account using Twitter's API. Thus, FamilyTweets comics offer a more dynamic approach for comic generation in that both elements (text and image) are constantly updated online (image changes daily and tweets approximately ever hour). Figure 11 shows four consecutive Family Circus comics with the latest tweets from Justin Bieber on that particular day.

FamilyTweets are generated by scraping the comic located on the homepage of http://familycircus.com/, using JavaScript and Ajax. Using Twitters API and querying by username, Justin Bieber's latest tweets are pulled and placed under the comic, and over the existing caption to create a new caption (using HTML Canvas). Thus, a new comic is generated every time a new Family Circus comic is released or Justin Bieber tweets. The tweets are styled to match the existing typography of the familiar comic, thus strengthening the incongruity with the reader. The result often places Justin Bieber as the voice of the children from Family Circus, thus making his online comments seem even more juvenile.

Figure 11: FamilyTweets output example

Discussion

While the comics produced by comedy53 are by no means comical genius, they do provide us with an approach for how we can generate humorous comics. It is the hope of this research that we can extend our knowledge of computational humour, and for the first time explore the field of computer generated humorous comics.

We believe the first step in designing an improved comedy53 system lies in using different (e.g. richer) databases for text and images. For example, in HystLyrical we believe our image database (http://film-grab.com) is limited by the fact that the film screenshots labels are often ambiguous or unrelated to the image itself. This limitation of human subjectivity is difficult to circumvent in this instance, but perhaps an image database that included a consensus of labels from multiple individuals would be more appropriate. Secondly, the image labels are often only one word, therefore they do not provide a rich or descriptive context. Lastly, roughly only half of the films found on Film-Grab.com contain keyword labels, and thus the database is limited in size. Based on these three limitations, we would propose using a different database for images in the future (e.g., Google Images).

We also believe our text database was limited in three features. First, while LyricFind.com is robust in the sense that it can transform the keyword to include a wider definition of the word and tenses (e.g. the keyword *swim* can be transformed to include *swim, swam, swimming,* etc.*)* the wider group of keywords are not recognizable when compared to the original keyword image, and thus HystLyrical will not recognize a direct match. Secondly, LyricFind.com does not always return complete verses. In our example of *Redrum*, note that the lyrics retrieved

include the incomplete "*I got a double edge ax in the back*" at the beginning of the verse. To avoid this problem, we have experimented with initializing our selection from the 'second' verse (i.e. starting after the first "/"), but this can also produce further incomplete verses, as the second verse may depend on the initial verse found before the first "/" to read as a complete sentence. Lastly, roughly one-fifth of the lyrics retrieved include undesired song descriptors such as "[Chorus 1]" that tend to spoil the comics. Taking these limitations into consideration, we would propose exploring a different text database for future work. We would also recommend exploring a text database outside of lyrics. For instance text could be generated from different mediums such as poetry or even news headlines.

We also propose future work that would incorporate user evaluation and interaction. Integrating user feedback, whereby viewers classify comedy53 comics into "funny" and "unfunny" classes, could help strengthen the comedy53 model of humour. For example, if users can rate comic output, comedy53 could learn which relationships of text and images are more effective at producing a humorous effect. An example of this approach was proposed by Costa et al. [20], using a Support Vector Machine (SVM), in conjunction with online crowdsourcing, to help classify joke – a task that is particularly subjective. Here, SVM operates by determining an optimal hyperplane between two classes (funny and non-funny jokes), through a supervised classifier. We suggest a similar *training* approach in the future development of comedy53.

Another form of human interaction in comic generation was described by Tobita [21] in which the users of their program, *Comic Computing*, can interact directly with the comic images by manipulating figures and objects in the comic's frames. In Comic Computing, even mundane and boring images can be stretched or deformed to produce interesting or funny results. The role of direct human interactivity with comedy53 could produce improved results as well. One obvious approach would be to allow users to edit and manipulate the text to create their own 'improved' caption to the image. In this sense comedy53 would provide a platform that could inspire creative or funny ideas within the comic.

We propose to analyze the relationship between computer-generated text and images in comedy53's output, in a future study. In this study, we propose generating a series (e.g., 20 series) of four different comic types: 1) comedy53 generated (images with computer-generated matched text), 2) controlled images (same images as comedy53 comic, but with unmatched text), 3) controlled text (same text as comedy53 comic, but with unmatched images), 4) human generated (same images as comedy53, but manual input of keywords to match images). Participants would then rank the four different comics in each series, from most humorous to least humorous. Thus, we could then analyze which approach (1, 2, 3 or 4) tends to create the most humorous comic. We would predict that the 4th approach (human generated) would have the overall highest ranking, but this study would also explore if comedy53 can produce more humorous comics than controlled images and text (approaches 2 and 3). If this is the case, this study would help support the idea that comedy53 has provided a heuristic approach for creating computer-assisted humorous comics – one that we can improve with our suggested future work. We would also be curious to know how well comedy53 would compare next to human generated comics.

We imagine exploring other avenues of image and text. For example, mashing popular Sunday Funnies comics in original ways through simple computation. We propose a few various automated series here:

Figure 12: Garfield Minus Garfield Plus Snoopy

i) **Garfield Minus Garfield Plus Snoopy** (Fig. 12). This scenario only mashes together images (no text) by mixing together images from Garfield Minus Garfield with Snoopy from Peanuts, in the final frame.

Figure 13: Sally Back and Forth

ii) **Sally Back and Forth** (Fig. 13). This manipulation simply swaps panels. Here the 2nd and 3rd panel have been swapped in Sally Forth comics to create ambiguity.

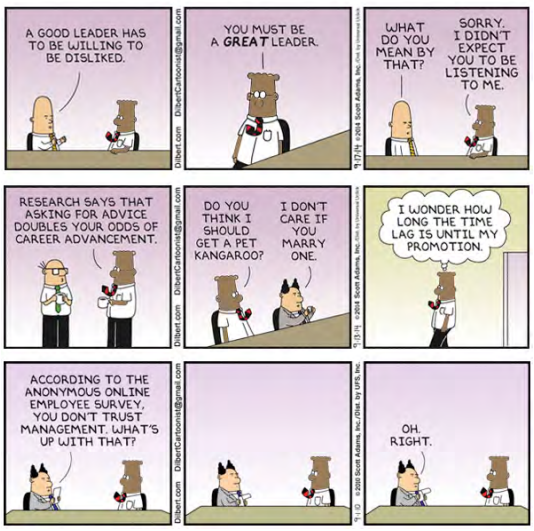

Figure 14: Black Dilbert

iv) **Black Dilbert** (Fig. 14). The comic could also be provocative and make us question racial norms. In this series of three comics Dilbert's skin colour has been darkened, changing the lens of perspective from a white to a black male.

Given the recent developments in computer generated image captions [22], it seems likely that innovative applications for generating comics will follow. For instance, using Deep Visual-Semantic Alignments in conjunction with simple word play substitution and manipulation with the produced captions, generating humorous comics and memes may come sooner than imagined.

The body of research surrounding computer-generated humour, specifically comics, is still in its infancy. Given that comics (i.e. images and text) are becoming "one of the most popular and pervasive media forms of our increasingly visual age" [23], it seems logical to investigate the field of computational comics to meet the growing demand as well as to expand and explore the medium for new possibilities. As our knowledge of computational humour progresses, so will the medium of comics.

Conclusion

This paper has described what has been done in the field of Computational Humour, while also examining the nature of humour in the context of images and text in effort to illuminate the possibilities involving computer generated comics. Here we've presented a basic framework for designing a system, comedy53, that can progress our understanding of computational comics. We suggest integrating user interactivity, subjectivity and evaluation into the comedy53 program to improve its comedic performance.

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The Order of Passions — A Portrait of Polyphonic Canada

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Abstract

In this paper we discuss the Order of Passions, generative media installation that visualizes dynamism, disturbance and unity within the diverse set of human facial expressions that together create a collective and emergent polyphonic portrait of Canada. We discuss critical compositional, technical and meaning making strategies for the creation of this generative artwork. The discussion is positioned from the perspective of artist-creators dealing with computational media as a medium for both, creative production and presentation of the artwork. We describe the tools and processes that were used and developed to support the creation of the project.

Keywords

Media polyphony; Canadian hybrid culture; identity; generative art installation; facial expression recognition; media ecology; emergence; complexity.

Introduction

This paper looks at some critical compositional, technical and meaning making strategies in the creation of generative artwork, the Order of the Passions. As a multimedia audio-visual installation the work expresses hybrid Canadian cultural identity as unity within a plurality of ethnic codes and affective expressions embedded in the human face. This dynamic ethnographic media environment distributed in space and time consists of multiple screens and audio channels tightly coordinated to present an image of the hybrid human face with voice, reflecting the understanding of unity through diversity. The Order of the Passions renders the metaphor of the broken mirror framed as a dynamic cultural mosaic reflecting a hybrid portrait of Canadian plural identity that evokes feelings of belonging through an emergent composition and dynamic experience. The empathic connection between viewers and the multifaceted community to which they belong is established through both the recognition of emotions represented in the composite face and diverse linguistic vocal expressions.

The discussion is positioned from the perspective of artist-creators dealing with computational media as a medium for both, creative production and presentation of the artwork. We examine creative relationships between artistic composition and expression, the generative processes that articulate and animate the work, and the emergent meaning embedded in the work. The first portion of this paper discusses theoretical, practical and semantic implications of this generative installation. The subsequent section describes the creative process, its innovations as well as challenges, and the paper concludes with a reflection on the conceptual and design contributions of the artwork.

Canadian Poliphony

The notion of a cultural mosaic has historically been central in describing Canadian polyphonic culture, with that concept sitting forming the basis of the Canadian Multiculturalism Act (1988), which aims to preserve and enhance multiculturalism in Canada. One of the criticisms of a cultural mosaic as symbol of preservation lies in the promotion of a coexistence of apparently static and separate elements (Schneider, 2008) and in the politics of difference (Thompson, 1995) that inhibits the construction of a stable identity.

As an alternative to the concept of multiculturalism John Ralston Saul (2008) proposes that Canada as a hybrid nation, inspired by Indigenous philosophy. At the centre of this hybridization and the source of Canadian imagination, Saul argues, is the First Nations concept of the ever-enlarging circle that expands and gradually adapts as newcomers join in (Saul, 2008). This concept provides a capacity to welcome immigrants and integrate them into an emergent culture. It explains the degree of comfort around ambiguity, complexity, cultural plurality and negotiation embedded in Canadian culture that, in its ideal form, acts as a civilization of communities, organically formed at a grassroots level. This hybridity also explains a core value of equality and equilibrium between a celebration of individualism and celebration of communities and group rights.

The concept of an ever-enlarging circle celebrates plurality and differs from the idea of the multiculturalism, which legislates cultural diversity to promote preservation. It also differs from the metaphor of the melting pot, where different peoples are assimilated into a uniform cultural identity. Saul argues that an individual's culture, within

Canadian plural hybridity, is not necessarily given by membership of a particular an ethnic group or nation, rather it draws from an Indigenous approach to belonging that is not racially rooted. The cultural ties for First Nations people are based on relationships with family, community and physical place — the land.

Saul identifies the challenge that contemporary Canada faces, in terms of how to express this hybrid reality, the reality drawn from a reading of Canadian history as an evolution of plural national character inspired by Indigenous philosophy (Deacon, 1933; Saul, 2008). The work we present in this paper is a direct response to Deacon's acknowledgement of the hybrid history of Canada and Saul's call for resolving our contemporary challenge to express this historical evolution. The Order of the Passions, as a hybrid media portrait, is a creative investigation into Canadian hybrid identity (Deacon, 1933; Parameswaran, 2002; Braz, 2010). This generative composition is a poetic visualization of Canadian hybrid culture.

Shattered mirror

A mirror is being broken and in each shattered piece different faces are reflected. No longer can you view your image in a single mirror. And a shattered mirror cannot be reassembled.

Toru Takemitsu, Confronting Silence (1995:70)

The Order of the Passions examines the notion of Canadian identity building on the idea of a mosaic but extending it with the metaphor a broken mirror whose pieces are positioned as if captured in the moment of breaking within the gallery space. The image of a broken mirror is inspired by Takemitsu's discussion of the shattered dominance of Western thought and further underlined by postmodern philosophy. The metaphor of broken mirror signifies the postmodern thought, with the idea that the truth can only be accessed when viewed from multiplicity of perspectives. The mirror is broken and each broken part reflects different face, a different point of view. The reflections in the individual pieces of the mirror can be grasped only through the whole, through multiplicity and diversity of all colours characteristic for the balanced plurality.

The symbolism embedded in this dynamic shattered mirror image, moves immobilized constituents into active, hybridized, ever evolving participants in the discourse on plural identity. By representing the polyphonic fabric of our Canadian experience through human faces, emotions, voices and languages this work reflects and points to an idea that we are all part of one body, one ecology and one planet. We therefore create a portrait of a human face that reflects the notion of humanity as one organism whose delicate ecology and health depends on balanced complexity, pluralism and diversity. One of the readings embedded in the work is that we are all one, rendered through a focus on basic form of human face and common character of facial expressions. A parallel reading points to the notion that we are each multiple, every one of us is composed of many influences, memories, and histories swimming in a river of rich and diverse world cultures. This work reflects the multiplicity that we live in today.

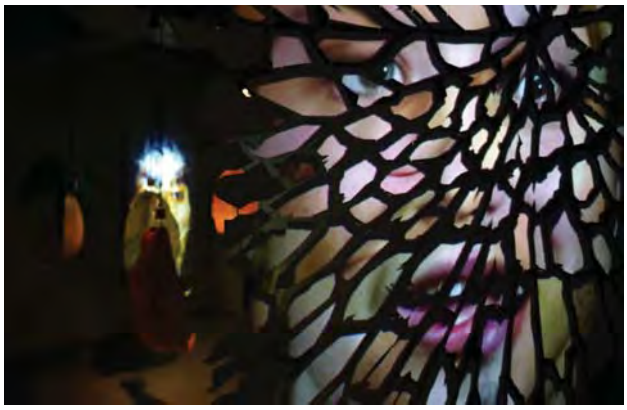

Figure 1: Detail of The Order of the Passions Installation

Visually, the diversity is reflected within differences in facial appearances. In the aural sphere, the linguistic richness of diverse cultures and their dialogic interactions is expressed through the representation of a Canadian multilingual environment. The resultant whole reflects a multiplicity of different voices singing simultaneously, not only in dialogue, but also with an ear to each voice's uniqueness and interdependence (Bringhurst 2009).

Figure 2: The Order of the Passions Installation view

Different people, their faces and voices, are projected across one hundred and thirty screens shaped as broken mirror pieces and eight audio channels. Those portraits, set beside each other, reveal difference and individuality. The perception of a collective identity emerges through a process of hybridization and transformation within a composite image that reflects to the viewer an image of multiplicity. The changing nature of the work allows for an active engagement in the construction and discovery of our identities as we observe this emergent portrait.

The human face and voice are core aspects of our communication; they are the instruments through which we present our selves to ourselves and to the world. Facial features and linguistic character of a voice allude to our ancestry, genetic heritage and our origins. Together, they paint an audio-visual portrait of a person's history, their familial background and upbringing. They are imprinted with our family histories and a sense of our ethno-cultural background. This composite portrait reveals at once unity, plurality and individuality.

The work reflects how our cultural, ethnic and linguistic differences collapse when we are presented with the expressions of basic human emotions. Despite cultural and ethnic differences, people are bound by the ability to read faces. Facial movements betray our emotions. In recognizing our own varied emotions expressed in the composite mosaic, we see our own multiplicity reflected in the mirror. The mosaic reflects our fluctuating self-identities and emotions as well as the comparable identities and emotions of our larger diverse ethno-cultural community. This allows for empathetic connections between constituents and reinforces the idea that shared emotions can enable understanding of shared identities. The empathic process can be understood as one of mirroring the emotions of another, and so the joining of many faces in a single expression is a visual representation of the mirrored emotion and empathy that must be present for a functioning plural community. The multifaceted identification through unity and difference provides an ontological ground that has ability to shift conceptual understanding of self and world in a transformative way, reflexively. As the image that activates the mind while speaking to the heart, this portrait is embedded with the accommodation and continuous negotiation drawn from Canadian plurality. As an artwork concerned with hybridity of culture the portrait can operate within the larger global context.

Complexity and emergent meaning

Could I ask you to explain the music of heaven?
Sounding the ten thousand things differently, so each becomes itself according to itself alone…
Who could make such music?
Chuang Tzu, A Little Talk About Evening Things Out, (Hinton, 2013)

The computer as a medium for artistic composition can take a role of a collaborator with creative inputs on its own, inspiring, provoking and challenging new modes of expression and meaning making. It enables a meaningful and creative dialogue not just with the artwork creators and the computation as a medium for poetic articulation but also with viewers that experience the semantic media space of the work.

The generative approach for art making offers modes of ambient media experience that are based on the incorporation of computational processes and system dynamics into the production of artistic whole. The complex output generated by the Order of Passions artwork provides both methodology and source of inspiration for meaning making. The processes, algorithms and mechanics that generate the work provide the artistic materials with which the work is crafted.

Computational process enables affective visualization of complex emergent collective thoughts that can be expressed through interrelationships among the parts within the whole — individual and explicit characters form connections that merge into a collective hybrid image. The computational media that enable this artwork reveal collective identity through a dynamic and infinite compositional process. Emergent visualization of this portrait allows creative engagement in exploration of and reflection on this collective image. The computational processes that drive this work bring together the concept of emergence in terms of how things come into being, through the notion of plurality, which is always becoming and never fixed. As the composite portrait and soundscapes emerge and transform, so do the meanings. The constantly transforming emotions written into this collective portrait created by the dynamic system, are sometimes peaceful and life affirming and at other times horrifying or grotesque.

The generative processes that drive this work act as a core rhetorical device in the composition that defines the experience of the work. The Order of the Passions artwork combines the diverse perspectives of subjects into a composite whole that suggests how we can see ourselves as cohesive community. It also revels tension, antagonism and friction between elements that provide force and move the image into a full spectrum of experience.

Content and form: designing transformation

The Order of the Passions artwork draws inspiration from the concept of an infinite game (Carse, 1986), in which the sole purpose is continuing the play. Players engaged in an infinite game are continually transformed through engagement with the infinite game of life. As an action that reaches toward an open horizon, engagement in an infinite game is a creative response to changing conditions of life. By focusing on the quality of engagement, an infinite game is about the process and understanding through experience. Infinite games are not prescribed; rather they are open to exploration within the soft limits of a set of flexible rules that can shift in order to continue the play. Infinite games cross the boundaries of the past and confront opportunities of the present moment.

As an infinite game, the Canadian cultural polyphony is open-ended and dynamic. The Order of the Passions sets

up an exploration and experience of a social space drawn from our Canadian cultural plurality. The work is situated within our Canadian cultural reality to form an artifact where contextual, place-based and temporal conditions are braided together into an infinite composition of present. The cultural context situates the work, yet it is remains deliberately open to different interpretations on the part of the audiences and readers (Eco, 1989). The strategy employed for this openness is enabled by computational form, which pulls and continually shifts diverse voices drawn form the community of participants into the composition.

While the multimedia content deals specifically with cultural identity, the concepts of situatedness, infinity, and open composition are deeply embedded into the form of computational composition. The element of multiplicity, enabled by the generative process, and the consequent effect of this processes on the reception of the work is a core formal element that defines the rhetoric space of the composition. As Jim Campbell (2000) points out, "If the new element particular to the medium of film was time, then I think that the new element to interactive art is the present. And it is the program that connects the present to the past." The use of computational strategies such as metatagged and coded databases of media to create interactive and generative art provide a medium for the infinite expression of rich differences embedded in our culture. The linear media production strategies — video and sound recording — in this work provide important compositional processes, but their effect is amplified by the inclusion of the recordings in a tagged database which is then used to dynamically compose the image.

How can computational media enable the artistic expression of infinity, situatedness and openness? Meta-tagged audio-visual databases used with dynamic computational composition enables modeling of the complexity, emergence and dynamics of the world in a way that can poetically reflect daily interactions, experiences and understandings. The system responsible for visual rendering of the artwork links a database of images within the structure of the composition. Each face image in the database is structured to consistently align key interest points — the eyes, nose and lips — to the same location on a 2-dimensional grid. This approach ensures the consistency of the overall composite face and its emotional expressions are visible in within the whole. The markup of an images database is the second step towards the development of grammatical structure of the composition. Each image is coded for specific facial movements — called action units — that identify basic variations in facial expression, for example raising the outer portion of an eyebrow. This ensures that the composite portrait can draw from multiple faces that share the same action unit and combine them to develop a cohesive overall facial expression.

Non-linear access to the database of faces enables surface variation of a deep compositional structure in expressing an infinite artwork composition. The surface variations are rendered by the compositional system, which can take different pathways through coded media elements. The generative software program enables this infinite exploration of affective face space.

Interactivity embedded in this work recognizes that interaction is ultimately about the connections among people and their environments. The work draws from source images of individual faces within the community to reflect an emergent community image. The computationally mediated interaction builds on the image of the community, but through the triggering of media composition, provides a sense of being in the right place at the right time. This computer-controlled interaction across the artwork and visitors further dramatizes the relationship between the image and the viewer. Interaction with the computational system of artwork is used here as dramatic strategy to reinforce the metaphor of the mirror. As the viewer approaches the artwork the new emotional expression of the collective human is reflected to the viewer. As the viewer approaches the screen, the system generates new and unique composite image from the image database.

The artwork visualizes the multi-directional space spanning individual uniqueness and cultural complexity that configures the fabric and the texture of our daily experiences. This complex mosaic brings together collection of individual characters who themselves are at the heart of the complex cultural interactions and understanding. Creative and dynamic exploration of the face space also encourages the sense of agency in the formation of collective understanding of our plural identity. Agency emerges through recognition that each individual is critical to the construction of a complex whole and adds to the individual sense of contribution to the outcomes and solutions of the emergent plural identity.

In this artwork the form and the content are tightly integrated and influence each other to form rhetoric space of the artwork. The compositional system that we designed enables exploration of the image as an ever-transforming process. We developed specific tools and a compositional system to enable us to visualize this collective portrait. The concept and artistic strategy informs the tools that we developed to enable the flexible and dynamic composition. This process-oriented form enables the content to be expressed in such a way that articulates the overall meaning and the concept. The computational composition enables articulation of meaning through the dynamic process. The process is always evolving within a set structure and the overall composition is re-combinatory and continually shifting. The evolving composite portrait dynamically draws from a deep pool of people so that the emergent quality of the community interactions can be visualized. Strategy, design, form and content are all integrated to reflect the emergent meaning of collective hybrid identity. The emergent phenomena enabled by generative art composition, as a basic development strategy for poetic articulation, renders the meaning embedded in the artwork.

Artistic inquiry

This work provides space for 'ontological reflexivity' (Dieleman, 2008) that involves understanding using lateral

thinking and intuitive methods of exploration within the experience of the work, focusing on a capacity to illustrate constructs rather than absolutes and invite an imaginative conversation with novelty, surprise, and improvisation as a way of reflecting on our cultural reality. Such reflexivity is dependent on a conception of generative art as a way of understanding the world, and as a methodology for exploring, understanding, and building realities. Sociologist Hans Dieleman (2008) makes a case for the unique role of the arts for creating a space of ontological reflexivity. He argues that artistic inquiry engages reality at a foundational or epistemic level, creating dialogue around habits of perception and action. Through sensory experiences, people have the opportunity to examine normative and alternative ways of being. The power of artistic and poetic articulation lays in its capacity as means of inquiry, as a way of knowing and understanding the world. Artistic inquiry provides awareness that reaches beyond conceptual framework, building on the capacity to know the world, which exceeds the capacity to categorize the world. The epistemological dimensions of artistic inquiry have the capacity to present realities as constructed, rather than fixed, in order to invite new cultural dialogues and construct new cultural narratives. The artistic inquiry in Canadian polyphonic culture positions the Order of Passions artwork as a unique conversational space, utilizing the capacity of artistic inquiry to provide an imaginative space of engagement and reflection on the multiple realities embedded in our culture and daily life.

Composition and design process

The form, content and creative process by which The Order of the Passions came about enabled the resulting meaning. In order to fully expose the bases and implications of the work, what follows is a description of our artistic design process.

Video recording

The visual material for The Order of the Passions was recorded at the University of British Columbia's Centre for Culture and Technology at the Okanagan Campus in Kelowna, Canada. Ethnographic interviews were conducted with 24 students, staff, and faculty at the university. The audio-visual recordings formed a database of faces employing an ethnographic film methodology to collect and develop strategies for recording authentic as well as dramatized emotional expressions. The recording processes expanded on techniques developed in previous artwork by Dulic and Newby (2008), where multiple community images were individually collected and brought together in a single installation environment. The recording environment was a black box studio with professional lighting and media recording equipment.

Each session lasted between twenty minutes and half an hour, and was attended by a camera operator, the interviewer and the subject. In each interview the subject was asked to recall and respectively recount moments in their life when they experienced six basic emotions: anger, disgust, fear, happiness, sadness and surprise. Subjects were also led through visualizations in order to elicit emotional responses that would register in their faces. They were asked to let their responses emerge not only in words but also in their facial expressions. In each session, the camera focused tightly on the subject's face to record the nuances of emotional responses in the highest possible resolution.

It was sometimes difficult to isolate a single emotion because responses would be complex and quickly play across a range of physical reactions. On occasion, subjects would be asked to repeat the description of an experience, in order to fully enter into an emotional state. As many of them were performance students and practitioners, this process resulted in more identifiable emotions that concentrated in their faces rather than body gestures. The ethnographic interview strategies were successful in recording the similarities in how faces register basic emotions despite the variety of experiences that were shared in the interview process.

Frame selection

The automatic facial expression recognition (FER) and processing system, developed by Kadish and Najjaran, enabled the rapid expansion of the database of facial images by eliminating much of the overhead work involved in selecting and aligning interesting frames from the recorded interviews. The system operated in 4 stages: robustly detecting faces in the frames, finding the facial action units shown, discarding repeated combinations of facial actions, and then aligning the remaining images.

Although the camera was trained on the subjects' faces, not every frame contained a full face. In some frames, the face was obstructed by hands, the head was turned out of the plane of the camera, or the subject moved resulting in a portion of the face being cut off. To ensure that each selected frame actually contained a face, two different face detection algorithms were used. First, a face detection system based on Haar wavelets Viola and Jones (2001) was used to identify the bounding box on the face, eyes, nose, and mouth. A bounding box defines rectangular limits on the position of a visual element, so that a bounding box for the face would mean that the entire face was contained within the box. If all of these elements are positively identified, then a second algorithm called FaceTracker Saragih et al. (2011) was run to detect 66 unique points on the face. If the results of the two algorithms overlap — for example, the eyes from the Haar-based algorithm were found to be in the same position as the eyes from the FaceTracker algorithm — the frame was passed to the action unit detection system.

The next step was detecting which action units were present in the image. Action units are the result of an attempt by Ekman and Friesen (1978) to identify the smallest units of facial motion, upon which all expressive facial movement is based. The units are motions such as "cheeks raised" and "lip corner pulled" which together form one of

the “happiness” expressions, according to Ekman and Friesen’s method. The action unit detection technique, based on a technique by Valstar and Pantic (2007), analyzed the position and motion of the points detected by FaceTracker. A second set of video clips, in which expression coding experts had pre-determined which action units were present, were used for comparison. If the position and motion of the points in the frame that we filmed matched the position and motion of points in the expert-labelled frames, our frame was determined to contain those action units.

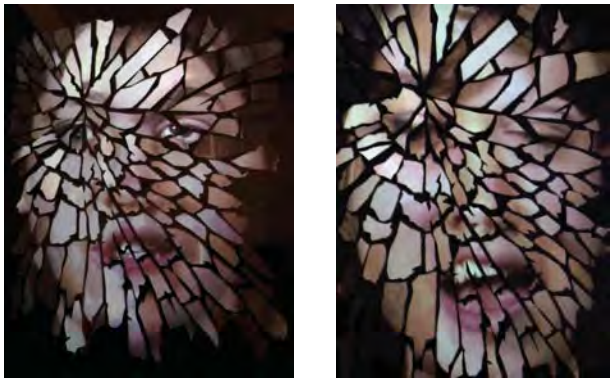

Figure 4: Two images (left and right) from The Order of the Passions Installation, showing different composite facial expression

This process was successful, but resulted in too many frames for each subject. To reduce the set of images, the list of action units found in the image was checked against the sets of action units that had already been detected for the subject in question. If all of the action units had already been found for that subject in other images, then the frame was removed from the set. Finally, the remaining images were aligned so that the eyes, nose and mouth of each subject appeared in the same place in each image. This was essential for the final projection to appear as a complete face.

Once the images were collected from the automatic processing system they were assessed by hand for their artistic quality and to ensure that they were free of blurring and interlacing effects. The list of action units generated by the FER system was also verified and modified as needed.

Media diffusion and screen production

The Media Diffusion System has been under development since 2004 by Dulic and Newby. The system is an integrated software environment for interactive multi-channel video and audio composition. The Media Diffusion System supports an unlimited number of coordinated discrete screens and sound sources that can be correlated with the machine vision and listening module through A/V capture and analysis. The creative potential of the facial analysis data for representation of emotion in a novel context was explored in The Order of the Passions as follows:

Given an ordered database of photographs of faces categorized by the analysis of action units, an emotion synthesis system was designed in MaxMSP that constructs a mosaic representation of a face in a specific emotional state. With the available analysis data it was possible to reconstruct, or re-synthesize, six discrete emotional states: happiness, sadness, surprise, fear, anger and disgust. Happiness, for example, can be described by the presence of two action units, one describing cheek raising, and another describing lip corner pulling. Selecting photo elements from the database based on queries for images with these two action units present — all other action units being neutral — resulted in a composite facial mosaic that presented this emotional state. By selecting the appropriate action unit combinations for the other five emotional states we were able to modulate the emotional state of the mosaic face accordingly.

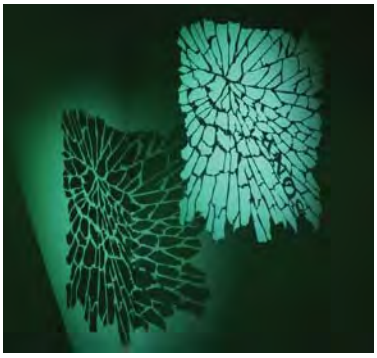

Figure 5: Positioning of screens

Media diffusion system is created in the Max/MSP programming environment and has the ability to communicate and accesses the database of images created with the FER system. As special database object was created for Max to be able to manage image feed crated and tagged by FER and distribute them to 130 screens via projectors that display the image. It determines which emotion or set of action units to display at a given time. Kinect motion sensing input device by Microsoft is used to detect if someone approaches the installation. If the presence is detected the system selects on hybrid emotional expression and reflects it to person in front of the screen. This approach is used to further emphasize the metaphor of a mirror.

A photograph of the shattered mirror image was traced and converted to the vector graphic. The vector graphic image of a broken mirror was used to guide the cutting of the screens out of thin white acrylic material using laser-cutting system. The 130 screens are cut, positioned and connected within a single 2D plain in order to be bale to hang it in a gallery space and apply projection mapping. Then the screens were positioned in a gallery space to create an illusion of the mirror shattering and freeing in the gallery space. The media diffusion system was used to do accurate projection mapping across multiple screens in the gallery space.

Audio recording and diffusion

The audio content of The Order of the Passions takes the form of a layered collage. The audioscape is rendered from a database of statements drawn from a variety of literary and poetic sources all revolving around the metaphor of a broken mirror and cultural plurality. All of the statements share semantic focus on the concept of the mirror in relationship to identity. Each statement was recorded in a variety of languages including English, French, Oneida, Mandarin, Malay, German, Spanish, Serbian and Japanese. It is

important to note that the selection of languages merely represent the community of project participants and their native languages. Each statement is recorded in normal speaking voice and in a whispered articulation. The diffusion and mixing of these statements poetically reflect the changes in emotional state of the mosaic image and modulated according to rules for mixtures of language and articulation. The voices are projected through eight channels of audio diffusion. The sound projectors are shaped and painted as leafs on of aquarelle paper. The paper leafs act as sound projectors created from the speaker-screen system, developed by Alex Stahl and Patricia Clemens. Building on their speaker-screen design during their stay at the Centre for Culture and Technology (CCT) we developed an audio mobile speaker system that uses aquarelle paper to act both as sculpture and as speaker channels.

Canadian cultural dialogues are expressed with these diverse voices, projected across eight audio channels, to signify a forest of linguistically complex environments that together build an image of diversity. Different voices, in different languages recite words about multiplicity of reflections seen in a broken mirror as a metaphor for a holistic understanding of diverse community.

Figure 5: The Order of the Passions Installation: view of audio projectors (leaf shaped speakers) in relationship to screens.

Excerpts form recorded text:

A mirror is being broken, and in each piece different faces are reflected. A shattered mirror cannot be reassembled.

Everybody took a piece of it. They looked at it and thought they had the truth. The truth was a mirror.
It fell and broke into pieces. No longer can you view your image in a single mirror.
We are the mirror, as well as the face in it.
Take a rock and shatter the mirror we reside in.

Conclusion

Cultural plurality is an important framework for living in diverse societies, and our multimedia installation disturbs the notion of cultural preservation embedded in Canadian multiculturalism and moves it towards the unity within cultural plurality by envisioning the face as a dynamic, expressive entity in which we can each see ourselves and others reflected.

In producing the project, we have developed innovative new tools and methods. The interview process used to collect emotional video recordings was highly experimental and resulted in valuable techniques for eliciting non-posed emotional expressions. The automatic facial expression recognition system combines known methods in a novel way to create a productive human-computer system for identifying artistically viable facial images. The Media Diffusion System builds on past work to introduce a new way of composing with audio-visual data using complex image mark-up to create an integrated moving mediascape. We look forward to the further development of these tools and the project as a whole as we continue to build and expand this work.

Figure 6: Detail of The Order of the Passions sound projectors

Future directions

The next step for this project is to develop mechanisms for collecting user-generated content via Internet and mobile applications to enable composition from a much larger database of community portraits and their emotional expressions. With this addition we would be able to engage a much broader public around the question of cultural pluralism, identity and belonging in Canada and beyond.

A parallel development for this project involves collection of images of non-human animal species and integrating them in this collective portrait. The strategy here is to explore environmental complexity across human and non-human animal relationship and the ultimate importance of biodiversity for human health and well being.

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Visual Arts Creation Assisted by BICASSO: Brain-Inspired Computationally Aesthetic Selective Savant & Observer

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Abstract

This paper describes the design of a computer program which will assist artists in producing aesthetically interesting pieces of visual art. In contrast of existing creative drawing computer programs, the proposed software will attempt to simulate the creation and perception of visual art. The program, called BICASSO, will be based on previous neuroaesthetics findings which offer an understanding of what the human brain considers beautiful. The program will include features representing the roles of the brain regions enrolled in visual perception, memory and decision-making. BICASSO will modify visual elements of the visual art being created, depending on aesthetic rules to render visual components easy to process by the human visual system. The aesthetic rules rely on the hypothesis that processing fluency and aesthetic pleasure are linked. The artist will give feedback so the program can learn and modify its behavior when its collaboration is not considered beneficial. As the program will only suggest aesthetic improvements (based on its knowledge, and ratings of the collaboration and the final products), we will be able to observe if this asynchronous collaboration can generate creative products which are considered as more valuable to the human eye.

Keywords

neuroaesthetics, collaboration, reinforcement learning, beauty evaluation, combinatorial creativity.

Introduction

This paper describes the specification and early design of a computer program which is currently in development to provide aesthetic expertise through asynchronous collaboration with a visual artist. The software will have its main features based on neuroscience findings. The software will represent the following cognitive phenomena: visual perception, memory, decision-making/learning. While many drawing artificial intelligence entities already exist, and aim to comprehend creativity, we focus on specific aspects of visual arts generation.

This report will first introduce some reflection about creativity and more specifically about combinatorial creativity. We then describe visual perception and related findings in neuroaesthetics in order to provide a better understanding of what is aesthetically pleasant in the visual modality. We will elaborate an aesthetic judgment procedure, as well as a strategy to aesthetically improve visual arts. The word "beauty" will describe a positive physiological reaction when exposed to an aesthetically pleasing visual stimulus, denuded of any embodied experience or context. To conclude, we will enumerate some of the questions raised by the proposed human-computer cooperation in visual arts creation.

Creativity, Neuroaesthetics and Visual Pleasantness

Combinatorial Creativity

The main factors in the assessment of creative works are: the person, the product, the process and the context [1]. A creative product can generally be assessed by its originality, usefulness and whether it is surprising or not. However, a creative product in visual arts does not follow the exact same criteria, as its beauty can be assessed objectively but also subjectively, relying on personal experience.

While novelty is crucial to creativity in general, we argue that novelty is much more valuable in a predefined context rather than in an open problem. For example, twitterbots which generate random sentences or images, are only appreciated by their audience when some context is added by media or history. Talking about contexts, a fundamental principle acknowledges that the social and spatial context will influence the way the audience appreciate visual arts.

One of the most popular strategies for generating creative solutions to problems is combinatorial creativity. This consists of selecting features from two or more existing concepts in order to create a new one. Even though it seems possible to combine features from two concepts, it is much harder to create an image which both respects socially established semantics and is aesthetically pleasing. That is why we decided to focus the project on visual grammar and aesthetic rules that can be used to guide the combination of different components.

While it is still unclear how the human visual system combines visual objects such as geometric shapes, one simple framework describes three different operations to merge geometric shapes (union, intersection and difference), similar to boolean operation on set [2,3]. We can also suggest another framework where two shapes would be combined in the same way as a noun and an adjective interact with each other, meaning that one would act as the main feature while the other would act as a modifier.

The main reason combinatorial creativity is so attractive for the model is that the process and the final product can be broken down into elements, while remaining sensitive to a given context.

Involved Brain Regions & Neuroaesthetics

Existing drawing computer programs and robots such as AARON or Paul do not rely on neuroscience to produce a creative behavior [4,5]. As mentioned previously, BICASSO will learn how to perceive beauty from the user's perspective. Taking into consideration that some objective visual features may help to predict the potential beauty of a visual stimulus.

As in textual pieces of art, grammar and semantic can be dissociated in the visual arts. Grammar is the set of rules about how visual elements are formed and combined, while the semantic is the meaning behind the visual elements and their combinations. Wishing to focus on visual arts, we decided to explore grammar rather than semantics. Perception of visual creative products are influenced by the way the different components of the piece of art are spatially organized and how they interact with each other. The human visual system is sensitive to the way pictures are organized. It implies that artists' decision making process is also altered by aesthetic pleasantness when producing a new painting/drawing, since they evaluate it throughout the creative process. Studies relating to visual perception of art are part of the emerging domain of Neuroaesthetics. This domain encapsulates studies looking for the source of aesthetic pleasantness, whether it is hidden in the semantics or the grammar of a piece of art [6]. Studies in Neuroaesthetics often split pieces of art into two categories: representational and abstract. Abstract works are themselves divided into two types. First, pieces of art which are purely abstract and do not aim to represent a particular idea. Second, artistic works that are defined as abstract, but which still represent concrete objects or scenes in an ambiguous manner [7]. A recent review has emphasized the idea that purely abstract paintings foster unusual conceptual associations, and no specific brain region was activated in relation to their exposure. Whereas in representational paintings, some brain regions are activated by object recognition processes [8]. Indeed, the advantage of purely abstract art is that its appreciation is mostly due to the visual components and their spatial organization.

Looking at a visual piece of art can involve in two processes: “seeing” and “contemplating”. Seeing is the instantaneous and unconscious reaction during the initial exposure to a piece of visual art, which might be more related to visual perception and activity in the visual cortex and the hippocampus. For example, some objective features (such as symmetry) can trigger different reactions. In contrast, during contemplation, beauty (from a subjective point of view) can trigger reactions in the medial orbito-frontal cortex [9, 10]. Indeed, we could define “seeing” as more objective than “contemplating” as the processing is unconscious, with less influences from emotions. Therefore, “seeing” might be more interesting in a computational context as it is more predictable and seems to depend less on the experience of individuals.

Whereas it is possible to analyze the semantic of a drawing, the placement of every visual component can also have its own meaning. The non-understanding of a pseudo-abstract painting can lead to differences in activity in visual brain regions and low activation in the right hippocampus, suggesting difficulties in encoding the scene [7].

Previous studies in neuroaesthetics have demonstrated that symmetry triggers positive feelings and could be used to prime positively the viewers [11]. However, not all types of symmetry have the same effect. Electroencephalogram (EEG) studies have shown that reflectional symmetry triggers stronger reactions, meaning that this type of symmetry could be easier to detect than rotational or translational symmetry [12]. We can suggest that pleasure provoked by symmetry could be due to the fact that visual perception and encoding of symmetric features might be easier than other visual stimuli.

Human-Machine Collaboration in Arts

The fact that visual artworks can be produced by non-intelligent entities is often a cause of discomfort among people, as creativity is considered as intrinsically human. The advantage of the proposed collaborative program is that it suggests computationally generated possibilities which would respect visual perception rules, so that the result looks attractive, pleasant and respects human perceptual grammar. Moreover, it could be used to constrain and modify the creative process such as in a recent example of human-machine collaboration in an enactive model of creativity [13]. In any case, whether the artist decides to follow the software's advice or not, their joint perceptions and memories will be modified and future creative processes will be influenced by prior experience.

Popular Painters, Aesthetic Improvements & Attractive Features

When searching for recurrent aesthetic features in paintings by famous artists, it can be tricky as some artists are known for social or innovative reasons rather than the actual beauty of their works.

While we are attempting to design and build a human-machine collaboration procedure that may improve the aesthetic aspect of the shapes in a visual piece of art, pioneers in computer and algorithmic arts such as Manfred Mohr or Frieder Nake have also explored shape generation with the only purpose of creating aesthetically pleasant artworks. It is interesting to point out that the artworks are fully attributed to the author of the computer program, which may be explained by the fact that the programs were executing tasks and no learning was involved. It would therefore imply that following the rules of a pre-defined visual grammar is not considered as a creative behavior.

While some painters like Wassily Kandinsky created abstract art with the intention of transcribing an idea, other artists only attempted to generate pieces of arts which are the most visually pleasant (e.g. William Dekooning). Paradoxically, Kandinsky's work also contains symmetry (reflectional, rotational and translational) even though it was not explicitly wanted by the artists. Likewise, some shapes in Dekooning's paintings can clearly be interpreted and identified as objects or animals. Even though these are only two examples, we can suggest that whatever the painters' point of view is towards abstract art, artists will tend to implement some symmetric and prototypical features in their arts [14].

When observing paintings, it is possible to distinguish some salient features that will attract the attention of the viewer. Francis Bacon was known to include more or

less abstract references to the representations of face and body in his works, which would intrigue the viewers [15]. In the case of optical illusions, like in the work of Bridget Riley, we can observe that our attention is attracted by a particular feature, but other visual components will become visually attractive as the attention is switched to another area of the painting.
Colors can also be used to influence the viewers' perception and make some components or areas of visual stimuli more salient. It can be noticed in paintings by Piet Mondrian and Brice Marden, for example. Piet Mondrian's paintings have been used to evaluate the importance of color in the global balance of a piece of art. Concluding that the larger a colored area is, the heavier the given color will be perceived by the viewer. This fact is especially true for red and yellow [16].

Design of BICASSO

The main goal of the project is to implement a computer program which can assist artists in the creation of drawings, while learning and giving aesthetic advice. From now on, our computer program will be defined as "Brain-Inspired Computationally Aesthetic Selective Savant & Observer", BICASSO. The Human-Machine collaboration will consist of having the artist draw a first element and then give control to the computer, which will attempt to find a matching pattern in its memory and make its own contribution by modifying the new element. The artist will have entire control over how much they want to draw before asking BICASSO for advice. The artist will then judge the suggestion and the program will tune its behavior to make the next aesthetic choice better.

As pointed out in a recent review [17], the main features of an objectively beautiful picture are balance and proportion, symmetry, informational content and complexity, contrast and clarity. The visual inputs could therefore be evaluated depending on those parameters but also depending on its prototypicality, as it has been shown that people prefer average-looking faces and objects [18]. Previous behavioral studies by Forsythe have shown that complexity ratings by humans can be estimated with image compression algorithms [19]. It also shows that complexity coupled with structural properties can give better prediction of how likely subjects are to find the visual stimuli beautiful [20].

In the drawing phase, BICASSO will search for patterns matching the new visual element in its memory, and suggest geometric modification which will bring aesthetic improvements to the initial input (Figure 1). The memory will consist of a gallery of images representing geometric shapes, classified by geometric features. The user will then be asked for feedback, allowing BICASSO to tune its behavior using reinforcement learning techniques. The user will then be invited to add other visual elements until they are satisfied with the product.

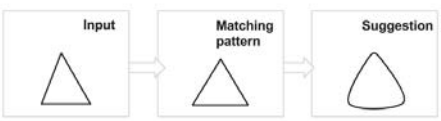

Figure 1: Example of suggestion procedure.

Looking for the most efficient and cheapest way to assess a creative product, a large number of novices have been proven to be as reliable as a small number of experts in term of evaluation of creative products [21]. The resulting drawings could be posted and rated by anonymous users on image rating websites. Our controls could eventually be drawings from the artist only, and drawings resulting from the human-machine collaboration but without any reinforcement learning. The ratings will indicate whether the collaboration is successful and if it improves the artists' creative process. As the model is thought to improve aesthetic features of a drawing regardless of the semantic, the artists will be advised to produce abstract or pseudo-abstract works (e.g. Wassily Kandinsky). While the model follows the artists' ideas, it will permit us to discuss about the influence of the decisions and aesthetic improvements brought by our computer program in the creative process, only relying on the beauty evaluation of the final creative product.

Visual Improvement & Reinforcement Learning

The core of BICASSO relies on its memory, which is represented by a gallery of images, each image representing a geometric shape. Exploiting a reinforcement learning algorithm called Q-learning, each shape is connected to other shapes with similar geometric features, with the strength of the connection (Q-value) representing the possible aesthetic improvement. The feedback will be considered as a reward or a punishment, similar to the dopaminergic system. The system therefore acts to facilitate the most rewarded options. Thanks to this feature, the artist will be able to teach the program and direct it towards suggestions which fit their work. This means that more abstract painters might enjoy some symmetric additions while representational painters might prefer prototypical shapes. Moreover, as there is no absolute beauty and that the suggestions will have to contain similar geometric features as the initial input, our image gallery contains several optimal solutions (considered as goals). The existence of several local goals makes the learning phase of our algorithm significantly longer.

Moreover, one main issue in reinforcement learning is that it initially requires a considerable amount of training before converging towards the expected behavior. To make the training phase faster and avoid asking the user for thousands of inputs before reaching an acceptable training level, the complexity and the structural properties of each shape will be analyzed, in order to select potential aesthetically pleasant shapes. Complexity will be evaluated thanks to the GIF compression algorithm, while structural properties will be represented by the type of structures (reflectional symmetry, rotational symmetry...).

Combinatorial Creation

One of the initial goals of this project is to explore creative decision-making in the visual domain. Once the learning phase complete, the goal will be to expand the image gallery, by combining two or more shapes. Instead of opting for one of the previous solutions enumerated, we will attempt to decompose the existing visual shapes into geometric components, which will then be stored into a library, parallel to the image

gallery. While we are exploring multiple ways of achieving this result, one solution would be to extract salient features (corners, curves...) of each shape.

The components in the library will be classified by beauty, and it will then include new visual elements into the gallery of images by matching the visual components of the shapes together. Once included in the image gallery, it will allow BICASSO to build grammar rules, thanks to the user's feedback.

Current Development

In the current state of the project, we have started developing a prototype including the image gallery and investigating ways to make the learning phase faster, as training by reinforcement learning with several goals can be long. BICASSO having no previous knowledge of what is considered as beautiful in its initial state, we are currently attempting to use objective measures (complexity and structural properties) to guide BICASSO in its first choices.

Future Implementations & Conclusion

The main idea of BICASSO is to design a computer program that can mimic the unconscious processing of images, so we can provide artists with a tool allowing them to reflect on their own process. Moreover, the outcome of the collaboration will permit us to have a better understanding on how well our different assumptions fit human visual perception. Saliency is also an element that will be observed in future iterations, as understanding the switch between local and global attention can be another key element to improve aesthetic.

The idea of a human-machine collaboration is also meant to challenge the idea that the author of the computer program is fully responsible for the creative product. The visual grammar that BICASSO will conceive will not only be built on arbitrary beliefs, as it will rely on neuroscience findings. Indeed, it is important to keep in mind that this is a high-level of modelling and therefore, we are implementing our interpretations of the findings.

To summarize, BICASSO will be built from an artificial intelligence perspective, but will appeal to broader audience than traditional studies. Hopefully, it will help to investigate the relationship between visual processing fluency and aesthetic pleasantness. On top of that, it could also be seen as a tool which will help to conceive future experiments about visual processing, from a psychology or cognitive neuroscience perspective.

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[Session 30]

Networked and Mobile Sound

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Distributed Interactive Audio Devices: Creative strategies and audience responses to novel musical interaction scenarios

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Abstract

With the rise of ubiquitous computing, comes new possibilities for experiencing audio, visual and tactile media in distributed and situated forms, disrupting modes of media experience that have been relatively stable for decades. We present the Distributed Interactive Audio Devices (DIADs) project, a set of experimental interventions to explore future ubiquitous computing design spaces in which electronic sound is presented as distributed, interactive and portable. The DIAD system is intended for creative sound and music performance and interaction, yet it does not conform to traditional concepts of musical performance, suggesting instead a fusion of music performance and other forms of collaborative digital interaction. We describe the thinking behind the project, the state of the DIAD system's technical development, and our experiences working with user-interaction in lab-based and public performance scenarios.

Keywords

Internet of Things, Spatial Audio, Sensor Network User Interfaces, Sonic Art.

Introduction

With the rise of ubiquitous computing technologies [1] come new possibilities for experiencing audio, visual and tactile media in distributed and situated forms, disrupting modes of media experience that have been relatively stable for decades. The DIADs (distributed interactive audio devices) project explores creativity and experience in the context of portable, networked, sensor-equipped audio devices. We have been working with an experimental set of devices over the past two years [2], innovating interaction design contexts in which electronically produced sound is both the product of a centralized performance, but also of multi-user participation.

With the reduction in size and cost of electronics, fully fledged computers are beginning to occupy roles formally served by dedicated electronics hardware, or microcontroller systems such as Arduino, particularly for prototyping contexts. This can make it simpler to program the Internet of Things (IoT), by making use of the advanced libraries, languages and tooling available for modern computer operating systems, not least because programmers can work in their creative environment of choice. These devices also make it possible to use rich audio and visual media in novel and diverse spatial situations.

Figure 1 - Natural interaction affordances with DIADs

The DIAD system is an experimental design for creative sound and music performance and interaction using multiplicities of networked, portable computers. Made from cheap off-the-shelf components, they can be programmed to run small, dedicated audio programs. A system for remote-controlling and remote-live-coding these devices from a central computer has been developed. This acts as an experimental platform to explore the techniques and tools with which one can creatively produce content for such networks of devices, and implement the novel interaction, exhibition and performance scenarios they make possible, particularly relating to synchronized audio played over multiplicities of devices. The devices have primarily been developed for musical performance contexts, but by their nature they do not conform to traditional music concepts, instead suggesting a fusion of music performance and other forms of collaborative digital interaction.

This paper presents the background to our present project, which we categorize under the umbrella term "media multiplicities". We present the DIAD design and our techniques for creating content and performing with them, reflecting on how creating content for media multiplicities can best be achieved. Finally, we reflect on the creative interactive opportunities that DIADs offer.

Background

DIADs are an example of a growing field of creative technology activity that we call "multiplicitous media". Wherever digital devices are used in number in some coordinated fashion, we may describe this as a "media multiplicity". The consistent progression of computing technology towards *ubiquitous computing* [1] highlights the emerging

importance of media multiplicities, which will require new conceptions of performance and composition, with, we believe, adaptive software behavior playing a pivotal role in achieving scalable, reconfigurable and context-sensitive goals. Media multiplicities allow media experiences to be less monolithic, involving both the closer integration of media elements (sounds and moving images) into existing or virtual environments (such as building façades, living rooms or performance spaces), and the distribution of content across multiple media elements, as an extreme continuation of work in multi-screen and multi-speaker environments. With the emergence of "second screen interaction" (e.g., watching a live TV show and interacting with that show via Twitter on a tablet), media multiplicities are already common in everyday experience. Our work imagines how rich multi-device interaction may play out.

Electronic music production has enabled the dislocation of the source of the sound from the device producing the sound signal. This has meant that sound can be produced that is unrelated to its physical source (unlike an acoustic musical instrument for instance), but this has the effect of limiting the clarity of the link between the sound object and the sound it produces. For example, the tacit physical knowledge that a listener builds about what sound will be produced when a drummer hits a drum with force is not the same with an electronic music experience.

Similarly, spatial sound reproduction is now commonplace, but is almost exclusively produced using sets of loudspeakers that have a fixed position (although there do exist some notable exceptions, e,g. [4]). By contrast, using movable, portable sound sources such as DIADs significantly complicates the control of a sound field, and in this new musical context typical spatial audio formats (eg. surround standards such as Dolby's 5.1) are unlikely to adequately capture the expected experience. New design processes and vocabulary may be required; the interactive nature of the spatial sound experience extends a more physical metaphor to the devices, and instead of the precisely positioned sound images that are prevalent in recorded music, for DIADs performances the sound image tends to be either located directly with each device itself, or within the 'swarm' or multiplicity of devices.

As a creative platform the DIADs build on research in network audio and networked music performance [5], which has become a significant field through the strong interest in laptop and mobile phone orchestras (e.g., [6]). Whilst the smartphone or tablet is already capable of everything our devices can do, our interest is looking at dedicated media device networks with alternative deployment and user experience connotations. There are reasons why a person may not want to use their personal device as a component in a media experience, such as an audience-interaction-based work. These include privacy, system security, personal space, battery life, and conflicting uses (such as wanting to use a social networking app or take photos). Additional obstacles to using personal devices may include the effort of logging onto a network, configuring system settings, ensuring device compatibility, and downloading large software files. Dedicated media devices such as DIADs can be designed for purpose, preconfigured and fully charged and do not pose conflicts to the user regarding the use of their personal equipment. They can also be made for as little as $100, thus easily accumulated in large numbers for dedicated events. As such, they join a plethora of dedicated low cost IoT devices.

Distributed Interactive Audio Devices

Our current DIAD system uses simple off-the-shelf components: a Raspberry Pi as a host computer, a standard USB WiFi dongle, an off-the-shelf Moshi Bassburger self-powered speaker, a Pololu MiniMu-9 IMU sensor (inertial measurement unit, consisting of accelerometer, gyroscope and compass), and an off-the-shelf mobile phone battery charger as a power source. The DIADs are pre-configured to automatically connect to a local WiFi network, and register with a server running on a central controller computer. Any DIAD that comes onto this WiFi network then becomes part of the DIAD multiplicity and can be remote controlled.

Once charged and activated, DIADs can be operated portably and remotely within the range of the WiFi network. They can be handled by people, incorporated into the environment and, depending on how robust they are, can even be thrown and bounced.

Software Design

The focus of DIADs development has been on the creation of a reusable software platform that allows creators to develop interactive audio content that can be rapidly and easily deployed across multiple devices. We have created a client-server architecture using Java. The Beads library for Java[1] is used for digital signal processing (DSP) on the Raspberry Pi's. Code written on a controller computer can be compiled and sent to the DIADs while they are running. The code is executed as soon as it is received, and this does not require the device to restart audio or be rebooted [2]. In other recent work we have started to incorporate realtime video as well as video streaming into our system.

A network synchronisation system loosely synchronises the timebase of all the DIADs so that timed events can occur in sync. The controller computer also runs a program with a graphical user interface that enables direct control of the DIADs, either in a group or individually. Code sent to the DIADs can access both the sensors on the devices but can also listen for, and respond to, open sound control (OSC) messages on the network. This means that, for example, it is easy to write a program that causes the on-board sensors to modulate the frequency of a filter, or that responds to incoming commands to play a note from the controller. Commands can be hand-typed by the performer on the controller computer, which makes for a versatile interface, or might be linked to physical interface devices.

[1] http://www.beadsproject.net

Importantly, rather than only transferring simple note instructions (as MIDI does for instance), a complete algorithmic composition, incorporating an associated interaction mapping system, can be transferred over the network to be executed imediately by the running DIAD, as is typical in "Live Coding" performance. This means that a performer can decide when to initiate an algorithmic composition, and on which devices, based on their engagement with the improvised musical context and the audience themselves. With this flexibility the toolkit allows powerful creative control in a multiplicitous media context. One of the main goals of our research, therefore, is to understand how creative practitioners will go about creating content and experiences for such contexts, and what future design improvements could be made to such an authoring and deployment framework.

Interactive Experience & Audience Responses

Within the research team, we have explored some of the interactive possibilities of the DIADs for individual and group play. Tangible interaction made possible through the physical form of the devices influences the way one thinks about composing interactive experiences with the DIADs. Spheres have an obvious appeal, and were part of the original conception of a set of interactive "sound balls". The sphere's affordances are self-evident, and they inspire an immediate association with games and playful interaction, fitting seamlessly into the theme of digital interactivity in gameplay found, for example, in the work of composer Jon Rose[2]. But we immediately began to explore deviations from the sphere, in order to see how the physical behavior of the device, when rolled or rocked, would itself form a pattern-producing system that could feed into the digital sound design. Hence the first proper prototype set of shells takes the form of various egg and rugby-ball shapes that allow limited and idiosyncratic forms of rolling along some axes while rolling more regularly along others.

Such affordances establish a user interface that differs significantly from a typical mobile phone or other consumer electronic device. At first glance there are no clear cues for how to interact, and the audience must explore the capabilities of the device by holding and manipulating it, looking and listening for changes that occur as they move, rotate or shake the device. Additionally, depending on the algorithm deployed to the device, these actions may have various effects at particular times in the performance, meaning that the exploration process is likely to continue throughout a composition.

In a pilot study, we gathered some provisional insights into the physical and social affordances of the current DIAD design. Of particular interest was the potential to retain the partially unpredictable and ambiguous character of the movement-to-sound relationship. Participants reported that the device shifted between seeming autonomous and being responsive to their movements. The lack of obvious interactive affordances meant that people were curious to experiment with different kinds of movement to get an effect, once they had realized that the devices actually were responsive to their actions. The tactile form and texture gives the DIADs an intimate quality; people want to hold them and just listen. The social collaborative aspects were less well developed and participants reported either a tendency to personal, individual engagement or a lack of motivation provided by the devices for collaborative interaction, although different responses were observed in the concert scenario, as described below.

The sound of the devices is conspicuously different from high-fidelity audio. The cheap consumer Moshi Bassburger speakers have limited frequency response and volume, and the audio performance of the Pi is sub-CD quality. Consequently, it matters a great deal to the effectiveness of the sonic experience what sounds are played through them. Noisy broadband sounds carry well and create nicely ambiguous spatial effects. The speakers struggle to compete with voices in noisy environments, except when producing high frequencies, but in quiet reverberant spaces eight speakers are able to make a great deal of noise. Their inability to fill space, however, can become an opportunity, in the way that this necessitates more intimate listening experiences, as explored by composer Miriama Young, through the study of intimacy in storytelling [2].

As tangible devices, the DIADs naturally provoke users to explore the relationship between the sound source and the body. Since the devices also include IMU sensors that respond to movement and affect the digital audio processing, interaction with the devices occurs with respect to both physical and digital affordances. Participants engaged in various gradual movements, focusing on producing slow and subtle changes. They placed the devices in different positions with respect to their own ears and to other people, including in contact with different parts of the body. They spun, threw, rolled and engaged in other rapid movements with the devices, obtaining a sense of the movement of the sound source, including Doppler effects.

In one instance, the devices were programmed so that they would only make sound when shaken, with the speed of playback of the sound influenced by the speed of shaking. The sound of an Australian kookaburra was used in one case, and a nightingale in another. This mode of interaction pointed to an obvious metaphor of a rattle or a bell, and resembled an interactive sound toy for children. More generally, this configuration establishes the metaphor of interaction with inanimate physical objects, which do not make sound unless interacted with. In other experiments the device was programmed to make sound regardless of what the user did, for example as a result of a live performer operating the devices remotely, with the user's actions only modifying the sound, not causing it. The user's conceptual model of the sonic interaction differs between these two cases. In the latter case, the device inevitably takes on an agentive relationship to the user: it does things, rather than having things done to it, or with it, and as such fails to satisfy the expectations of an instrument or physical

[2] http://www.jonroseweb.com/f_projects_ball.html

sounding device. This was reflected in participants' responses, as noted above.

We have yet to fully chart the design space that exists between these categories, how we might suspend the user in a state that combines active and passive elements, or can be shifted seamlessly between them. Thus a next step in design is to categorize the simplest cues that establish the user's sense of control.

Figure 2: Audience passing DIADs in concert. Image courtesy of NIME2014 organizers.

Concert Performances

The devices have been presented at different concerts and exhibitions during 2013 and 2014. The most recent concert, at the New Interfaces for Musical Expression (NIME) conference (Goldsmiths, University of London, July 2014), explored the performance potential of handing the devices to the audience to pass around as part of the performance. This was presented through the proposition that "the speakers were being taken down from the walls and placed in the hands of the audience". The devices were handed out at the beginning of the concert and audience members were simply asked to explore and pass them on as they wished. A set of pre-prepared sonic scenes was remote-controlled in realtime from a laptop on stage. Sensors in the devices made minor modifications to the sounds, so that the composition maintained its coherence whilst allowing simple interactivity. Thus the predominant nature of the performance was that the on-stage performer was controlling the devices. Unlike certain audience-interaction experiments, there was no suggestion that the audience were involved in creating the work. Only minor modifications, such as changes in filter frequency or slight detunes of the source sound, were made possible through audience interaction. The musical content was largely drone-based in nature, focusing on the spatial sound-world enabled by distributing the droning devices throughout the space, but it included other simple musical structures that were designed to work in a distributed manner, such as simple arpeggiated melodic patterns running at different tempi.

The audience response, as observed on video recording of the performance, included amusement and engagement, and a range of playful interaction behaviors was observed. People explored different modes of passing, rolling and throwing devices between each other, as well as posing for fun in front of others, and shaking, rotating and so on, to explore the sonic interactive potential of the devices. Since one could also cup one's hand over the speaker or cover it using a piece of clothing, this mode of acoustic interaction was also explored frequently. One person held the device to his mouth to modulate the sound, whilst another walked one of the devices up into the auditorium gallery to provide even more spatial spread. The playfulness with which the audience took to the interaction could be said to create a transformation of the mood in the performance space, with all attention inward onto fellow members of the audience. With the eight small devices scattered and constantly moving around the space, individuals were peering, turning around in their chairs, standing up and whispering to each other, with pockets of activity around each device as it moved around the space.

Conclusion

This paper has given a brief overview of the DIADs project, and has described its artistic motivations, the technology, the design challenges, and some of the informal outcomes of our creative work. Whilst we acknowledge the incomplete and speculative nature of many of our observations, these observations offer clear conceptual directions for further research and development. The work highlights the need for a more rigorous technological and user-focused understanding of emerging multiplicitous media experiences, which is our current theoretical focus.

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The audiovisual ghetto blaster effect

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Abstract

In this paper I explore the transition from static to mobile audiovisual media and the implications of this transition in the construction of collective or individualised audiovisual experiences. The focus is on how the transition from static to mobile technologies enables novel audiovisual experiences in the public realm. To explore the transition, I delve into how technological developments reduced the size of the devices that facilitate the display of audiovisual content, and how the size constrains or expands the affordances for interaction with audiovisual media in public space. Although the current trend of reducing the size and improving battery autonomy of portable electronic devices might amplify the isolation from the immediate environment and lessen opportunities to engage with other people in the public realm, I argue that with the incorporation of mini or embedded speakers and portable projectors into portable electronic devices (PED) audiovisual content can be brought back into the public space.

Keywords

portable electronic devices, portable projectors, expanding and sharing audiovisuals

1. Size dependency, from static to mobile

Collective audiovisual experiences and static media

In this section, the focus is placed on the size and weight of the first devices that enabled access to audiovisual content such as cinema projectors, screens, radios, and later televisions and computers. The size and availability of technology influences the interaction of people with its content. It had also an effect on the cultural environment in which people encountered the audiovisual material and the communities that were build around the devices.

If we consider the size of devices as constrains upon their affordances to be moved around and present anywhere, then the bigger, heavier and bulkier the device the more difficult it is to move. Like the foundations of a house (Bachelard 1994, 20), the traditional cinema-theatre is fixed to the screen and projection device, each strategically installed in the room, like the upholstered seats, carpet and speakers. Although the cinematic experience was initially a temporary setting, an event for which projectors would be installed, tested and de-rigged, as Wim Wenders illustrates in Die Gebrder Skladanowsky (Wenders 1995), or as the Brothers Lumiere showed when presenting *The Arrival of a Train at La Ciotat Station* in the Grand Café (Bolter and Grusin 1999, 155). The experience of projected moving images soon became attached to a location, normally inside a building where its fluid content and its rolling film became anchored to the bolts and wheels of the cinema projector and the well-fitted projection screen. The fixity of the cinematic experience was caused by the size and weight of the device required for the projection and the accessibility to electricity supply to power lightbulbs and mechanics of the projector.

In the case of the first radios or televisions, the device may have become the centre of the household in a similar manner the chimney, patio or kitchen were previously. The gathering around a place or object served to share everyday, historical and cultural experiences. Although these rooms were not necessarily public, the activities that took place in them seem to be related to the public realm described by Hannah Arendt in *The Human Condition* (Arendt 1998). Arendt in her extensive account of public and private realms and how these and the relationships that take place in them have changed through time, describes the origins of the term public in association with ancient Greece. The public sphere is where individuals are relieved from the duties of their homes and are able to start dialogues and discussion with their peers (Arendt 1998, 28-37). Martijn de Waal in his article "The Urban Culture of Sentient Cities" (Shepard 2011) dicusses Arendt's ideas of the public sphere and refers to Habermas' account of the activities in 17th Century cafes and the importance of the information provided by newspapers to offer topics of discussions and opening up conversations about the role of media in public spaces.

With the arrival of the first radios in the early nineteen hundred and later with that of the television (TV), the places for gathering shifted towards the AV devices, and the locations these devices occupied. As Arendt elaborates, with the rise of the social and the convergence, and even inversion of the functions of the public and private realms, conversations and public discourse moved indoors before the arrival of AV devices. Devices like the radio were initially restricted in their mobility and probably only present in domestic and professional bourgeois environments. Although initially inaccessible to everybody, furniture-like radio devices may have become a gathering point for people, not all which were necessarily part of the household (neighbours, friends and relatives

were also attracted), who could engage with the broadcasted content together. This notion of radios being hubs of social engagement also applies to devices that offered the possibility of displaying visual content such as TVs. Once the receptors of mediated content are embedded in everyday life and camouflaged as furniture, broadcasted information becomes more readily available, but still limited to broadcasting times and scarce amount of content. The content travelled in the form of waves in the air, and accordingly, existed in motion. In contrast, the first AV devices were static, dependent on electrical power, and were plugged into architectural infrastructure. Devices were constrained to specific locations while information was able to move from one place, that of the broadcasting studio, to a multitude of places simultaneously.

People gathered around these devices eager of new content, but the nascent broadcasting industry was still developing methods to produce compelling audio and visual content. The amount of AV material depended on the ability of the media industry to develop new techniques and gadgets with which to produce AV content. There seems to be a constant: development and innovation accelerates exponentially and correlates with the pursue of mobility and the transition from static to mobile practices. Nicolas Negroponte in *Being Digital* (1995) reflects on the development of technology and media up to the mid nineties, addressing examples such as the development of computers and the rise of the internet. To sustain the claim that innovation has sped up with the advent of electronic and digital technologies he refers back to one innovation in the production of moving images:

> *From a historical perspective, the incubation period of a new medium can be quite long. It took many years for people to think of moving a movie camera, versus just letting the actors move in front of it. It took thirty-two years to think of adding sound. Sooner or later, dozens of new ideas emerged to give a totally new vocabulary to film and video* (Negroponte 1995).

The incubation period as Negroponte mentions *can be quite long*. However, the moment it takes place and the technologies and methodologies are accessible to others, emphsooner or later these *others* start building on these innovations. When comparing the content the industry was able to produce back when the camera had a static point of observation with the wealth of content that is produced now, we can see an exponential increase in the amount and variety of content and the routes available to access AV content. The different devices and locations where AV material can be accessed have an impact on the strategies people use to engage with others and the environment. There is no room here to argue for or against technological determinism in relation to the size of and the interactions that AV devices afford. Michael Punt in *Early Cinema and the Technological Imaginery* extensively discusses technological developments of early cinema, and challenges advocates of hard technological determinism for not taking into account the correlations of a 'network of social, economic and technological determinants' (Punt 2000, 101). For our purpose, it is worth noting that it is the interrelationships between individuals, places and devices that are significant in the transformation of AV content from static to mobile. In this respect, the devices shape the interaction to the same extend that people shape the devices to suit certain needs ands requirements.

Personalised AV experiences and mobile media

In this section section, the key is the reduction in the size of devices that enabled access to and production of AV content. When the devices for displaying and producing audiovisual content became smaller, and to somehow portable, they moved out from their static locations and people started to move around carrying them to the beach, park, boat. The leap from analogue to digital technology, is what ultimately made the reduction of the size of the devices possible.

Although the focus is to enquire into the reduction in size of the devices that enable the display of AV content, it also applied to the devices that recorded this content. Both types of devices are becoming smaller as their electronic circuits and components become smaller every day. To significantly reduce the size of the devices, the analogue mechanics had to become digital. This change, was a slow transition throughout decades rather than a sudden technology leap. It is worth noting that the change from analogue to digital, as Negroponte fleshes out, seems like a leap because of the speed with which digital technology has evolved since its conception. The change started slowly. First the components in radios, televisions and computers -valves, capacitors, resistors and the like- had to be designed and engineered to be smaller, and so furniture-like devices slowly became portable. Only when the size of the electronics shrunk could the devices that produce and displayed AV material shrink as well.

Figure 1: Image by Mikey G Ottawa, CC BY-NC-ND 2.0

Mikey G Ottawa's picture *Figure 1* shows a PED which is still big if compared with later devices such as walkmans or audio players (i.e. iPods). The person carrying the battery-powered Ghetto Blaster is able to move, and is not restricted to the immediacy of a power socket (Ottawa 1987). The fact that the device is not small enough to fit in a pocket or handbag, affords for a collective engagement with technology and the environment. Battery-powered PEDs like the Ghetto Blaster enable people to gather around and engage with the audio content collectively. Whether in motion or in a static

location sound permeates the public and private spheres, and although the PED may only be directly accessible to a small group, its content permeates outside this group. Unlike visual content which is directional and concentrated in a specific surface, audio can move into contiguous areas. The content played on the Ghetto Blaster may not suit everyone in its vicinity, but it is blasted outwards into the environment no matter who is around. An indoors analogy could be the Jukebox, a device that due to its size is constrained by its power cable to a location, normally a bar or public establishment. The device plays the content that an individual, or group, selects, pays for and wants to listen. The decision is temporal, but affects all those who happen to be in the establishment. If the selected tune is appropriate, the sound could bring people together, but if not, it could also encounter critics or detractors.

The reduction in size of the television set presents a different engagement than that of the Ghetto Blaster. Portable TVs moved people away from the group with which they would have normally engaged when watching TV. Portable TVs favoured one-to-one experiences with the AV material the facilitated access to. Mauricio Kagel addresses the break from static to mobile AV devices in his experimental black and white film *Antithese* (18:35 min) (Kagel 1962). In the film, the main character is operating, playing and breaking AV devices, tangling himself in a mesh of film and tape strings, shooting and hammering television and radio sets, coming in an out of the frame. At the beginning of the film we see bulky, heavy furniture-like audio and television devices that he connects, plugs and unplugs. The devices continue taking part in the scene for a while, then a portable radio appears and later even a portable television which the character takes out of a bag full of film and tape stripes. Before taking the television out of the bag, he grabs a sandwich from inside the bag (12:45 min) and starts eating it. Then, he puts the sandwich in his pocket and takes the television out of the bag (13:20 min), places it on the floor, lays down and finishes his sandwich. Then, takes the television and starts rolling on the floor while holding it, in a sort of dance, staring at the screen and its images, tangling himself in a mass of film and tape until he puts the television back into the leather bag (14: 25 min).

A portable wireless TV of the late 70s was, according to the Museum of Technology, a treasured device that costed in weight more than Silver. In the Museum of Technology website, Tim Vanns from Watford commented in 2010 that the Sinclair Microvison TV1B (see *Figure 2*):

> *. . . certainly came into its own when I went camping. If you held it about the same distance away from your eyes as you would if reading a book, the picture was superb. It was powered by AA batteries that gave you about 12 hours of viewing.* (Tim Vanns)

From the shape and design of the device but also from Vanns' comments we could infer that the device was used as if it were a book, as a media to engage with on an individual basis. This is baffling, specially if we consider camping to be a group activity in which people gather around a fireplace and cook together. Still it makes sense that someone would prefer to look at a moving picture when inside a dark tent, because reading would be difficult due to the bad lighting condition that torches offer. Assuming that this is the specific case in which this person used the TV1B device, we could extrapolate that a new trend emerged towards the 80s. People started to engaged with PEDs in an individualised rather than collective manner.

Figure 2: Sinclair Microvision TV Model TV1B, 1978, 4 x 6 x 1.5 inch. Image credit (http://freakism.tumblr.com/)

A different way of bringing AV content outdoors aside from the miniaturisation of devices, can be found in drive-in cinemas (1930s onwards) and more recently, as Richard Coyne mentions in *The Tuning of Place* (2010), in urban screens dedicated to "showing Sky or CNN broadcasts" in the middle of contemporary urban environments (Coyne 2010, 219). Although Coyne refers to these screens in relation to how they borrowed the use of frames and the externalisation of sound from cinematic practices, it seems relevant to discuss their potential to engage people. If compared with drive-in cinemas, urban LED screens do hardly ever function as places for gathering and social interaction. Drive-in cinemas only run at night and have specific film programmes –normally B films– which serves as an pretext for people to gather and engage with others (i.e. friends, family, partners) (Reid 2008). On the contrary, outdoor urban screens run their programmes uninterruptedly while people move around and mostly ignore them. Urban screens only become useful as a gathering places when international events such as World Cups and Olympics are broadcasted live. Often, these screens occupy a place in which people are not interested in exercising their public lives. The reason behind might be that although the content is constantly changing with the latest news, it is not dynamic, it always shows the news and cannot be tuned to suit the AV interests or need of people in the surrounding area. If people were able to use the screen for a specific purpose, even if only temporarily, and the screens were potentially used to showcase the content or online applications that people can select via smartphones (i.e youtube, iplayer), then they could become relevant and play a meaningful social role.

Back in 1980, artists Kit Galloway and Sherrie Rabinowitz proposed a different type of engagement with AV dis-

play technologies than that offered by personal computers and outdoor urban screen such as advertising screens (i.e. New York's Times Square). They were interested in getting passers-by to participate in the first outdoor telepresence project, a collective teleconference event in which people from two cities (L.A. and N.Y.) were connected via satellite. People could hear and see each other across the continent, thus interact with people thousands of miles away. *Hole in Space* was not meant for a particular group, it was open to all those who happened to be there. Some people came to the projection-streaming place alone, some with a group. Their purpose could be peeking or performing and interacting with people on the other side. Some wanted to communicate and see relatives that lived at the side of the country, and so placed themselves in from of the screen. Either as an observer or a participant, people made this telepresence project possible collectively. Individual conversations were broadcasted publicly and were readily available for anyone to participate in. The two places where the screens were installed became a site for social interaction, dialogue and exchange, a genuine public place.

The communication flew between the two coastal cities for a week. This taster probably left a large number of people waiting for the technology to be available to use at home and other convenient locations. For this technology to become available, a few decades had to pass. Only when personal computers became more common, in particular PEDs (e.g. laptops, digital tablets, smart phones), and Internet connections more reliable could telepresence really become widely available. From Galloway and Rabinowitz's *Hole in Space* up to the first decade of the 21st Century, telepresence has slowly ceased to be a collective activity and has become part of personalised technologies. The audiovisual blaster effect of *Hole in Space*, drive-in cinemas and movie theatres, furniture-type television and radio set, and the Ghetto Blaster, have become silent in the pockets of people, who engage with AV content through small PEDs screens and headphones.

From individual to participatory audiovisuals

Individual places moving towards collective

When individuals turn their backs to those present in their immediacy and engage with AV content through ever smaller individualised PEDs (e.g. smart-phones), the environments in which they are and move cease, to some extend, to be public. The person is physically present in public, but does not take part or seems not interested in engaging and sharing AV content with others. The content is experienced individually without the need for engaging with others. In this context, people become accustomed to be isolated, and to plug their earphones and concentrate on PED screens.

The transition from collective to individual audio and audiovisual experiences has been gradual: slowly devices have become smaller and their capabilities to play and record AV material greater. In the 80s, with the progressive declivity of the Ghetto Blaster in favour of the 1979 Sony Walkman, shared aural experiences were left aside and transformed into individual aural experiences. Paul du Gay in *Doing Cultural Studies: The Story of the Sony Walkman* discusses the impact of the walkman on culture and people's personalised experiences of sound (du Gay 1997). With the walkman, the person walks hands free with the device strapped to a belt, or stuck in a pocket or handbag. Its headphones cancel external noises and sound cues, so the person is deafened towards others in the surroundings. A chosen alienation where the person prescinds from the aural information of the surrounding environment and takes distance from others. Images from the Sony Walkman advertising campaign show people listening to walkmans in the company of others (du Gay 1997, 38) which seems strange because with headphones on and a cassette playing, no mater how low the volume, the content played by the device hinders the communication between people.

When asking for directions, we are more likely to address passers-by who walk without earphones or headphones, who are not looking at PED screens or conversing with their mobile phones, because these people seem to be out of reach. People using PEDs in public, tend to be in and move in a hybrid environment, where external sounds and surrounding people are not totally excluded, but fade into the background. In the *Tuning of Place*, Coyne elaborates on the idea that through ubiquitous computing and PEDs people are able to synchronise with different spatio-temporal realities (on-, offline environments) simultaneously. These two coexisting realities blend in everyday life, because digital content and environments are readily available on PEDs at any time. AV content is accessible from online platforms and hard-drives, is produced by broadcasting companies and friends, peers, colleagues, family, experts, and is abundant and accessible asynchronously. People spend more time in-between physical and digital environments, combine them at their convenience and sometimes loose contact with those around them.

Figure 3: Family watching television, ca. 1958. Image credit to Evert F. Baumgardner, Internet Archive, public domain (Baumgardner 1958)

Based on Coyne's account of tuning and the idea that most people have PED, the place that people occupy is individually crafted and build around the digital content they create or access. These exclusive tuned experiences put aside the possibility of gathering physically around a device like it was possible with the early television set (see *Figure 3*). However the voluntary isolation that small PEDs draw forth, can be counter fought with initiatives such as Breakout!

Breakout! is a project commissioned by the exhibition *Toward the Sentient City* organised by Mark Shepard in 2011 (Shepard 2011). The project developed around the idea of bringing people together that would normally work in isolation because of cubicle-type office environments, freelancing, working on start-ups, or working from home or cafes. Taking into account the need for being connected to the internet as a prerequisite for working in the 21st Century, Breakout! enabled people to gather to work on their individual tasks in public with a reliable wireless internet connection. So people could interact and help each other. Breakout! started with a website which enabled the coordination of a group of people interested in meeting and working together in a concrete place in the city. Breakout! is a step forward to bringing people physically together and fostering dialogue and collective action in the public realm. In the introduction of the *Sentient City*, Mark Shepard poses the question:

> *if the meaning of urban public spaces is as much a product of their spatial and material arrangement as it is of the conditions of their use, what new types of activity can be enabled in these spaces, and toward what ends?* (Shepard 2011, 14)

The question opens up the possibility of using technology in public environments to create new types of social interactions. If PEDs and ICT infrastructures enable digital communication in urban contexts and open the possibility of bringing working environments outdoors, it seems also possible to use the same technologies to enable creatively mediated AV encounters that are not work related. In *Wanderlust* Rebecca Solnit addresses the issue of bringing work into every aspect of everyday life, and the threat that PEDs pose to the activity of walking in public and outdoor environments. For Solnit, walking is a time to think, but PEDs open up the possibility of always being connected and able to access AV content, and in that way load with work the time that needed to move from one place to another (Solnit 2002, 10).

Although Solnit's approach might seem appropriate to desaturate everyday life from the hectic of ICT and the immediate responses PEDs secretly enforce on us, it might be difficult to disentangle personal from working time when most people walk around with and are hardwired to PEDs. A response against labour permeating every aspect of our lives, might be to use these technologies and devices to devise creative ways of engaging with AV content and media, and doing that collectively instead of in isolation. Either in digital or physical environments, the term public that referred to the sphere where dialogue and conversation and the embodiment of the public live were performed in Ancient Greece (Arendt 1998) can be brought back as a place for collective engagement and experiential exchange hub through PEDs like portable projectors and speakers.

Audiovisual content embedded back into the group

When people and their PEDs are no longer distinguishable from one another, because the devices are so deeply rooted in the concept of the self that the device turns into an extension of the person and a means of the interactions with others, AV content is no longer fixed to places but can move around in the environment with the person. Then, AV content can be displayed anywhere, blowing up and expanding AV experiences to previously unimaginable places. Reduced size and battery autonomy grant the possibility of broadcasting AV content anywhere. Depending on the display size and the power of in-build sound systems, PEDs may become the focus of attention, the locus where people gather in public.

Coyne draws on Pfeifer and Bongard's *How the Body Shapes the Way We Think* when he uses the term "wearable" in connection with mobile phones, which according to Pfeifer and Bongard "are parasitic... Phones exploit their users by hitching a lift with them!" (Coyne 2010, 135). Drawing on this idea of *hitching a lift* we could go further and say that the relationship between PEDs and people has become so intimate that the distinction between the host and the guest has almost vanished as if we were cyborgs (Turkle 2011). The technology that displays AV content is not hidden away inside the projection room, living room, office or institution anymore. On the contrary, although some devices like wireless receptors and cameras may have become smaller (iPod Nano), invisible (RFID cards) or so small that they are imperceptible (nano implants), PEDs designed to display AV content (laptops, tablets, smart-phones, etc.) are fitted with generous and bright screens, even with projectors (e.g. Galaxy Beam II) and loudspeakers at the front.

Devices for displaying AV content such as the HTC One's BoomSound smart-phone are designed to offer better sharing experiences in public environments. The screen is bright and big enough for a small group of people to engage with and the in-build speakers at the front improve the AV experience by imitating the stereo systems that would normally be set up in DIY home cinemas, where the sound comes from the front –where the moving image is– to avoid the uncanny sensation of acousmatics (Chion 1994). People can share AV content better with bigger displays than with small screens. If we compare the screens of the first mobile phones with the current ones, we note that: when it comes to size, resolution and the data they are able to display, there is an abysm between the two. The technical advances that make possible the display of good quality AV material on PEDs could also be used for more creative purposes than those of mainstream holly- or wolly-wood online cinema or advertising campaigns.

According to the British Film Institute (BFI) *Opening our eyes* 2011 report on how people engage with cinema compared to other leisure activities such as sports or culture, one of the main points is that 23% of the films are viewed online or on mobile devices, and 11% of survey participants reported watching "a film on a mobile device at least" once a month (Alliance and MediaCT 2011). This *watching a film on a mobile device* refers to a wide range of devices which may include tablets, mobile phones, iPods and others, and maybe

even portable projectors. Although portable projectors are not yet fully embedded into smart-phones and tablets like for instance cameras, there is the potential that they may soon be, because they are becoming smaller and more affordable and can be engineered into PEDs and commercialised as an extra feature. With the spread of portable projectors embedded in PEDs, films may no longer be watched on screen, but beamed out into the environment: a wall, a door, a ceiling, a stone, a tree.

In 2005, Finland's company Upstream Engineering, prototyped an light-emitting diode (LED) projection system of match-box size that could potentially be incorporated into PEDs. Using a different technology, Texas Instruments (TI) have been developing nano digital light processing (DLP) technology and showed a mobile-phone prototype at the Consumer Electronics Show (CES) 2007 in Las Vegas (Jan 8-11) and 2007 CTIA Wireless convention in Orlando, Florida (Mar 27-29). Some of the first mobile-phones with portable projectors incorporated were shown at CES 2009, where Logic Wireless debuted with the Logic Bolt phone and Samsung with the MBP200 which incorporated DLP technology from TI. Previous to those were the Shenzhen Showork N70, Javes PMP-N70 and Epoq EGP-PP01 mobile phones with portable projectors. The specs for a later TI projection technology of the size of a pencil tip is DLP® LightCrafter Display 2010 TI can be found at `http://www.ti.com/tool/dlpdlcr2010evm`. In 2009, MicroVision applied for the PicoP® patent and the next generation PicoP® Gen2. MicroVision's pico projector uses MEMS control algorithm and the projection device is made of two components: Integrated Photonics Module (IPM) and Electronics Platform Module (EPM). For the projection technology to become even smaller research is also being undertaken to reduce the lens size, as for instance the FLGS3 Series lens developed by Alps Electric.

It is a race, and whoever develops the smallest, brightest, most cost effective solution will win the market share, at least for some months. Despite a number of manufacturers developing such devices, it looks as though Samsung is currently one of the few that is pushing these type of PEDs into the market. After the MBP200 and W9600 models, Samsung launched the Galaxy Beam in 2010 which has now been superseded by Galaxy Beam II launched in China in April 2014. UK mobile providers did not offer the Galaxy Beam, and it is still uncertain whether they will offer Galaxy Beam II. Its market is niche and mainly in Asian-Pacific regions. It is worth noting that in the near future, mobile phones with projector may become available at similar prices than other PEDs. In fact, probably most PEDs will have a projector of some sort. The projection capabilities of mobile phone thus far are not optimal: the resolution is low and the light swings between 15-20 lumens, which is not particularly high. When using PEDs with low luminescence and resolution and projecting onto nearby surfaces (close distance), image quality is fine. However, as expected, the batteries of mobile phones are drained fast when projections are carried out. This is an issue that manufacturers will have to pay special attention to if these devices are to take off in the market. These type of PEDs may soon be in people's pockets, and their projections may serve as point for gathering, interaction and exchange.

The playful social engagement these portable projectors offer has been considered by companies such as Disney where researchers have investigated their potential to enhance gaming. Disney is aware of the impact these PEDs may have on their activities. On their website, the company says: "market research predicts that as many as 39 million devices with embedded projectors will be on the market by 2014." (DisneyResearch) Thus, they have been researching how portable projectors and mobile phone technology can be used to design interactive games. PEDs with projection capabilities offer the possibility of engaging with games and animations while projecting the content in the environment, and Disney Research Lab is exploring their potential through projects such as MotionBeam (2011), SidebySide (2011) and HideOut (2013). They are foreseeing the spread of PEDs with portable projectors and investigating how people could used them to augment their environments to play together.

When people use handheld projectors, they externalise AV content contained in their PEDs and expand it into the surroundings, where others can also engage with it. The projection beam turns into an AV blaster that affects the person holding the PED, and those in the vicinity. For the person holding the projector, the PED is an extension of the self. The technology disappears in the action and gesture of projecting, in a similar way the pencil or keyboard disappears in the writer's hand when immersed in the writing process. Hence, handheld projectors become "ready at hand" (Heidegger 1973) when the person no longer thinks about how to use the intricate piece of electronic equipment but uses it as if it were a pencil with which to draw with light. The PED becomes an extension of the body. The projected visuals create a magic lantern event, where performance and communication take place between people. The projection is simultaneously an intimate and a collective activity: the experience of projecting is embedded in the person that projects, while the projection is embodied by all those around it. Although the projected content has no physical reference unlike in the old film reel, the person holding the PED is physically bound to the AV material through direct contact with the source of the beam. The person holding the device can direct the AV information and to some extend touch the textures of the environment, even if only visually, through the light beam.

Just like when going to the cinema, the audiovisual content contributes to develop social engagement. When people gather for a purpose such as experiencing audiovisual material their activity is collective and defined by their presence, their use of portable devices and their motion in space. In the cinema as well as in AV walks, people exchange their views of the AV content and what their experience of the content was. With expanded AV experiences such as AV walks as well as with cinema screenings, people participate and socialise in public environments, share opinions and concerns while walking, or over drink or food. Simply by communicating their emotional experience with each other, even if briefly or only through body language and gesture, the AV event provides a ground for social interaction. There are attempts to bring the audiovisual experience out of the built environment of the cinema theatre. Initiatives such as the drive-in-cinemas

or outdoor-summer-cinemas expand social interaction to an outdoor environment but also portable cinemas. Examples such as the *Portavilion* (2008) (Uffelen 2009, 128-9 (van Uffelen 2009)), the smallest cinema in the world composed of 6 seats, constructed by the Hopkins Architects and Expedition Engineers for the London Festival of Architecture 2008 are attempts to bring the indoor audiovisual experience outdoors. We could extrapolate that when engaging with audiovisual material such as video or film people need not to be alone isolated from others. Even in the smallest cinema in the world one can meet others, laugh at and be scared by the film with others, discuss a specific moment, express enjoyment or discontent through gestures, and ultimately communicate with others the individualised experience of the world of pictures and sounds and that of the world of the tangible.

Conclusions

An overall view of how size influences the way in which people engage with devices and others. While moving from the first audiovisual devices and their static and heavy nature to smaller, lighter devices people have adapted their social interaction and shaped the devices to fit these. Devices have shaped and changed the way in which people communicate and participate in their social and public life to the same extend as people utilise and design the devices to suit specific needs or purposes. From the radios to the television, from furniture-size to pocket-size devices, from the magic of audiovisual illusions to the commercial agendas of devices' manufacturers, all in all can be refocused to bring people together, to get people to share audiovisual content and to engage with it, and to be open to engage with novel or experimental approaches on how the technology can be used. By taking part in creative locative and audiovisual activities people will be able to see their everyday life anew. In the mean time we will wait for projection technology to become common among us.

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The Tomb of the Grammarian Lysias: Real-Time Performance and Crowd-Distributed Music Diffusion with Networked Mobile Devices

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Abstract

"The Tomb of the Grammarian Lysias" is a setting of a poem by Constantine P. Cavafy for voice and audience members' mobile devices, composed by Ben Houge, based on software developed by Ben Houge and Javier Sánchez. During a performance of the work, a vocal soloist sings the poem in Greek, recording fragments of his or her voice using a custom application; these recordings are distributed wirelessly to the mobile devices of audience members for further processing and deployment, providing the crowd-distributed accompaniment to the soloist, with no other sound reinforcement required. The result is a uniquely portable and scalable performance environment in which the audience enables the work without directly interacting with it, representing an underexplored realm of app-based music performance.

This paper presents an overview of the work's genesis and antecedents, a description of the technology developed to enable the performance, and a discussion of its unique aspects and aesthetic ramifications. In closing we share some of the challenges related to presenting a piece that involves audience members' mobile devices, including a comparison of the work's two incarnations: as a native iOS app and as a web app using the Web Audio API.

Keywords

Mobile Apps, Networked Audio, Crowd-Sourced Performance, Granular Synthesis, Algorithmic Systems, Generative Music, Multichannel Sound, Greek Poetry, Microtonality, iOS, Web Audio API.

Genesis, History, and Previous Work

Constantine P. Cavafy (1863-1933) was an early Greek modernist poet who lived in Alexandria, writing in relative obscurity during his life, although his work has risen in prominence since his death, beginning with the advocacy of friends including E. M. Forster and champions like W. H. Auden [1]. Composer Ben Houge encountered Cavafy's poem "The Tomb of the Grammarian Lysias" on a trip to Greece in August 2013, and several aspects of the poem resonated with his work in real-time media and video games, prompting a desire to set it to music in a nonlinear treatment.

The poem is presented here in a new translation by Niko Paterakis, reproduced with kind permission:

> Very near to the right of the entrance to the library
> of Beirut, we buried wise Lysias,
> a grammarian. The spot is very well suited.
> We placed him near to those things that he may still
> remember there—commentaries, texts, technologies,
> variant readings, volumes filled with Hellenistic studies.
> And also this way, his tomb will be seen and honored
> by us, when we pass by the books.

The poem does not present a sequential, linear narrative; rather it describes a space, the final resting place of the fictional scholar Lysias. This kind of spatial organization suggests multiple, even infinite, possible trajectories through space, and this multivalence can be evoked in a musical treatment that incorporates statistical or stochastic processes at run time to create a dynamic sonic environment that varies from performance to performance. The poem goes on to list different types of texts found in a library, but not an ordered list, compounding a variable spatial organization with the notion of perusing a library's stacks of books (as one doesn't read a library from beginning to end). Finally, in several translations, the Greek term γραφές is rendered "variant readings," presenting a third enticement to set the poem in a way that maintains the idea of variation and extends it to live performance. These three observations as well as various personal associations provided the impetus to compose this music and to incorporate real-time, nonlinear processes.

The composer Ben Houge comes from a background in classical electroacoustic music via a nineteen-year career developing audio in the video game industry. The considerations brought to bear in this piece are informed by the exigencies of music composition for interactive digital media. Principal among these are twinned goals of allowing music to continue for an indeterminate duration (ideally using techniques more sophisticated and less fatiguing than a blunt loop) and allowing music to respond, transi-

tion, and evolve according to unpredictable events received as a result of real-time input. The medium of video games (and by extension video game music) is inherently indeterminate; once a system is made to allow user input, that system must be prepared to accommodate whatever agency has been afforded the user. When considered in these terms, the link to the spatially organized (rhizomic, and therefore variably navigable) themes of Cavafy's poem becomes apparent.

In addition, video games, especially 3D games, often deal with spatial organization in a more overt manner: sound sources positioned in 3D space may be encountered in infinite combinations as users variously navigate the virtual environment. Inspired by an understanding of spatially organized sound deployment in video games as a kind of virtual sound installation, Houge has developed several works for various configurations of multiple speakers, including the four-channel works *Lukou* (2009) and *Landscape with Water and Woodblocks* (2012), the six-channel composition *Kaleidoscope Music* (2009), the sixteen-channel incidental music for the dance performance *Please Be Seated* (2014), and the thirty-channel sound environment developed for a series of restaurant-based, audio-gustatory events called "food operas" (beginning in 2012), developed in collaboration with chef Jason Bond of Bondir restaurant in Cambridge, MA, USA, which presented an emergent, customized soundtrack for each diner during a five-course meal. [2]

So while this work does not contain an overt game element or virtual representation of space, the overlap with the concerns of video game music practice is considerable. In the discussion of the work's specific audio processing capabilities, additional connections to previous work will be presented.

The memorial nature of the poem as well as its language and cultural provenance suggested a link to the ritual music of Greek Orthodox Chant. This music is often sung not by a professionally trained choir, but by religious officiants, for whom the music's liturgical function takes precedence over performance practice considerations such as blend, precision, and intonation. The resulting sound possesses a rich heterophony that is well suited to a musical setting deployed across multiple mobile devices, transforming the audience into a kind of choir, spatially articulated, in which each member presents variations on common source material. This association with choral music practice is heightened by the fact that the sound being distributed is the multiplied voice of the soloist. [3]

The musical setting of this poem evokes a sense of solemnity and serenity, such as one might find at a funeral ceremony, again evoking the contours of traditional Greek Orthodox chant. Furthermore, in its application of indeterminate, real-time processes, this setting presents a series of static musical behaviors; while the piece has a finite (if statistically variable) length, the processes themselves could continue indefinitely, giving the music a sense of timelessness, fitting for a memorial. The work, with its strong links to the spatial aspects of sound installation practice, suggests an environment in which listeners could come and go at will and remain for an indefinite amount of time.

The setting is in just intonation, linking Cavafy to another prominent Greek from Alexandria, second century mathematician and theorist Ptolemy, who first articulated a musical tuning system based on varying small number frequency ratios. It has been observed that voices and other instruments capable of continuous pitch will tend towards just intonation when performing tonal music as a homogenous ensemble, and so this use of non-tempered tunings evokes once again the genres of choral music and Greek Orthodox chant. [4]

A final consideration in deciding to compose this setting for a soloist's voice deployed via audience members' mobile devices is the observation that recording, transmitting, and reproducing the human voice is the primary purpose for which mobile phones were designed, rendering this idiosyncratic medium uniquely suited for this type of setting.

Of course this is not the first work to exploit audience mobile phones.

Golan Levin, Gregory Shakar, and Scott Gibbons collaborated on *Dialtones (A Telesymphony)*, premiered in September 2001 at Ars Electronica in Linz, Austria, a famous early example that invited participants to register in advance to receive a pre-composed ring tone and sit in a designated seat in the concert hall; the piece was performed by dialing the phone numbers of the audience members according to a pre-composed scheme, resulting in a structured performance of about half an hour. Two hundred phones were registered, and up to sixty could be dialed at once. [5]

Jason Freeman's work investigates related issues, and his *Telephone Étude 1: Shakespeare Cuisinart* (2001) involved participants reciting text into a phone, where it was recorded, manipulated, and played back, although as a private, one-on-one experience. [6]

In some aspects, the format of our work is related to the Stanford Mobile Phone Orchestra (MoPhO), founded in 2008, which has spawned sibling ensembles in Helsinki, Michigan, and Hong Kong. While these ensembles focus on phones as instruments and coordinated performance, there is less emphasis on audience participation, resulting in fewer discrete sound sources, and the native acoustic properties of the phones are circumvented by the use of external speaker peripherals. [7] These Mobile Phone Orchestras can be considered portable descendants of the Princeton Laptop Orchestra (PLOrk) as described by Dan Trueman. [8]

The Collaborative Situated Media group at IRCAM has been working along similar lines, with their *Sound Checks* suite of Web Audio studies and the *Drop* composition they presented at the First Web Audio Conference in January 2015 (where the Web Audio version of our work was also premiered). [9]

Perhaps the researcher whose work mostly closely parallels to our own is Lonce Wyse at the National University

of Singapore, whose descriptions of the infrastructure, aesthetics, and challenges of his ADiffusion system mirror ours in many aspects. He also presented his work at the First Web Audio Conference and shared plans for a large-scale audience participation work in Singapore in the months ahead. [10]

Levin helpfully provides "An Informal Catalogue of Mobile Phone Performances, Installations and Artworks" on his website, comprised mostly of works from around the time of the premiere of *Dialtones*: http://www.flong.com/texts/lists/mobile_phone/. [11]

In January 2014, Houge established the Berklee Valencia App Choir, the first new ensemble in Berklee's new Music Technology Innovation program. This ensemble uses mobile devices to teach coding concepts with a tripartite focus: networked music systems (including audience devices), live sample manipulation, and on-the-fly score generation. The present work corresponds to this research trajectory.

Development

Javier Sánchez comes from a wide-ranging background in software development and computer-aided design. He brings extensive experience in app development, dating back to shortly after Apple opened up the iOS ecosystem to third party developers in 2009. He has linked his work in app development with electroacoustic research as a visiting scholar at Stanford University's Center for Computer Research in Music and Acoustics.

To develop the project, Houge began by composing the music for the vocalist and developing a prototype of the system in Max/MSP. Then he enumerated his goals and needs for the piece, and Sánchez proposed and outlined the architecture of the system framework, which Houge later expanded and filled in, programming in C, Objective C, and Python, with frequent input from Sánchez.

"The Tomb of the Grammarian Lysias" was premiered at the opening concert of the joint International Computer Music Conference/Sound and Music Computing Conference in Athens, Greece, on September 14, 2014, in the Ceremonial Hall of the University of Athens. The Chinese premiere of the piece took place on October 24, 2014, at Beijing's Central Conservatory of Music, as part of the Music Acoustica electronic music festival.

Houge later recast the work as a web application using HTML5, JavaScript, and the Web Audio API. This version was premiered at the First Web Audio Conference, co-hosted by IRCAM and Mozilla, January 26-28, 2015.

Performance Description

A rendering of the composition and score are available via the following links:

http://benhouge.com/resources/HougeTheTombOfTheGrammarianLysias.mp3

http://benhouge.com/resources/HougeTheTombOfTheGrammarianLysiasScore.pdf

As indicated above, the work exists in two formats: one based on a native iOS application and one based on a web application using the Web Audio API. We shall first describe the iOS version and then address how this work was adapted for the web, following the chronology of our work.

In the iOS incarnation, are three technical components to a performance of this work: the audience members' client app (for iPad, iPhone, or iPod Touch), available from the Apple App Store; the performer's iPad app; and a server running on a local wireless network. The performer uses the iPad app to record fragments of singing and to send messages to the server. The server broadcasts the data to the audience members' apps, which perform some local audio manipulation and play the sound using their built-in speakers. No other amplification or sound reinforcement is required, resulting in a highly portable piece that may be easily presented in unconventional spaces.

Timings are loose, there is no steady pulse, and metrical synchronization is not the desideratum; the local processes introduce random timing offsets while also accepting the unpredictable lag of data transfer over the network as a natural and inherent aspect of the piece.

A performance of the piece lasts a little less than five minutes.

Unlike the client app, the performer's app is not publicly available via the App Store. This app serves two primary functions: it can record fragments of the performer's voice during the performance and send them to the server, and it can send performance control messages to the server. Each audio file is associated with an index, corresponding to an allocated slot in each client app's memory, where it can be saved for subsequent deployment. There are eighteen available slots that can be filled with sample data from the performer's app. Audio is compressed using the AAC format before sending. Control messages trigger various audio deployment behaviors on the app, as described below. There is also a button to connect to the network and a button to stop all current processes. Several buttons serve more than one function (e.g., record and send a new fragment of audio while also triggering one or more audio behaviors on the client), in effect encoding the score of the piece into the app.

The client app presents a very simple interface, spread out over three different screens: the text of the poem, instructions, credits, and a connect button. The connect button instructs the application to search for a specific IP address on the network (currently hardcoded to the IP address 192.168.0.110, which on the router is a reserved DNS for the computer running the server, to streamline the setup process) and attempt to connect.

Once connected, the app can respond to network messages instructing it to download audio files from the server or to perform simple audio processes on files it has already downloaded. It has memory allocated to store eighteen

different audio files. There are two basic behaviors it can perform on this audio data. It can play the whole file back intermittently (choosing a number of repetitions, bounded by a minimum and maximum range, and a duration of time to pause between repetitions, also bounded by minimum and maximum values, as specified via incoming network messages). It can also perform a simple granular synthesis algorithm using the downloaded audio data as source material.

There are three variations of the app's granular synthesis behavior: a simple sustained tone, a string of several tones (specified by a set of possible frequency offsets, a minimum and maximum value bounding the number of tones to play, and a minimum and maximum value bounding the duration of each tone), and a variation on the string of tones in which pitch offsets are sorted such that they only move downward in pitch (resulting in a behavior consisting of the following steps: choose a tone from the available set at random; choose a tone between the current tone and the lowest possible tone; if the chosen tone is the lowest possible tone, and if a specified maximum time range has not elapsed, choose another pitch from the set at random and repeat the process). In all cases, the messages indicate an audio behavior of finite duration (even if the duration is variable and determined independently for each client); this is to preclude the possibility that any "note on" message might be sent without a corresponding "note off" message, resulting in stuck notes.

The iOS application launches upside down, encouraging users to intuitively invert their devices and point the speaker upwards for increased audibility.

There is no interface for audience member interaction, which sometimes surprises participants. Instead, the format of the piece can be thought of as a crowd-distributed speaker array. While the notion of audience participation in the performance of a composition via mobile applications is full of possibility, in this case, there was no meaningful way for the audience to contribute to the piece's progression; on the contrary it was feared that some trivial interactivity would detract from the focus on the piece.

The client app is designed to detect the device on which it is running and scale its functionality accordingly. For older, less powerful devices, fewer simultaneous sounds will be played; if a new sound is requested to play, but the device is already playing its maximum number of sounds, it will randomly decide whether to play the new sound or to continue playing the previous sound, promoting a more variegated heterophony throughout the space. In its first release, the app supports iOS7 and newer.

Both the client and performer app were written in Objective C. The simple granular synthesis algorithm is written using the low level Core Audio framework. The intermittent sounds rely on the high level AVFoundation library, although the intention is to move everything to Core Audio in a future update for more unified control.

The server is written in Python using the Twisted framework. Twisted implements a reactor design pattern. The bulk of the server consists of simple message parsing. When a message comes from the performer app, the server iterates through all connected clients and forwards the instruction to either download new data from the server (performing some checks to make sure all of the audio data has been successfully transferred) or perform some audio behavior on the client app.

The Web Audio API version of the piece is simpler in every regard. No advanced set-up is required from either the performer or the audience members; no local wireless network needs to be installed, and rather than downloading an app and connecting to a dedicated network, the audience can simply visit a web page URL projected on a screen. The performer and audience iOS applications are replaced by two different web pages. The communication system involves the performer app writing to a JSON file on a server (by means of a very brief PHP script), while the audience app regularly polls, looking for changes in the JSON file. (This leaves much to be desired, as the caching systems of various browsers often refuse to get a new JSON file, even if it has changed. We plan to replace this system with a more sophisticated and robust server architecture very soon.)

The version presented at the First Web Audio Conference did not involve real-time recording of the performer's voice; instead, recordings were made in advance, and when audience members visited the relevant web site, all of the necessary audio files were loaded into the corresponding buffers for future manipulation. Subsequently, Houge has developed a version of the work that does record and transmit audio in real-time on the web, making use of Matt Diamond's Recorderjs library, although this version has yet to be tested on a large scale. All of the other functionality of the piece is the same as for the original iOS version.

Technical Observations

We can draw several lessons from the three public performances of the work so far.

The premiere in Athens did not go off without a hitch. A challenge of being on the opening program was that there was little opportunity to request audience members to download the app prior to the show. The composer was obliged to recruit performers at the conference registration desk. As the venue did not have a public wireless network, one of the conference organizers supplied a private address that participants could use to download the app. Just prior to the performance of the piece, the composer (also the performer) announced the name and password of the local network that was used to run the piece, intending to remind the twenty or so participants who had been recruited earlier what they should do next. This was a bad idea. The network router, a D-Link DIR-655, was quickly overwhelmed with requests, presumably from audience members who thought that they would be able to connect to this network and somehow participate in the performance, not realizing that an app was required and that this local network was not connected to the internet. The performance started smoothly, but the composer was shortly dropped from the

server due to high traffic and was no longer able to control the piece. With the approval of one of the organizers, he restarted the server, and on the second try, the piece went flawlessly, but in the brief interim a somewhat confusing announcement was made in regard to the after-concert reception, and unfortunately many of the audience had already begun to leave.

The subsequent performance in Beijing, by contrast, went flawlessly from the beginning. For this performance, about twenty Central Conservatory students were recruited to download the app in advance, with a brief rehearsal prior to the concert. They were distributed through out the audience, and at the appropriate time in the program, they launched the app and connected to the network, enabling an ideal performance of the piece; these twenty performers represented about one fifth of the audience, resulting in a pleasing density of sound in the hall.

The version of the work premiered at the First Web Audio Conference, however, approached 100% audience participation. All that was required was for audience members to visit a URL that was displayed on a large screen at the front of the venue. An iOS device was no longer required, and by obviating the need for a local server, many more participants could connect. As a perhaps unnecessary precaution, the performer logged into a different wireless network from the rest of the audience (kindly lent by WAC keynote speaker and Mozilla software architect Paul Adenot).

Our observation from these performances as well as from our various tests and rehearsals is that, when the audience is involved, the set-up cannot be too simple. Even asking the audience to download an app and connect to a wireless network can be considered a complicated and error-prone request, especially compared to the ease of a web application. Also, maintaining a local network to run an on-site server represents an additional failure point that can be avoided with a web application.

Aesthetic Observations

The macro level structure of the piece is fixed, and each performance lasts about the same duration (with not much more variation than an a cappella singer might introduce from performance to performance). However, at the micro level, the piece is very open. Individual phrases play intermittently, with different numbers of repetitions and durations of pauses for each device, allowing them to interpenetrate, to use a favorite term of John Cage's. [12]

The processes are given a finite duration (or, in most cases, a range of durations) when they are set in motion, but the processes themselves are easily discernable as something that could continue indefinitely. As in much of the non-teleological music of Olivier Messiaen, there is a sense of a slice of eternity, of a music that could continue forever. In this way, the setting supports and reinforces the text, which describes a tomb, a memorial. Instead of a story with a determined beginning and ending, the poem presents a space in which the listener may linger indefinitely.

The result is a texture based on the singer's voice, varying in density, evocative of natural processes like rain or crickets chirping. These kinds of natural phenomena are often used to describe stochastic, granular textures, and in this case, the spatial aspect of these phenomena is also preserved, evoking, for example, the sound of the cicadas that Iannis Xenakis cites as a model (which were very active in Athens during the ICMC/SMC conference where the piece was premiered). [13] Diffusing this sound on multiple devices of similar playback capabilities throughout a performance space allows for a shift in perspective; the devices' built-in speakers are no longer merely poor speakers with limited frequency response and little dynamic range, an imperfect portal through which to imagine an ideal sound; instead these speakers become components in a larger spatial composition, instruments in their own right, and these attributes are embraced simply as the inherent qualities of a unique sound object, individually sited in space. In contrast to the common configuration of multiple speakers at regular intervals surrounding the audience, here the sound sources are interspersed among listeners. The performance takes on aspects of a sound installation.

The rich yet economically generated texture that results from multiple layers of intermittent sound has been explored by Ben Houge in several previous works, going back to the early 2000's, including the acoustic graphic score *A Reading from* _____ (2003), *Radiospace* (2004), and *Psalmus* (2005, also known as *Posuit flumina*). This type of organization also forms the basis of the music engine he developed for Ubisoft's real-time strategy video game *Tom Clancy's EndWar* (2008) and the thirty-channel interactive music system he designed for the food opera project mentioned earlier (beginning in 2012). [14]

While the small size of the speakers of audience members' mobile devices inevitably colors the sound significantly, it is important to note that these devices are designed primarily to convey human voices and are optimized for this type of signal, rendering a composition for voice and mobile devices particularly appropriate.

This configuration questions some of the most fundamental tenants of electro-acoustic performance. Since no sound reinforcement system is required, the system is highly portable, allowing for impromptu performances in unexpected locations. It is also scalable with the size and position of the audience. The stochastic organization of the sound materials is extended to include the playback apparatus itself.

A unique kind of community emerges from this arrangement. Through the act of activating and exploring the app on their personal devices, audience members become invested in the work and even responsible for successful performance. In many cases, a mobile device is a very intimate accessory, held in the hands, in close contact with the mouth or ear, so the degree of investment is greater than if users were simply handed a device for temporary use during a concert. Following the Paris performance, an audience member remarked that this was one of the rare events at which the audience wasn't distractedly fiddling

with their phones, sending messages or engaging with social media, since they were actively using their phones to enable the music.

However, we have rejected a persistent suggestion in relation to this work. Many people, when hearing the piece described, suggest inserting an element of user interactivity, providing the means to manipulate the sound as it is playing back. This is a valid approach, but one alien to the goals of this composition. To allow users to manipulate the sound would require either spending time to teach the piece to them in rehearsal or devising an interface that would constrain their behavior to an extent that it would fit within the objectives of the piece, rendering their actions trivial while distracting from the apprehension of the music.

Instead, this project identifies a little-explored middle ground between auditor in the traditional sense and performer in the digitally enabled sense; audience members operate in the field of the invested enabler.

Future Work

The portable, crowd-distributed, real-time sound deployment mechanism developed for Ben Houge's setting of "The Tomb of the Grammarian Lysias" is rich with suggestions for future work.

Most immediately, there is a desire to compose new work for this system, beginning with additional Cavafy settings (particularly other memorial poems or epitaphs, of which Cavafy composed several). In addition, the system could be expanded to include multiple performers recording their voices (or other sound sources) into their mobile devices, enriching the sonic resources available to the system. As of the time of this writing, Houge is preparing a setting of Elisa Gabbert's "Ornithological Blogpoem" for premiere at the first Vox Festival in Valencia, Spain, in June 2015, using a framework similar to the Web Audio API version of "The Tomb of the Grammarian Lysias."

One of the primary challenges of the work is to ensure that there are sufficient mobile devices connected to the system distributed throughout the audience to enable a satisfactory performance. It is expected that not every audience member will have a device, but due to the limited sound reproduction capabilities of typical mobile phones, a certain density, which varies with the size, configuration, and acoustical properties of the performance venue, is necessary to achieve if all audience members are to have a satisfactory listening experience. While this can be accomplished by planting participants in the audience, the crowd-distributed aspect of the work is only fully realized when audience members are able to participate freely with no advance notification.

By adapting our work as a web application using the Web Audio API, as opposed to a native application, we dramatically increase the number of audience members who are able to participate, without incurring the development overhead of support different native platforms. Audiences are no longer required to download a dedicated application in advance of the concert, but can simply be shown a web page URL at the time of the performance. The performer need not set up a dedicated network to run the piece; instead, the audience can connect to the venue's existing wireless network or use their personal data plans. This renders the work even more portable, allowing for performances in any space with no advance set-up.

Following the Athens premiere, one audience member commented that the iOS restriction (which was simply a function of development resources) could be considered elitist, denying participation to users of other devices. The Web Audio API version of the piece opens up participation to many more potential participants (although of course a mobile device of some kind is still required). However, a new set of challenges emerges, familiar to any web developer, which involves developing fallbacks to support as many different browsers and devices as possible. This affects not only Web Audio API support, but also audio format and compression settings. Other challenges mirror those enumerated by Lonce Wyse: audience members must actively keep their phones from going to sleep, app-based performances are dependent on the battery life of the phones, and a system that is dependent on a large number of simultaneous users is difficult to test. [10] Especially given the battery life dependency, works of long duration are challenging to execute. We observe rapid advancement in this area, and we anticipate being able to involve even more audience members as recent and emerging standards are more broadly adopted.

While the two systems developed for this composition exhibit many idiosyncratic qualities and pose some unique challenges, it should be expected that the mobile device ecosystem will continue to develop, resulting in increasing attach rate (already near ubiquity) for audience members, faster internet connections, broader adoption of new standards, and improved speaker quality. With this in mind, the authors believe that "The Tomb of the Grammarian Lysias" represents a promising paradigm for app-based, audience-enabled musical performance that is likely to increase in prominence as mobile technology continues to develop.

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Author Biographies

Ben Houge has been developing audio for video games since 1996, including seven years at computer game pioneer Sierra in Seattle and four years at Ubisoft in Shanghai. Career highlights include his acclaimed string quartet score for *Arcanum: Of Steamworks & Magick Obscura* (2001) and the innovative cell-based music deployment system he designed for *Tom Clancy's EndWar* (2008). From 2004 to 2010, Ben lived in China, where he was active in the experimental sound scene. Previously he contributed Seattle's new music community as a founding member of the Stranger Genius Award-winning Seattle School collective. He has recently produced a series of "food operas," using video game techniques to score the indeterminate events of a five-course meal. Ben holds music degrees from St. Olaf College and the University of Washington and currently teaches in the Music Production, Technology, and Innovation department at Berklee College of Music's new campus in Valencia, Spain.

Javier Sánchez has been developing iOS apps since 2009. He is co-founder at Xculpture and Lingualia and has been involved in the development of iOS apps including Letsbonus, DressApp, Xculpture, iLoowi, Match My Music, and Multituch Me. From 2008 to 2011, Sánchez was a visiting scholar at the Center for Computer Research in Music and Acoustics at Stanford University, working at the Stanford Intermedia Performance Lab. He received his MS (1995) and PhD (2006) degrees in Mechanical Engineering from TECNUN, University of Navarra, Spain, where he focused on computational methods for the generation, manipulation and representation of tensile membrane structures in real time. His current work involves the relationship between art and technology and human computer interfaces, especially as related to industrial design, tensile membrane structures, and music. Sánchez current teaches app development in the Music Production, Technology, and Innovation department at Berklee College of Music's Valencia campus.

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Weblogmusic: A Performance Platform for Ensembles of Individually Time-Shifted Improvisers

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Abstract

Weblogmusic is a web-based venue for time-shifted improvising ensembles. By embracing the asynchronously created, glitch-prone nature of internet fora, the project allows each performance to be unique in the viewer's browser, with unpredictable network latency disrupting cause and effect in ensemble interactions. The project brings focus to extramusical elements including presence, authenticity, and causality as well as the non-transparent effects of mediatization, allowing the audience to reflect on the unique properties of live performance and the unique properties that emerge from mediated performance.

Keywords

Aesthetics, glitch, improvisation, interdisciplinary, mediation, music, telepresence, web

Introduction

While modern citizens are busy keeping up with communications technology, they are missing out on many human elements in communication like presence and authenticity. While some say we will get used to life mediated by screens and some prefer to wait for technology to get fast enough so we can recreate some of those human elements, there is value for artists in exploring the expressive potential of liveness as a unique dimension in a performance. Aesthetic concepts are established to show what is lost when a performance is mediated, what it gains from the of mediatization, and how mediated, once-live events can establish a new kind of authenticity within a performance, even if their authenticity is lost. A number of web-based mediated performances are analyzed to demonstrate the nature of creating performances for mediatized environments.

Substance in Live and Mediated Performance

Reflecting on some innovative compositions of the mid-twentieth century, author and theorist Umberto Eco revealed a useful tool for finding the value of such works. Speaking of "open" works (whether they are chance-based or simply subject to many interpretations), Eco says, "the form of the work of art gains its aesthetic validity precisely in proportion to the number of different perspectives from which it can be viewed and understood." (Eco 1989, p. 3)

Similarly, philosopher Stephen Davies differentiates between compositions that are *ontologically thin* such as lead sheets (only specifying a melody and chord changes) and compositions that are *ontologically thick*, ones that are fully scored in detail (Davies 2001, p. 180). I have found it useful to evaluate works on a continuum of *substance* between the ontologically thin and thick (Morris 2009) and to extend this model farther to accept that part of the substance of a performance may lie outside its purely content, even in the case of performances we consider to be purely musical (Morris 2013).

This approach can be used to discuss works like John Cage's *4'33"* (1960), in which the score merely instructs the performer to be silent, and many of Anton Webern's compositions, known for their brevity. Neither can be fairly evaluated by the number of notes it contains, whereas one might use duration as one measure of substance in music by Mahler or Wagner. For Cage, one might find substance in the clever approach of turning a mirror on the audience for all its sonic content or in the specialness of witnessing one live performance, knowing there will never be another exactly like it. For Webern, one might appreciate its reserved, deliberate textures and articulations. Great substance can be found in Webern's pitch structures if one inspects them. *Summary:* There is more to a musical performance than the notes we hear.

Stage Presence. Traditional musical instruments require the performer to *move* in order to play them, and the ways in which they move communicate much to the audience, demonstrating the difficulty of a passage or modeling how the audience should feel during a passage. The cello creates a lively intermedial counterpoint between the actions seen and the notes heard. When the bow moves horizontally, we hear notes. When the left hand moves toward the bridge, the notes we hear are higher overall. However, these relationships are not linear as they are on a keyboard instrument. The speed of the bow controls loudness, and the portion of the bow used at any time affects tone, but the most visually obvious parameter, the direction of the bow's movement, is not as significant. While the left hand's position shifts most pitches in a general way, it is still common for pitches to go down as the hand stays still or moves closer to the bridge, as the player is switching to a lower string or an open string. This visual portion of the substance of any traditional performance comes

naturally and often does most of the work to evoke a satisfying stage presence.

In computer-based performances, however, this portion of the substance is absent unless it is purposely built into a performance. When one keystroke can trigger any number of sounds and that keystroke can be so subtle a movement that it goes unnoticed, or if it is hidden behind a computer display, a live electronic performance can be as awkward as a composer sitting on stage during his own acousmatic composition. Technology-based performance begins with a deficiency of substance manifest in stage presence.

An increasing number of technology-based performances are making efforts to reconstruct this obviousness of causality (Energy). While making one-to-one relationships between actions and results clear may seem to be an obvious solution, it still lacks the subtle and complex counterpoint of the cello performance, for example. *Summary:* The nature of the instrument and the performance situation are (once-given) standard dimensions to build substance in a performance.

Mediated Presence. Philip Auslander argues that the direct and mediated (e.g., Jumbotron) versions of a live performance are of equal value to modern audiences (Auslander 1999). Further, Julio d'Escrivàn argues that audiences will become accustomed to live performances by unmoving laptop performers, counting them as equal to fixed media acousmatic music without missing any of the traditional elements of stage presence (d'Escrivàn 2006), suggesting that we will eventually value and regard live and recorded performance as the same in nature.

However, Peggy Phelan has suggested,

> To the degree that performance attempts to enter the economy of reproduction it betrays and lessens the promise of its own ontology. Performance's becoming…becomes itself through disappearance. (Phelan 1993, p. 146)

Elements like stage presence are lost when they are mediated by technology. Some music survives mediation better than others, which is probably one reason why telephone ring tones quoting Mozart are more common than ones quoting Varèse. Pitch and rhythm carry a larger portion of substance in Mozart's music, and those parameters survive mediation through small monophonic speakers tucked away in pockets better than the timbre and other cues of vastness. However, both suffer a loss, and the more faithfully an element *can* be reproduced, the less substance it probably carries.

Further, mediation is not transparent. Besides sacrificing some content, it imposes artifacts that we can see and hear. Jean Baudrillard has argued that when live events are mediated by close-up screens, they become *hyperreal* (Baudrillard 1981): they can be experienced, enhanced, and manipulated beyond the limits of real experience, and this added value simultaneously makes the mediated version the preferred version of reality and erodes our sense of authenticity in the events, because we know the mediated version is disconnected from reality. For example, visual elements superimposed on the field during a sports broadcast provide rich information about the event, but they may make it feel like a video game without real human players. When an event has lost certain elements and gained others through the mediation process, Baudrillard says the event has been *mediatized*. *Summary:* Some elements are lost through mediation; others are gained. Some forms of music suffer more than others, depending on where the substance lies.

YouTube Symphonies A number of artistic projects have used non-real-time video streams in a variety of ways. While one of them actually bears the name YouTube Symphony Orchestra, the existence of other unique works based on non-real-time video streams suggests that the term *YouTube symphony* might be used to indicate their genre. The original YouTube Symphony Orchestra project culminated in a traditional orchestral performance in Carnegie Hall directed by Michael Tilson Thomas; the unique factor was that auditions were submitted via YouTube and evaluated by YouTube users.

For other projects, the final performance is "born digital" (that is, the genesis of the fully realized performance is ultimately made possible within a digital realm), and it remains there. *In Bb* (Solomon), a play on Terry Riley's *In C* (1964), invited performers to submit videos through YouTube, playing freely in the key of B-flat major, avoiding metric patterns and dense textures, and optionally playing along with a provided audio track for inspiration. In performance, the viewer clicks to play any videos at will, starting at any time, with any number of them playing at once. In contrast, *Thru-You* is an album of songs created from videos that were already on YouTube, not created for this project (Kutiman). The artist cleverly edited and mixed the solo videos into tightly-produced ensembles. The result is not malleable or influenced by the viewer like *In B-Flat*. Even in the case of the YouTube Symphony Orchestra, because of YouTube's role in the process and because it sponsored the whole project, the process generated great amounts of video material, allowing the full performance to be recreated in a fixed-media "mashup" using several original audition videos.

These works highlight the limitations of this form of mediation (non-real-time solo videos) and some sacrifices that can be made to overcome them. The YouTube Symphony project only used the media to substitute for live auditions, and then the resulting videos became material for future fixed-media projects. The composer, conductor, and later the video editor retained full control. *In Bb* uses the video content directly in the final product, but the musical must avoid meter or density, in order to avoid cacophony. Pads and drones add up nicely especially if they share a tonal center, but rhythmic coordination, form, expressive changes in intensity, and harmonic shifts are all given up: most of the things that make for memorable moments in a performance. The composer allowed freedom to performers but only within a narrow, safe range. While *Thru-You* delivers a satisfying "born digital" result, this editor has also taken full control. The result, while entertaining, is the same every time. It is now fixed media void of liveness. Other approaches that allow for user interaction and rhythmic coordination resort to looping step sequencers, so users may specify what happens during the *next* cycle, sac-

rificing expression, interaction, and variety as a result. *Summary:* There is rich potential for mediated performance as a genre, without merely being a substitute for unmediated performance. However, it involves embracing the effects of mediatization and strategic sacrifices.

Weblogmusic

Weblogmusic (`http://weblogmusic.org`) is a web-based platform for born-digital performances by improvising ensembles, using the asynchronous and episodic but still conversational structure of a weblog ("blog") to shape the performance process. The project contains a number of *mixes*, each of which is a unique performance realized in a web browser window. Each mix contains several *tracks*, each containing one performer's contribution. In performance, four tracks are randomly selected from within the given mix and are played in tandem, forming a quartet ensemble. Each performance functions both as a live performance and as a pedagogical tool for improvisation, as the viewer is welcome to play along with the improvising ensemble.

Instead of attempting to overcome the limitations of this heavily mediatized form, trying to sweep its artifacts out of view, Weblogmusic embraces the rigid and sometimes faltering properties of the mediation as a compositional element. Unpredictability in loading times for each video and glitches in playback due to fluctuating data bandwidth contribute to make each performance unique, even if the same four tracks happen to be selected for two different performances. The rigidness of asynchronous collaboration, the reshuffling caused by network glitches, and the fact that no one can tell which video came first all work together to playfully challenge our sense of causality and authenticity.

It embodies a value of promoting awareness of mediatization in our human encounters instead of pretending that communication only consists of notes/words on a page. It also promotes a value of letting human behaviors find their own ways to "grow" within these synthetic structures, for we may discover new aspects of ourselves and our communications.

Structure and Process Weblogmusic uses Wordpress for its basic episodic structure and YouTube as a streaming server. This removes significant bandwidth and storage demands from Weblogmusic's own server and eliminates the need for custom-coded in-browser video recording and transcoding software. It does require that contributors manually upload their videos to YouTube, but YouTube's interface for this is well polished and need not be reproduced just for this application.

Six musicians were originally invited to initiate signature mixes (by contributing the first track for the mix) and to contribute additional tracks to each others' signature mixes. Although the first track may not always be heard in a performance of a mix, its influence is manifest in all future tracks, because they are either direct responses to the first track or responses to those responses to the first track. In this way it is the foundation or perhaps the DNA of that mix, making it unique.

When recording each additional track, the performer sees and hears what any viewer would see and hear: a random selection of previously recorded tracks from that mix (sharing the same root inspiration), and the performer records himself or herself playing new material as the other tracks play (in headphones, for the sake of isolating each track as it is recorded). While recording a track, the performance is subject to the same unpredictable loading order, delays, and other glitches as any viewer would see, and those unpredictable phenomena may take a role in shaping the track being recorded, which may in turn influence future tracks. For example, if one track is briefly paused (due to faltering network speed) during a rhythmic motive, that rhythm has been transformed in an unexpected way, and the performer who is recording at the time may choose to echo that motive as he or she heard it, causing the temporary glitch to take an active role in transforming musical material.

Aesthetics Weblogmusic captures the intermediality of performance (i.e., the visual stage presence elements in addition to musical sounds) by juxtaposing camera angles of each performer in his or her own "natural habitat" or at least in a setting depicting their personal style or mood. Each is on his or her own "stage" and those stages are brought together into this new venue.

The performances play on the viewer's sense of causality and authenticity. Not only is it impossible to determine which elements occurred first and evoked other tracks to respond, but there is no official, authoritative version of the performance. Each track a performer records is a "fork" in the evolution of the mix, and it will later be recombined with tracks that were responding to tracks in different forks. It is meaningless to attempt to see a performance that is free of network quirks, because they are a welcome part of the composed environment, and similar quirks have likely interfered with the creation of the tracks that are played. Further, there is no "master copy:" one could play all tracks of one mix simultaneously, but this is a reality that has never existed. It is the sum of all intertwined forks, parallel pedigrees of causality. The only authoritative performance is the one in the viewer's web browser in the moment it is being watched, even though the viewer knows that it is only a subset of all tracks recorded, causality can only be guessed, and network glitches are interfering with its creation and delivery. This conundrum of authenticity is native to the world of mediated performance. Whereas we see elements of authentic human presence lost through mediation, in the right environments, these mediated materials can gain a new kind of authenticity, as the mediated content plays a dynamic role in the performance as if they were original content created for that purpose.

Conclusions Weblogmusic juxtaposes the loss of the traditional trappings of concert-going with the creation of new texts, different with each viewing. While the "aura" of authenticity accompanying a live performance is lost through its mediation (recording and playback), new value emerges as we notice—or sometimes are fooled by—coincidences that appear like planning or live interaction among the perform-

ers. This interchange of "liveness" value allows audiences to reflect both on the value of live performance and the usually-transparent effects of mediated communications.

This interchange brings attention to the medium itself as audiences realize that the performers are not live; only the medium is "performing" in the moment. Glitches, stalls, and unpredictable unsynchronization thwart our ability to tell cause from effect, and when we are sometimes fooled to perceive interaction or causality, they allow us to reflect on what properties actually evoke those assumptions in our minds. As the site continues to populate, performers in all time-based disciplines will be invited to join the collaboration. Instead of attempting to create technology that makes musical synchronization feasible among performers, Weblogmusic embraces and brings focus to the dis/reconnection of web-mediated communications and the glitches and unpredictability of media channels.

Through performances like the ones discussed here, I am hopeful that humans will cultivate a sensitivity to the human elements that are lost in mediation, lest we forget how to be human by the time technology solves all our problems. Human values of presence and authenticity can allow us to find ways to be human *despite* the mediation of so many screens between us. In environments like Weblogmusic, performers are finding ways to be expressive and human by embracing these quirks, remembering our values of human connection, and discovering new ways to build creative works that are native to these synthetic worlds, instead of accepting them complacently as substitutes for real human connection.

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Jeff Morris is a composer, performer, and director of the PerfTech program at Texas A&M University (USA). He creates instruments and performance situations that allow audiences to consider the impact of techno-mediation on the human experience: presence, authenticity, and the passing of time. Often, this involves novel sounds, ways of moving on stage to play an instrument, and ways of building a musical performances. He uses performance to ask, "What does it mean to be human in the twenty-first century?" Morris has presented works in the Milano Triennale museum, Onassis Cultural Center (Athens), Austin Museum of Art (Texas), Flea Theater (New York City), and the Lyndon B. Johnson Presidential Library and Museum (Texas). He also curates the Fresh Minds Festival of audiovisual art.

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Automatic Genre-Dependent Composition using Answer Set Programming

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Abstract

Harmonic music composition adheres to declarative rules and has, hence, become more and more subject to automation techniques. Specifically, Answer Set Programming (ASP), a declarative framework for problem solving, has been successfully used in recent attempts to compose music based on either a certain genre or a composing technique. However, the composition based on the combination of both has not been supported so far. This paper introduces *chasp*, an approach that considers the problem of automatic music composition from a more general perspective. More specifically, *chasp* creates simple accompanying pieces of different genres. To accomplish this ASP is used to solve the problem of chord progressions, based on the rules proposed by the theory of harmony. This results into a harmonic sequence that eventually provides the basis for the creation of simple musical pieces by applying genre-specific templates, through an additional imperative control framework.

Keywords

Automatic Composition, Answer Set Programming, Harmony theory, Logic Programming, Declarative Rule Languages

Introduction

Music creation and consumption generally involves emotions. As computers are commonly considered unable to reproduce or express human feelings, one could easily assume that it might be nearly impossible for a computer to create 'good' music. Conversely, there are many rules regarding music. Some rules regulate the way harmonies are supposed to follow one another, other rules describe the way certain composition techniques are executed (e.g. counterpoint[1] or twelve-tone technique[2]). There even exist rules for the expression of emotions through music[3]. This leads to the basic idea of using those rules to automatically compose musical pieces with a computer, which afterwards may be altered by a human to fit his needs.

Composing is mainly known as a pen and paper activity. Nonetheless, people nowadays increasingly tend to use the help of computer software which ranges from simple scorewriters like Sibelius and sequencers via music production software (e.g. MAGIX music maker[4]) and music workstations through to music creation games on the internet[5].

In-between these mostly auxiliary programs many different approaches to completely automated composition have been made and refined. (Ames 1987) and (Opolka 2012) give a detailed summary of those. Hence, only some of the most important achievements will be briefly mentioned here. One of the first known approaches to automatic composition is Mozart's "Musikalisches Würfelspiel" (Musical Dice Game)(Mozart 1793) where the player randomly chooses different snippets of music out of a given chart and plays these in a certain order, which always produces a new musical piece. Since the 1950s numerous kinds of approaches to the problem of automatic music composition emerged including Computer Aided Composition (CAC), automatic composition without any human interference, and specific new artificial languages developed for the purpose of human music composition and the application of Artificial Intelligence. In 1965, a first composition using CAC was produced by Martin Klein and Douglas Bolitho using random numbers (Ames 1987). Iannis Xenakis developed stochastic music (Xenakis 1971; Myhill 1978) and Gottfried Michael Koenig used statistics to create musical pieces (Koenig 1978; 1971). Among automatic composition there are well known works such as the Illiac Suite (Hiller 1959) or the approach on the harmonization of chorals in the style of Bach by Kemal Ebcioglu (Ebcioglu 1986; 1990). The former applied different sets of rules and Markov Chains on a given starting situation while the latter used rules of the counter point technique. Ebcioglu initially used Prolog for his approach but later he developed an own language for the problem, because Prolog was not meeting his expectations. Other languages especially developed for the purpose of composing and producing music as final output are SuperCollider by James McCartney (McCartney 1996) and ChucK by Wang and Cook (Wang and Cook 2003). A younger approach from François Pachet (Pachet 2002) utilizes Artificial Intelligence, i.e. Machine Learning. His program, Continuator, analyzes musical pieces and ap-

[1] http://en.wikipedia.org/wiki/Counterpoint
[2] http://en.wikipedia.org/wiki/Twelve-tone_technique
[3] http://en.wikipedia.org/wiki/Doctrine_of_the_affections
[4] http://www.magix.com/gb/music-maker/
[5] http://www.musicgames.com/games-by-category/compose-music-games/

plies the patterns learned in the process to create new compositions in a similar style.

chasp (Composing Harmonies with ASP), the approach introduced here, uses Answer Set Programming (ASP; (Baral 2003; Brewka et al. 2011)), a declarative reasoning framework, to produce accompanying pieces based on harmony theory and genre-specific characteristics. There already exist two similar projects using ASP, one of these being Anton, capable of creating musical compositions based on the rules of counter point (Boenn et al. 2010), the other being Armin, which is based on Anton and produces musical pieces that follow the characteristics of the trance genre (Pérez and Ramírez 2011). Although ASP is a relatively young logic programming paradigm which has not been developed for the sole purpose of composing music, it has been shown to be adequate for "teaching" the computer facts and rules about it. Both approaches mentioned earlier use rules specific to either one musical genre or composing technique and are thus only able to create music of this one small domain. Furthermore, the programs strongly depend on creating a melody and using it for the composition of the final piece. As opposed to this, *chasp* is able to autonomously create musical pieces of many different genres and doesn't even consider a melody (yet), but instead focuses on the harmonic basis of a piece. Initially, *chasp* uses ASP based on a knowledge base representing rules concerning music theory, especially harmony theory, to create a chord progression in a certain length and key which may be indicated by the user. Later, rhythm and a distinct guideline to use the notes of a given harmony are applied through a Python framework to produce different genres from one and the same harmonic basis. The decision to use ASP in this context is also motivated by its declarative nature that allows to compactly describe the problem rather than the solution. This way musical rules can easily be added or changed while at the same time it is unnecessary to consider how to execute them, as one inevitably would have to do when using an imperative approach. That is, we only use an imperative Python-based framework to transform the resulting chord progression produced by ASP into an adequate output format, i.e., as sheet music for piano in PDF and MIDI format. Altogether, *chasp* autonomously creates a musical piece based on rules concerning harmony theory and specific genres, where the user can optionally customize length, key and genre of the piece to his desire.

Initially, this paper considers the music theory behind *chasp* followed by a short introduction to ASP. Then, *chasp* is introduced in detail by first describing the process of creating chord progressions and afterwards explaining how genre specific rules are applied to these to create a musical piece. Subsequently, the paper discusses an important aspect for optimization and concludes by mentioning possible future work.

Music Theory

Music is a vast field with many different sets of known rules specific to a certain time (e.g. Baroque or modern age), an area (e.g. eastern or western) or a genre (e.g. Jazz or Metal). The approach proposed here is using western music theory based on rules from the early 19. century to the late 20th century, with a strong influence from Arnold Schönberg's "Harmonielehre" (Schönberg 1966). The general rules used by *chasp* are:

1. Two consecutive chords have to share at least one note but may never be the two same chords.
2. Disharmonies have to be prepared, i.e. the preceding chord has to contain the according disharmonic note.
3. Each cadenza begins with a tonic and ends with a dominant-tonic sequence.

The harmonic theory describes the structure of harmonies and rules for their utilization when composing with the main interest being the handling of chord progressions. There are many different types of harmonies, starting with a simple triad to which one can add one or more notes to create a chord of four or more notes. For all of these chords there exist rules defining which notes exactly form a chord as well as terms describing a specific chord's structure (e.g. Cmaj7 or IV^6).

chasp only uses two types of chords which still results in vast possibilities for different pieces of music. First, all triads from major and minor scales are being used as well as the seventh chord, where a minor seventh is added to a triad. This repertoire of chords is mostly known from folk or pop music. Still, under the consideration of rhythm and specific ways to utilize a chord's notes different genres can be created. This process will be explained in detail further below. For a more detailed explanations of the rules mentioned above as well as the resulting consequences for chord progressions you may refer to (Opolka 2012).

Answer Set Programming

ASP is a declarative framework for problem solving, originally designed for the Knowledge Representation and Reasoning domain. It is based on a simple yet expressive rule language that allows users to model problems as compact, purely declarative logic programs. The computational search for solutions, called *answer sets*, is handled by powerful high-performance ASP solvers (Gebser et al. 2007; Leone et al. 2006), whose internal design and optimization profit from the strict separation of problem description and control in the ASP workflow. Overall, ASP is a modern, proven approach to model and solve combinatorial search problems, ranging from P up to Σ_p^2-completeness, in a steadily growing number of domains e.g. Automated Planning, Robotics, Model Checking, Systems Biology, etc.

Subsequently, we only provide a brief introduction to the syntax and semantics of logic programs with cardinality rules and integrity constraints, and refer the reader to (Simons, Niemelä, and Soininen 2002) for further details. A (normal) *rule* r is an expression of the form

$$a_0 \leftarrow a_1, \ldots, a_m, {\sim}a_{m+1}, \ldots, {\sim}a_n \qquad (1)$$

where a_i, for $0 \leq m \leq n$, is an *atom* of the form $p(t_1, \ldots, t_k)$ with predicate symbol p, and $t_1, \ldots, t_k$ are terms, viz. constants, variables, or functions. Letting $head(r) = a_0$, $body(r)^+ = \{a_1, \ldots, a_m\}$, and $body(r)^- = \{a_{m+1}, \ldots, a_n\}$, we also denote r by $head(r) \leftarrow body(r)^+ \cup \{{\sim}a \mid a \in body(r)^-\}$. A (normal) *logic program* R is a set

of rules of the form (1). The *Herbrand universe* of R consists of all variable-free terms constructible from constants (by default including all integers) and function symbols occurring in R. A *ground instances* of an atom a (a rule r, resp.) occurring in R is obtained by substituting all variable in a (in r, resp.) with some element of the Herbrand universe of R. The *ground instance* (or *grounding*) of R, denoted by $grd(R)$, is the set of all ground rules constructible from rules $r \in R$. A set X of ground atoms *satisfies* a ground rule r of the form (1) if $body(r)^+ \subseteq X$ and $body(r)^- \cap X = \emptyset$ imply that $a_0 \in X$. We call X a *model* of R if X satisfies every rule $r \in grd(R)$; X is an *answer set* of R if X is a subset-minimal model of $\{head(r) \leftarrow body(r)^+ \mid r \in grd(R), body(r)^- \cap X = \emptyset\}$.

In addition, logic programs can be extended by shorthand expressions to succinctly describe certain aspects. Specifically, in the subsequent section we will make use of *cardinality rules* and *integrity constraints*. These are expressions of the form

$$h \leftarrow a_1, \ldots, a_m, \sim a_{m+1}, \ldots, \sim a_n \qquad (2)$$

where a_i, for $1 \leq m \leq n$, is an *atom* of the form $p(t_1, \ldots, t_k)$ with predicate symbol p, and $t_1, \ldots, t_k$ are terms, viz. constants, variables, or functions; the head h is either a *cardinality constraint* of the form $l\,\{h_1, \ldots, h_k\}\,u$ in which l, u are integers and $h_1, \ldots, h_k$ are atoms, or the special symbol $\bot$. We call an expression of the form (2) *cardinality rule*[6] if h is a cardinality constraint, and an *integrity constraint* if $h = \bot$. A set X of ground atoms satisfies a ground cardinality rule if $\{a_1, \ldots, a_m\} \subseteq X$ and $\{a_{m+1}, \ldots, a_n\} \cap X = \emptyset$ imply that $h = l\,\{h_1, \ldots, h_k\}\,u$ and $l \leq |\{h_1, \ldots, h_k\} \cap X| \leq u$; and a ground integrity constraint if $\{a_1, \ldots, a_m\} \not\subseteq X$ or $\{a_{m+1}, \ldots, a_n\} \cap X \neq \emptyset$. Intuitively, a ground cardinality constraint in a rule's head assures that it is only satisfied by a set of ground atoms X if X does not satisfy its body[7], or otherwise X must contain at least l and at most u atoms of $\{h_1, \ldots, h_k\}$. Furthermore, a ground integrity constraint assures that it is only satisfied by a set of ground atoms X if X does not satisfy its body. Technically, both cardinality rules and integrity constraints can be implemented as a set of normal rules, to which they are typically rewritten for uniform evaluation. Hence, the set of stable models for a logic program containing those short-hand statements is identical to the one of the normal logic program retrieved by this translation.

In the following we present our ASP programs in the technical input syntax of ASP grounder *gringo*, version 4.4 (Calimeri et al. 2012; Potassco 2014). We also assume familiarity with built-in arithmetical comparison predicates and functions typical for ASP grounders, i.e., {'=', '!=','<','<=','>=','>'} and {'+', '−', '∗', '/'}, which are evaluated upon instantiation.

[6]For simplicity, we here limit the definition to cardinality constraints occurring in heads of rules. In practice, cardinality as well as weight constraints can occur likewise in rule heads and bodies.

[7]That is, it does not hold that both $\{a_1, \ldots, a_m\} \subseteq X$ and $\{a_{m+1}, \ldots, a_n\} \cap X = \emptyset$

chasp

chasp[8] uses ASP to create chord progressions based on the rules of harmony theory and Python as imperative control to produce simple musical pieces of different genres.

Chord Progression

```
1  note(c;cis;des;d;dis;es;e;f;fis;ges;
2          g;gis;as;a;ais;b;bes).
3  next(c, ( cis; des ) ).

5  halftones(T1,T3,H+1) :-
6          note(T1); note(T2); note(T3);
7          halftones(T1,T2,H); next(T2,T3);
8          H < 12.

10 halftone_steps(maj,1,2,2).
11 key(A,K,M,S+1,T2) :-
12         key(A,K,M); key(A,K,M,S,T1);
13         halftones(T1,T2,H);
14         halftone_steps(M,S,S+1,H);
15         note_acc(A,K); note_acc(A,T1);
16         note_acc(A,T2); S < 7; H > 0.

18 triad(maj,4,3,3).
19 chord(R,T1,T2,R,maj,0) :-
20         key(A,R,maj);
21         halftones(R,T1,H1);
22         halftones(T1,T2,H2);
23         note_acc(A, (R;T1;T2));
24         triad(maj,H1,H2,_).

26 chord_inv(R,T1,T2,R,R,CM,6) :-
27         chord(R,T1,T2,_,CM,0).
```

Listing 1: Describing the musical domain

A computer has no knowledge of music. To be able to create a chord progression one first has to teach it basic musical concepts like notes, scales and chords. Only then one can describe a chord progression and rules for its creation. Listing 1 shows an excerpt of the principal rules describing the basic musical knowledge. The concept of notes is represented in lines 1 to 8. There are 12 different notes in sound and 17 in name as described by `note/1`[9] in lines 1 and 2. For each note the succeeding note is determined by `next(T1,T2)`, with `T1` being the first and `T2` the succeeding note, as shown in line 3. Between each two notes `T1` and `T2` there exists an interval of semitone steps `H` as described by `halftones(T1,T2,H)` in lines 5 to 8. Lines 10 to 16 represent the rules for scales. The intervals between any two out of seven consecutive notes produce a scale. As an example, line 10 shows `halftone_steps(maj,1,2,2)` describing the first two notes of a major scale. This can be generalized as `halftone_steps(M,T1,T2,H)`, with `M` being the mode (e.g. major), `T1` and `T2` two consecutive notes and `H` the amount of semitone steps between these two notes. The rule in lines 11 to 16 generates the actual notes of each

[8]Source code and technical documentation are available at http://potassco.sourceforge.net/labs.html

[9]`note/1` is a predicate containing one argument.

scale step. `key(A,K,M,S,T)` distinctly describes each note of a scale, with `T` being the actual note (e.g. e) on scale step `S` (e.g. 5) in key `K` and mode `M` (e.g. A Major) with `A` as the nature of its accidentals (e.g. sharps). Similar rules describe the structure of a chord in lines 18 to 24. In line 18 `triad(maj,4,3,3)` gives the intervals between all four notes of a seventh chord in a major key. Generalized, each `triad/4` describes the intervals between the notes of a specific chord. while `chord(R,T1,T2,R,maj,0)` in lines 19 to 24 generates the actual notes `R`, `T1` and `T2` of a chord with root `R` and mode `M` in no inversion. A chord's inversion is indicated by the last argument of `chord/6` which contains a number that is based on a notation known from the figured bass where `0` equals no inversion, `6` the first and `46` the second inversion. `chord_inv/7` in lines 26 and 27 gives an example for a rule generating a chord's first inversion.

```
1  next_step(scale_step_inversion(1,0),
2          scale_step_inversion(3,0)).

4  1{cadenza(N+1,T2) : next_step(T1,T2)}1 :-
5          cadenza(N,T1); cadenza_step(N+2).

7  cadenza_chord(N+1,R,CM,I) :-
8          cadenza(N+1,(S,I2));
9          cadenza_chord(N,_,_,_);
10         chord(R,T1,T2,T3,CM,I);
11         cadenza_step(N+1);
12         thiskey(K,M); key(_,K,M,S,R);
13         key(_,K,M,_,T1); key(_,K,M,_,T2);
14         key(_,K,M,_,T3); indicator(I,I2).

16 cadenza_notes(S,R,T1,T2,T3) :-
17         cadenza_chord(S,R,M1,I);
18         chord(R,T1,T2,T3,M1,I);
19         thiskey(K,M); key(_,K,M).
```

Listing 2: Creation of a cadenza

With this knowledge base one can describe the desired solution, i.e. the chord progression. The essential part are the rules describing chord progressions themselves by determining which chords may follow one another and which may not. For each chord this is represented by rules like the one shown in lines 1 and 2 of Listing 2. Each `next_step/2` describes a valid chord progression. The cardinality rule defining `cadenza/2` in lines 4 and 5 generates a chord progression by choosing exactly one succeeding chord from all eligible `next_step/2`. A chord is represented as `scale_step_inversion(S,I)` with `S` being the scale step over which the chord is established and `I` being its inversion. Again, the notation is based on the figured bass. The representation used here implies, that the lowest note of a chord in a given inversion is the note of the scale step over which the chord is being build, e.g. in the key C Major `scale_step_inversion(6,6)` represents a chord with the lowest note a in its first inversion[10], which applies to F Major. As chords are normally represented in the latter notation, lines 7 to 14 translate `cadenza/2` into that form, which is described by `cadenza_chord/4`. For further use of the chord progression (shown in the next section) a third representation containing the actual notes of each chord is provided by `cadenza_notes/5` in lines 16 to 19.

[10]The lowest note in the first inversion is the third of a basic triad.

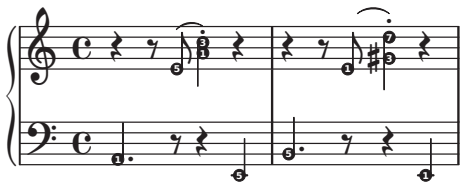

Figure 1: Sample for an accompaniment in the style of a tango

The solution output from ASP contains `cadenza/2`, `cadenza_chord/4` and `cadenza_notes/5` atoms. `cadenza/2` contains a lot of information compressed into an abstract notation based on numbers. This notation is not exactly human-readable but instead designed for ASP to be able to compute a valid next chord through mostly arithmetic calculations. To provide a faster and easier understanding of a created cadenza, the additional representation `cadenza_chord/4` is generated and integrated into either the raw ASP output when debugging or the final sheet music to give an overview of the harmonic structure of each created chord progression. As our Python framework does not contain any background knowledge about music theory and, thus, cannot directly deduce a chord's notes from its chord representation, these are provided by ASP through `cadenza_notes/5`. The process of sheet music creation through the Python framework will be explained in the following section.

Musical Piece Creation

Based on (Frank 1996), (Frank 1997) and (Kroepel 1977) general characteristics of different genres have been extracted to create lilypond templates. Using Python these are applied to the chord progression given by ASP to create musical pieces. This process will now be explained by means of an example.

(Frank 1996) proposes the two measures given in Figure 1 as a sample for an accompanying pattern in the style of a tango. A lilypond template describing these rules would contain the exact same rhythm and notes at the corresponding times. These notes would not be absolute but rather be described by a number which represents the scale step of each note in the key of the chord per measure. Translating these rules to a lilypond notation with numbers instead of explicit notes results in the following template for the right hand's first measure:

```
r4 r8 5,( <1 3>4\staccato) r4
```

This template can now be applied to the notes generated by ASP to create a complete and valid lilypond file. A cadenza generated by ASP contains information on the notes played at one time step in `cadenza_notes(T,R,N1,N2,N3)` as shown in Listing 2 with `T` being time or step of the chord in

the cadenza, `R` the root of the chord, `N1` the third, `N2` the fifth and `N3` depending on the nature of the chord either the seventh or the root again. Considering one time step equals one measure the resulting tango piece consists of as many measures as the given cadenza contains chords. As an example, when generating a four chord cadenza in e-minor ASP may give the following output:

```
thiskey(e,min),
cadenza(1,(1,0)), cadenza(2,(4,7)),
cadenza(3,(5,7)), cadenza(4,(1,0)),
cadenza_chord(1,e,min,0),
cadenza_chord(2,a,min,7),
cadenza_chord(3,b,min,7),
cadenza_chord(4,e,min,0),
cadenza_notes(1,e,g,b,e),
cadenza_notes(2,a,c,e,g),
cadenza_notes(3,b,d,fis,a),
cadenza_notes(4,e,g,b,e)
```

`thiskey/2` contains the key in which the cadenza was created. The details of `cadenza/2`, `cadenza_chord/4` and `cadenza_notes/5` were introduced in the previous section. This output is passed to Python and used to create the actual sheet music by filling out a lilypond template and thus creating a complete lilypond file. With the actual notes of the first measure as in `cadenza_notes(1,e,g,b,e)`, a complete lilypond notation for the right hand's first measure would thus become:

```
r4 r8 b,( <e g>4\staccato) r4
```

Eventually, we create a complete lilypond file by applying the lilypond template to the output given by ASP resulting in sheet music as shown in Figure 2.

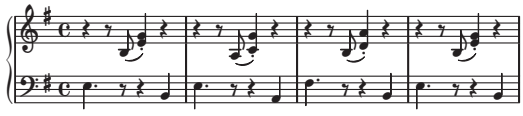

Figure 2: Final sheet music output created with lilypond

Optimization

The implementation shown so far has one weak point: with our current ASP program it takes unreasonably long to find solutions for cadenzas with a length of more than five chords. The cause for this is a relatively large grounding of the program due to its large number of rules for allowed chord progressions. In fact there are more than 600 of these particular rules. A common way to optimize the performance of an ASP program is the reduction of possible choices by abstraction. Therefore, the music theory behind the program was analyzed once more to discover a way to abstract chord progressions: instead of an extra rule for each and every valid chord progression, all chords were put in one of three groups to which the same rules for succeeding chords could be applied. The first group contains all triads in no or the first inversion, the second group all second inversions and the third group contains all seventh chords in all their inversions. These groups are represented by rules like `group/2` in the lines 1 to 3 of Listing 3 which describes group 1 as explained above. Lines 5 to 9 show the new version of `next_step/2` which we introduced in Listing 2. Now the rule describes valid progressions for groups of chords instead of a single specific chord. For a detailed explanation of these formulas you may refer to (Opolka 2012).

```
1 2 {group((T,0),    (T,          0));
2    group((T,0), (((T+1)\7)+1,  6))}2  :-
3         scale_step_inversion((T,0)).

5 next_step((T1,0), (T2,46)) :-
6   group((T1,0),_); group((T2,46),_);
7   1 { T2 =  T1   \7+1;
8       T2 = (T1+3)\7+1;
9       T2 = (T1+5)\7+1 }.
```

Listing 3: Abstract rules for chord progressions

To illustrate the differences in the implementation's performance before and after, Table 1 shows a comparison of resource-related statistical data for the problem instance of generating a 5 chord cadenza in C Major, which was run with gringo 4.4.0 and clasp 2.1.4 on an Intel(R) Celeron(R) CPU 1017U @ 1.60GHz with 4 GB RAM. Furthermore, we modified the experiment by increasing the number of chords to 6 which yielded no results for the naive encoding after running for 30 mins, whereas the abstract encoding was even capable to find a 50 chord cadenza within 5.5 seconds.

statistics		naive encoding	abstract encoding
Time	:	6.350s	3.004s
CPU Time	:	6.300s	2.970s
Choices	:	121	40
Conflicts	:	12	4
Atoms	:	15928	11120
Rules	:	36559	19628
Equivalences	:	33676	23098
Variables	:	8253	3001
Constraints	:	37463	13380

Table 1: Excerpt from clasp's statistics output when generating a 5 chord cadenza

Future Works and Conclusion

In this work we introduced a method to create musical pieces of many different genres on the basis of one chord progression. With minimal (and not neccessarily required) input through the user *chasp* autonomously generates music based on rules regarding harmony theory and genres.

Particularly, the declarative nature of our approach makes it convenient to add and change rules to describe the underlying concepts of composition. An obvious future enhancement for *chasp* lies, thus, in the addition of further genres through additional lilypond templates. It might be worth considering the possibility to convert part of the information used to create these templates into rules for ASP. Currently, the possibility to create a 4-voices homophonic choral is in development. Integrating additional types of chords and their specific rules in

our approach poses an increasing challenge. So does enhancing the current result by adding a melody to the accompaniments as well as rhythm for the choral output. Besides that, it may also be worth considering to add the possibility to reverse the current work flow and create an accompaniment to an already existing melody.

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Extracting Visual Information to Generate Sonic Art Installation and Performance

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Abstract

A procedure for generating sound using visual information is outlined that allows for a data artist to interpret a visual work of art using the parameters of an Inverse Discrete Fourier Transform. This paper discusses the historical progression of musicians responding to visual artists, as well as the relevance of parametric articulation and how it relates to the science of audio analysis. A process is outlined that discusses how such techniques can be used to generate sonic art installation and performance.

Keywords

Music Information Retrieval, Sonification, Audification, Inverse Discrete Fourier Transformation, Procedural Composition, Parametric Articulation

1. Introduction

There is a historical tradition of composers drawing inspiration from visual art. Modest Mussorgsky's "Pictures at an Exhibition" was famously based on the work of artist Viktor Hartmann. Mussorgsky planned to "draw in pictures" the watercolors and drawings of his recently deceased friend. [1] Morton Feldman emulated the work of the abstract expressionists, which inspired the composer to attempt a music that was "more direct, more immediate, more physical than anything that had existed heretofore." [2] These composers and others like them were working with the inspiration drawn from art, and in turn, exploring how to directly transform visual works into sound.

Our motivation was drawn from this tradition, as we utilized a more direct way to generate music and sound based on visual artworks. While the human element of translating visual art into sound may be partially obscured by procedural techniques, the technique outlined still allows for ample subjective control of the resulting sound.

Other applications do exist that can sonify digital images in real time. SonarX, while originally meant to aid blind users, has found applications for art and performance. [3] SonarX has mappings for pitch scale, timber, and other musical parameters. This paper does not wish to delegitimize this use, but instead offers a different way of sonification that uses only the IFFT itself.

This paper will first discuss the use of the Inverse Discrete Fourier Transform and its legitimacy as an interpretive tool. It will then outline the process of generating sound from images and discuss any technical or subjective considerations that arise. Finally, it will discuss the aesthetics of the discussed method, as well as the application of such a process for installation and performance.

2. Inverse Fast-Fourier Transform and Composition

A direct translation from image to sound is available using an Inverse Fast-Fourier Transform (IFFT), as sound can be generated directly from the visual data of various works of art. To explain the motivation behind using an IFFT on images, the process of using a Fast-Fourier Transform (FFT) on audio must first be touched upon.

It is common in the field of Music Information Retrieval to utilize a Fast-Fourier Transform to gain meaningful information from a piece of audio. Likewise, it is also common to display this information as an image that represents the frequency content of the audio, see Figure 1.

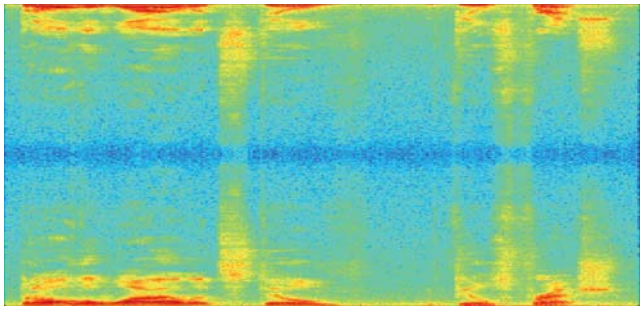

Figure 1. A spectrogram of a vocal excitation containing the words "All the while it still..".

The above image is a frequency domain representation of audio. A Fast-Fourier Transform is utilized to analyze several frames of the audio, which are then sequentially ordered in the image above.

Even though by using a reversal of this process it is possible to reconstruct the audio from the information that was extracted from the original audio, it is also possible to utilize this same reconstruction process starting with visual data that was not originally audio. This is done by using an Inverse Fast-Fourier Transform to turn images into sound instead of using the Fast-Fourier Transform to turn sound into images.

Our motivation behind this method of sound generation is based on the compelling visual similarities between spectrograms and the work of modernist painters. A natural curiosity arises to imagine how a Mark Rothko or a Jackson Pollack painting might sound. While a spectrogram is not the only way to visually represent sonic data, it is germane when comparing modernist paintings to a visual representation of sound.

This method of sound generation is a natural extension of the ones used by composers who have relied strictly on process and acoustics to guide their compositions. James Tenney would compose his music according to a process "for the sake of perceptual insight," as many of his compositions were guided by acoustics. [4] Directly translating works of art using an IFFT follows a similar procedural method and allows for a glimpse at the perceptual insights that Tenney sought.

In the music of Tenney, parametric focus and parametric articulation surpass pitch, as he stresses "the greater importance that has been given in 20th-century music to *all* the parameters of musical sound." [5] In this tradition, parametric articulation stands alongside other aspects of music such as pitch, texture, or rhythm. Following in Tenney's footsteps, conventions can be established to stay within the confines of a process when utilizing an IFFT, which are determined by the program in which the data artist utilizes an IFFT. Examples of such options are the amount of frame overlapping, the IFFT-size, or the type of windowing. These will be discussed more in depth further in the paper, but for now serve to elucidate how the technical parameters of the IFFT become the compositional and interpretive methods of the construction process.

After the IFFT procedure is complete, no post-processing of the resulting audio is done. The IFFT is sufficient for the data artist to who wishes to create a direct translation of a visual work. We posit that there is enough interpretive control given the parameters of the IDFT that there is no need for further interference. Since the procedure involved is the IDFT itself, any further modification of the of the audio would take focus off this procedure. The resulting audio could be characterized as raw and direct. Because our source material stems from modernism, it is natural to also draw from their ideals. Frank Stella famously described his work with the quote, "My painting is based on the fact that only what can be seen there is there.. What you see is what you see." [6] In our case, the audio is based on the fact that only what can be seen is heard, what you see is what you hear.

3. System Design

A digital scan or photograph of a painting exists in computer memory as a collection of pixels. Because of the manner in which audio is extracted from visual data, the size of the image must be taken into account. The resolution of the image corresponds with the amount of audio generated; a larger image will generate more audio content than a smaller image.

To put it in terms of an IFFT, the IFFT-size is linked with the amount of samples produced. An IFFT-size of 1024 will produce exactly 1024 samples, while an an IFFT-size of 256 will produce exactly 256 samples.

Considering that common IFFT sizes are generally powers of 2 (256, 512, 1024), it will most likely be necessary to resize the image. The data artist has a choice as to what resolution they wish to resize their image to, knowing that the pixel height they choose will determine the length of their composition.

Color Space Considerations

Because color images have three channels of data (red, green, and blue), further subjective choices are presented when deciding on how to interpret the red, blue, and green value of each pixel. Outlined are multiple methods for handling the three channels.

The first method consists of reducing the three color channels down to a single grayscale channel. The first and simplest choice is the luma equation, which is an average of the three channels with weighting coefficients, shown in Figure 2. [7]

$$Y = 0.21\mathrm{R} + 0.72\mathrm{G} + 0.07\mathrm{B}$$

Figure 2. Luma grayscale equation.

This is more perceptually accurate than simply averaging all three channels, but it is possible to be more perceptually accurate by converting to a CIE XYZ color space and using the "luminance channel as a grayscale representation of the original color image." [8] The luminance channel being Y in Figure 3.

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \frac{1}{0.17697} * \begin{bmatrix} 0.49 & 0.31 & 0.20 \\ 0.17697 & 0.81240 & 0.01063 \\ 0.00 & 0.01 & 0.99 \end{bmatrix} * \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

Figure 3 CIE Y grayscale equation. [9]

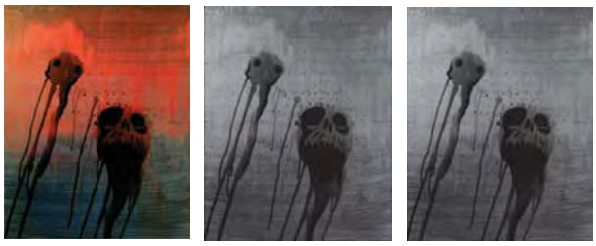

Figure 4. The luma grayscale conversion (middle) and CIE Y grayscale conversion (right) of Sean Ryan's "Soggy Spirits" (left), printed with permission.

Because the three channels have been reduced to one, we are also reducing the resulting number of audio channels to one. While a grayscale conversion loses the

original color data, necessary information about the image is retained and an accurate aural representation can be produced that is tied to human perception.

There is also the option to not convert to grayscale at all, and instead give each color channel its own audio channel. This route could be considered the most perceptually inaccurate of the three. This approach also grants the freedom to convert to any color space the data artist sees fit, and allows for various spatialization techniques because there are more audio channels resulting from the IFFT process.

Mapping Color Components

Since our RGB values range from 0 to 255 and the magnitudes of the IDFT algorithm range from 0.0 to 1.0, we have the option of mapping our color components linearly from the interval [0,255] to the interval [0.0, 1.0]. This preserves our grayscale conversion and is the most straightforward approach.

We have also explored using standardization instead of linear mapping, and found it useful in limiting the influence of outliers in our spectrum. The equation is shown in Figure 5.

$$x_n = \frac{x_n - \bar{x}}{\sigma} \qquad \sigma = \sqrt{\frac{1}{N-1}\sum_{n=1}^{N}(x_n - \bar{x})^2}$$

Figure 5. The standardization, which is the removal of the mean divided by the standard deviation.

If we standardize, we ensure that the spectrum is not skewed considerably by a datum that is significantly larger than the others. The major drawback of standardizing our data is that we begin to stray from our goal of creating a direct sonic portrayal of the visual work.

Inverse Fast-Fourier Transform

An IFFT usually reads from complex numbers, which consists of magnitude and phase. We will be mapping our color components to the magnitude input of the spectrum, and reading our image left-to-right with a left-bottom origin.

An option can be taken to create artificial phase values to feed into the IFFT alongside the visual data. This step is not entirely necessary, but remains a subjective decision for the data artist.

The hop size is the amount of overlap present between sequential IFFT frames. Hop sizes are generally a fraction of the IFFT-size, and are another consideration for the data artist in determining the length of a composition. For example, a hop size that is 50% of the IFFT-size will result in a composition that is half the length of a composition with a hop size of 100% (or no overlap).

Windowing is then performed to envelope the individual audio frames generated by the IFFT. A variety of envelopes were constructed based on the various window functions used in an FFT. Subjectively, we found the Parzen window to sound the best when applied to the audio generated from the IFFT. The Hann, Blackman-Harris, and Exponential window functions also performed well. The equation for the Parzen window is provided in Figure 6.

$$w(n) = \begin{cases} 1 - 6\left(\frac{|n|}{N/2}\right)^2 + 6\left(\frac{|n|}{N/2}\right)^3 & n \le |n| \le (N-1)/4 \\ 2\left(1 - \frac{|n|}{N/2}\right)^3 & (N-1)/4 \le |n| \le (N-1)/2 \end{cases}$$

Figure 6. The equation for a Parzen window, which is to be used on the audio frames extracted from the IFFT. [10]

4. Aesthetics and Practice

The resulting audio is extremely raw, but a significant amount of information is heard. Each "row" of the painting corresponds to a center frequency bin of the IFFT, which provides sound throughout the entire audible spectrum (granted program's sampling rate is set to 44100 or above).

Because the source material is treated with a limited amount of interpretation, the data artist has created a system that allows the painting itself to be heard instead of only hearing the artist's interpretation of the painting. Thus the meaning found in the sonification is shared between the artist and the painting. This point is salient, considering that sonification is "concerned with the creation of representations of data that facilitate inference and meaning making." [11]

Both installation and performance are available to the data artist. Off-line computation is done for installation work, with the audio being presented alongside a visual projection of the artwork used for analysis. Multiple works of the same visual artist are typically presented by the musician, ensuring a thematic continuity. The paintings of Mark Rothko have been a favorite for their striking similarity to spectrograms. The technical parameters of the audio are altered per piece, and tailored to each image. These parameters can be fine-tuned to highlight the aural differences that arise from the visual differences between these visual works, and more importantly, can also be seen as an artist's interpretation of the work. The Python programming language is used for off-line sonification, with the data manipulation possible using the Numpy and Scipy modules.

Real-time performance by an artist is also available, the variation of the technical parameters becoming paramount to the performance. This allows the artist to respond to the sonification in real-time. Performance is made possible by the music programming language, ChucK. [12] A real-time IFFT is utilized, and dynamic control of its parameters are available to the performer. An excerpt of this code is shown in Figure 7.

```
fun complex[] calcWindow(float frame[], float mag, float
phase)
{
   complex X[frame.size()];

   // loop for creating a fram
   for (int i; i < bins; i++) {
        // phase incrementing
        (ph_inc[i] + ph[i]) % tau => ph[i];
        polar temp;

        // color components being assigned
        Math.fabs(frame[i]) * mag => temp.mag;

        // artificial phase being assigned
        ph[i] * phase => temp.phase;

        // result to be ChucKed to the
        // IFFT.transform
        temp $ complex => X[i];
   }

   return X;
}

fun float[] playWindow(complex X[], dur window) {
   0 => X[0];
   // inverse fft that reads the window
   ifft.transform(X);

   // dividing to envelope length
   window/2.0 => env;

   // sets attack and release of
   // the window function envelope
   win.setParzen();
   win.attack(env);
   win.release(env);

   win.keyOn();
   env => now;
   win.keyOff();
   env => now;
}
```

Figure 7. ChucK code including two functions. calcWindow() implements artificial phase by phase-incrementing a series a sine waves corresponding to the frequency bin it belongs to. playWindow() sets the windowing function type (Parzen in this case) and plays the inputted frame of visual data.

An understanding of the various IFFT parameters is necessary for performance, with parametric articulation allowing for expressive control over the general rhythm and timbre of the piece. A reaction to the paintings by the data artist is heard in real time, allowing both a direct transformation of the visual data into audio, as well as a raw interpretation of the painting by the performer.

This interpretation is heard in how the performer allows the IFFT to translate the data. A Triangular window could be used instead of a Parzen window in if the performer requires a rougher sound, or the sound can be made sparse by decreasing the rate at which the data is read.

The overall process allows the data artist individual expression while still abiding to a principled process. The manner of translation and parametric articulation continues upon a compositional tradition, and allows for a direct yet interpretive translation of visual art to sonic art.

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Manifesto for a Musebot Ensemble: A platform for live interactive performance between multiple autonomous musical agents

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Abstract

In this paper we draw on previous research in musical metacreation (MuMe) to propose that novel creative forms are needed to propel innovation in autonomous creative musical agents. We propose the "musebot", and the "musebot ensemble", as one such novel form that we argue will provide new opportunities for artistic practitioners working in the MuMe field to better collaborate, evaluate work, and make meaningful contributions both creatively and technically. We give details of our specification and designs for the musebot ensemble project.

Keywords

Generative music, autonomous agents, performance, computer music, musical metacreation, live algorithms.

Introduction

Musical metacreation (MuMe)[1] is an emerging term describing the body of research concerned with the automation of any or all aspects of musical creativity. It looks to bring together and build upon existing academic fields such as algorithmic composition [1], generative music [2], machine musicianship [3] and live algorithms [4]. The wider field of metacreation [5] involves using tools and techniques from artificial intelligence, artificial life, and machine learning, themselves often inspired by cognitive and life sciences. MuMe suggests exciting new opportunities for creative music making: discovery and exploration of novel musical styles and content, collaboration between human performers and creative software partners, and design of systems in gaming, entertainment and other experiences that dynamically generate or modify music.

In this paper, we begin by making the case that there is a need to establish new contexts (in effect, new 'genres') that allow incremental innovation in musical metacreation. To this effect, we present our recent efforts to design and build the infrastructure necessary to bring together community-created software agents in multi-agent performances. We frame the current proposal in its social and technical context, make a case for the value of such a project and the opportunities it will bring, discuss the challenges and questions faced, and present the design and specification of our multi-agent system, along with a set of tools and example agents that we have created.

[1] http://www.metacreation.net/mume/

Objectives and 'Genres' of Musical Metacreation

MuMe straddles and sometimes integrates scientific and artistic objectives. Some MuMe tasks have identifiable measures of success — either because they are fully objective [6], or can be clearly measured by expert users [7]. Others have clear usability goals in contexts where the aim is to support creativity [8]. Yet others face problems of evaluation because of their creatively open-ended nature [9]. As an example, the established practice of creating autonomous software agents for free improvised performance [10] usually involves idiosyncratic, non-idiomatic systems, created by artist-programmers [11, 12]. A recent paper by the authors [13] discussed how curators of MuMe concerts face a challenge in balancing aesthetic and technical factors in their evaluation of submitted works. The paper also showed how evaluating the degree of autonomy in systems is non-trivial and involves detailed discussion and analysis, including subjective factors. The paper identified the gradual emergence of MuMe specific genres — i.e., sets of aesthetic and social conventions — within which meaningful questions of relevance to MuMe research could be further explored. We posited that through the exploration of experimental MuMe genres we could create novel but clear creative and technical challenges against which MuMe practitioners could measure progress.

One potential MuMe 'genre' that we considered involves spontaneous performance by autonomous musical agents interacting with one-another in a software-only ensemble, created collaboratively by multiple practitioners. This concept was touted in discussions amongst MuMe practitioners, and while there are isolated instances of MuMe software agents being set up to play with other MuMe software agents, this has never been seriously developed as a collaborative project. The ongoing growth of a community of practice around generative music systems leads us to believe that enabling multi-agent performances will support new forms of innovation in MuMe research

and open up exciting new interactive and creative possibilities.

Previous Work

Such multi-agent "metacreative" musical performance encounters issues of network music, new models of electroacoustic ensemble performance, creative musical agents, and autonomous machine performance, all of which are well-established areas of research. In this article, we offer brief overviews of each of these research topics, in order to frame this new research area.

Network Music

With the advent of microcomputers such as the KIM-1 [14] in the 1970s, and their adoption for use by electroacoustic music composer-performers, the potential to connect them through available serial networks in concert was explored by the League of Automatic Music Composers [15]. This ensemble later grew into "The Hub", which specialized in network computer music performance [16]. As computer networks became more ubiquitous in the 2000s, their use in music similarly expanded. Weinberg [17] gives a history of network music up to 2002, and Renaud *et al.* provide a more recent review [18]. Open Sound Control (OSC) [19] has emerged as a simple and widely used format for network communication, with implementations in all commonly used computer music environments. A number of developers, particularly those working in laptop ensembles [20], have provided tools to ease network communication in the context of music collaboration (e.g., [21], [22]) and these are now emerging in commercial contexts. Widely used network-audio tools such as JackTrip [23] are evidence of the growth in practice of telematic music performance via audio communication. With the browser emerging as a veritable computer music platform under the WebAudio standard [24], network music is destined to become increasingly fluid [25].

Creative network music practitioners such as laptop orchestra organisers have, through their work, thoroughly explored those musical aesthetic considerations that may contribute to an idea of what we might expect from a multi-agent metacreative performance.

Laptop Performance

The move from analogue to digital technologies in the 1990s provided composers with many new tools. For many, the computer replaced the traditional analogue studio as a music production facility. The laptop became a vehicle of solo music performance [26] and live generative music [27], and afforded new models for digital orchestras [28]. The popularity of the laptop orchestra has generated many new compositional models [29, 30, 31] and tools [32]. Laptop performance introduces many possible forms of automated control of realtime music, such as timing quantised transitions, executing envelopes, choosing random numbers and more responsive behaviours such as pitch tracking. These are typically seen as too weak to be described as 'autonomous' behaviours, although any strict measure of autonomy is elusive. Importantly, the growing power, programmability and sheer diversity of laptop performance styles and techniques is heralding an explosion in both generative and collaborative music techniques, available to a growing community of electronic music practitioners, including artist programmers [33]. A number of musical styles now routinely involve generative processes in their production and performance [34].

Creative Musical Agents and Autonomous Machine Performance

The potential for the application of both agent-based computing [35] and autonomous machine performance to live musical interaction has been examined in detail [36, 37, 38, 39, 40]. Bown *et al.* [41] review the history and potential for autonomous machine performance with particular attention to how artists conceptualise and work with autonomous behaviours in their practice. Live MuMe work has been largely focused in either improvised genres or classical music performance where there is generally some attempt at imitating or creating a software substitute for human performance, for which there is a rich body of literature. We are also beginning to see subtle forms of musical generativity being employed in an increasing diversity of application domains, such as in the modification of everyday experiences[2], and exotic applications such as "food opera" [42]. Commercial generative music products are emerging [43], and an increasing number of artists are moving from static recordings to forms of music distribution that may enable interactivity or generativity [44].

The "Musebot Ensemble" Proposition

A *musebot* is here defined as a "piece of software that *autonomously creates* music collaboratively with other musebots". Our project is concerned with putting together musebot ensembles, consisting of community-created musebots, and setting them up as ongoing autonomous musical installations.

The creation of intelligent music performance software has been predominantly associated with simulating human behaviour (e.g., [45]). However, a parallel strand of research has shed the human reference point to look more constructively at how software agents can be used to autonomously perform or create music. Regardless of whether they actually simulate human approaches to performing music [46], such approaches are more general issues of

[2] e.g., http://reactifymusic.com/portfolio/vw-underworld-play-the-road/

software performativity and agency in creative contexts [47]. The concept of a "musebot ensemble" is couched in this view. i.e., it can be understood as a new musical form which does not necessarily take its precedent from a human ensemble. We imagine that a musebot ensemble might be most naturally found in the chill-out room of a club, where attentive awareness of any performer would be minimised. We follow an open-source philosophy, allowing for anyone who is interested to offer contributions to the design of our framework, to fork the project, and to adapt it to their needs. We expect the framework to take shape through this process. As for whether individual musebot contributions are open-source is up to their makers, but we encourage it.

Our initial steps in this process include coming up how musebots should be made and controlled so that combining them in musebot ensembles is feasible, and has predictable results for musebot makers and musebot ensemble organisers. Musebots needn't necessarily exhibit high levels of creative autonomy, although this is one of the things we hope and expect they will do. Instead, the current focus is on enabling agents to work together, complement each other, and contributes to collective creative outcomes, in other words, good music.

This defines a technological challenge that, although intuitive and easy to state, hasn't to our knowledge been successfully set out before in a way that can be worked on collaboratively. For example, Blackwell and Young provided a framework for practitioners to work collaboratively on modular tools to create live algorithms [48, 49], but little community consensus was established for what interfaces should exist between modules, nor was there a suitably compelling common framework under which practitioners could agree to work. In our case, the modules correspond clearly to the instrumentation in a piece of music, and the context is more amenable to individuals working in their preferred development environment.

In order for musebots to make music together, some basic conditions need to be established: most obviously the agents must be able to listen to each other and respond accordingly. However, since we do not limit musebot interaction to human modes of interaction, we do not require that they communicate with each other only via human senses; digital symbolic communication (i.e., network messaging) has the potential to provide much more useful information about what musebots are doing, how they are internally representing musical information, or what they are planning to do. Devising a specification for musebot communication is a key strand of this research and will be discussed below. Following the community-driven approach that we advocate, we remain open to the myriad ways in which parties might choose to structure musebot communication, imposing only a minimal set of strict requirements, and offering a number of optional, largely utilitarian concepts for structuring interaction.

Motivation and Inspiration

The initial practical motivation for establishing a musebot ensemble was as a way to expand the range of genres presented at MuMe musical events. To date, our own MuMe events have focused heavily on free improvised duets between human instrumental musicians and software agents. This format has been widely explored by a large number of practitioners[3]. However, continuing with this established tradition might run the risk of stylistically pigeonholing MuMe activity.

Three possible reasons for the success of the free improvised duets genre are:

- It is non-idiomatic (insofar as it is possible to be so). More accurately, this is an area where minimal adherence to a given set of rules is central[4], as compared to more prescribed improvisation contexts such as be-bop or blues. There is a large free improvised music community for whom there is a familiar and relatively free set of expectations for engagement. This is also important as it gives the creator freedom to work with digitally created sound and gesture that does not resemble existing human musical instruments, as simulating human instrumental performance is challenging. Arguably, it is also simply easier to model: Our perception of "poor melody", "awkward harmony", and "stiff rhythms" have been set through hundreds of years of common practice music;
- One musician playing with one software agent means that there is a clear and focused process of interaction between the two elements. This can be clearly observed in most cases (except, for example, when the system samples the performer, or the performer is playing electronic music);
- The creative focus on the system is on real-time interaction. This draws greater attention to the participatory interactive nature of the agent, rather than as a creative intelligence, which lessens the burden on the system designer to create a system capable of producing diverse and novel outputs.

For the present project, the genre we hope to target is electronic dance music (EDM). Because it is fully or predominantly electronic in its production, and thus avoids issues of expressive human performance [50], we feel that it offers great opportunities for MuMe practice; furthermore, metacreative research into this genre has already been undertaken [51, 52]. In 2013, the Algorave movement, based primarily around the musical practice of live coding [53], became well known. The 2013 MuMe Algorave (Sydney, 2013) showcased algorithmically composed electronic dance music as well as live coding performances. In this context, however, the presentation of algorithmi-

[3] for example, see http://www.metacreation.net/mumewe2013/index.php?pg=program for the program of a MuMe Weekend.

[4] although it may be far from *inclusive*; it is still a genre with norms and expectations.

cally composed pieces was problematic given the lack of a live performer, as well as, related to this, the awareness that there was no need for the music to be produced in realtime.

Reflecting on this event, it was agreed that it would be more engaging to present the work in realtime, and in order to do so in a meaningful way, agents needed to be placed in a context where they were responding to something. Responding to the audience was considered, as was responding to a data source, but this was deemed too gimmicky and too far removed from the immediate challenges of creating powerful, compelling musical metacreative systems. Thus it was agreed that performances should be collaborative, with various agents contributing different elements of a piece of music. This context therefore embodies the common creative musical challenge of getting elements to work together, reconceived as a collective metacreative task. Thus although the metaphor of a *jam* comes to mind in describing this interactive scenario, we prefer to imagine our agents acting more like the separate tracks in a carefully crafted musical composition.

We summarise the above motivating factors, adding a number of others below:

- Currently, collaborative music performance using agents is limited to human-computer scenarios. These present a certain subset of challenges, whereas computer-computer collaborative scenarios would avoid some of these whilst presenting others. Most existing live MuMe activity is limited to improvised genres such as jazz and blues, free improvisation, or scored genres such as classical music where the focus is on score following and expressive score interpretation. Endemically digital genres such as electronic dance music lend themselves well to musical metacreation, but currently offer no collaborative creation opportunities for MuMe practitioners in either live or non-live contexts;
- It allows us to build an infrastructure, which can be useful for commercial MuMe applications. Specifically, it provides a modular solution for the metacreative workstations of the future;
- It provides an easy way into MuMe methods and technologies, as musebots can take the form of the simplest generative units, whereas at present the creation of a MuMe agent is an unwieldy and poorly bounded task. Musebot ensembles can be educational, and could be used as the brief for an undergraduate course on generative music, or a workshop for one of the common computer music platforms, such as SuperCollider[5] or Max-MSP[6]. Musebots and musebot ensembles potentially could be experienced and interacted with (e.g., remixed) by non-programmers using end-user interfaces;
- It provides a platform for peer-review of systems and community evaluation of the resulting musical outputs, as well as stimulating sharing of code. We believe this will help clarify and provide a shared platform for reaching technical research goals in music AI, in a way that scientific communities such as the music information retrieval (MIR) community have managed through MIREX: the Music Information Retrieval Evaluation eXchange [54]. As MIREX illustrates, research progress can depend on articulating problems and building research infrastructure. An interesting additional direction is that musebots could be run in offline simulations to examine their dynamic properties, satisfying the proposal of Bown and Martin [55];
- It encourages and supports the creation of work in a publically distributed form that may be of immediate use as software tools for other artists;
- It outlines a new creative domain, which explores new music and music technology possibilities. The opportunities for remixing, mashing up, branching, coordinating, reappropriating and recontextualising musebots are all rich and open-ended areas of potential innovation;
- It defines a clear unit for software development. Musebots may be used as modular components in other contexts besides musebot ensembles. It modularises and distributes the task of automating composition, since the task of formalising aspects of musical composition in simple generative modules – such as a dubstep bassline generator, or a flamenco *cajón* player – is regularly and easily achieved. This also lowers the bar for entry.

System Design

Technical and Aesthetic Design Considerations

How should an ensemble of musebots be coordinated? While ecosystemic or other bottom-up methods are conceivable [56], the use of a conductor agent that initiates performance and oversees general musical parameters such as tempo, time signature, and overall density is a more pragmatic solution: Eigenfeldt [57] offers one such implementation. The use of a conductor agent does not negate the potential for agents to communicate amongst themselves directly: the amount of attention paid to the conductor is open to the individual agents, although we do strictly require that agents respond to on/off and volume commands. We therefore nominate the "musebot conductor" (MC) as a central tool and guiding design principle for musebot ensembles.

Another immediate concern is how individual agents assume roles. Again, while the potential for self-organization is one option, issues of practicality suggest that pre-defined musical parts, or even collaboratively devised musebot ensembles, are more feasible. One possibility is that the conductor "build" an ensemble, by first assigning beat-generation to one musebot, then basslines to another, then harmonic aspects to a third, until a given set of musical roles are filled. Another possibility is that a pre-

[5] http://supercollider.sourceforge.net/
[6] https://cycling74.com/max7/

built ensemble may be submitted in which these roles are already defined. More generally, these are decisions that each organiser of a musebot ensemble event might make differently. In order to cover all scenarios, we use a properties file, readable by both machines and humans that describe the capabilities and style of the individual musebot.

Clearly, potential designers of musebots will create software agents in unique ways. We assume that most designers will have some experience with metacreative systems, and an awareness of an important difference between human and virtual performers [58]; whereas human improvisers will expect other performers to be keen listeners that adapt accordingly, this is, in fact, extremely difficult to replicate in virtual agents. Instead, higher-level goals of emergence, conversation, and journey [59] are objectives that we may only hope to achieve incrementally [60]. For example, instead of designing a bass player that performs patterns for a specific drum pattern (a standard method of composing EDM), a more useful method would be to design a bass agent that can adapt to different drum beats (as provided by a separate beat agent), as well as a changing harmonic patterns provided by another agent. This is a good example of how we think musebot ensembles will drive innovation in the underlying principles of musical intelligence: for example, in establishing the relationship between a beat and a bassline, what simple pattern representations (as opposed to the musical *surface*) might best convey the musical sense.

The Musebot Agent Specification

An official musebot agent specification is maintained as a collaborative document, which can be commented on by anyone, and edited by the musebot team. An accompanying Github page maintains a repository of source samples and examples for different common languages and platforms.

A musebot ensemble consists of one MC and any number of musebots, running on the same machine or multiple machines over a local area network. As discussed above, the MC is responsible for high-level control of connected musebot agents in the network. The MC maintains control of the overall clock tempo of the ensemble performance and manages the temporal arrangement of agent performances (via volume mixing, on/off commands). The MC also assists connected agents inter-Musebot communication by continuously broadcasting a list of all connected agents to the network.

As a minimum requirement, a musebot agent must reveal itself to the MC upon connection to the network by providing a unique client ID and a periodic heartbeat, and respond to volume and shutdown commands received from the MC. All other communication is optional, although responding to the MC's timing messages is strongly recommended. Musebots may also broadcast any messages they want to the network, providing they maintain their unique name space allocated for inter-Musebot communication.

Our musebot specification states that a musebot should also "respond in some way to its environment", which may include any OSC messages as well as the audio stream that is provided (a cumulative stereo mix of all musebot agents actively performing). It should also not require any human intervention in its operation. Beyond these strict conformity requirements, the qualities that make a good musebot will emerge as the project continues.

An Example

For teaching, development and testing purposes, a number of elementary example musebots are provided along with the musebot agent specification, with source code and supporting libraries, developed using a range of the most popular creative computing environments (MaxMSP, PD, SuperCollider, Processing). Musebot creators can hack these examples to make their own agents, and we plan for additional creative computing environments to be catered for in time.

The example agents can be downloaded along with a draft MC application, and the ensemble can be run (in this initial case it is up to the user to manually turn on and off the agents). As the project progresses, this example will be joined by a growing population of musebot agents, and new versions of the MC. Instructions are provided for how a network of individual computers can be configured to run the ensemble in a distributed manner over a local network.

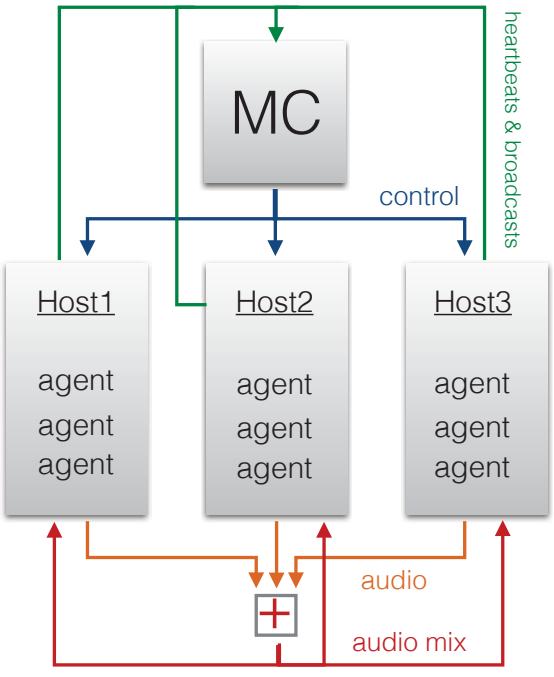

Figure 1: Interactions between agents and the MC.

The First Year of Musebot Ensembles

The musebot specification and call for contributions was published at the end of 2014 and a series of musebot ensemble events have been organised to occur throughout 2015. Although we would strive to provide existing musebot agents to designers in the future, for use in "rehearsing" their own agents, the premiere performance will most likely involve agents performing as an ensemble for the first time (if the ensemble has not been designed as a whole). In this case, it is envisaged that through consultation with the community in the open call process, a series of musebots will be designed that will compliment each other musically. This initial collection of musebots will provide the basis for future iterations of musebot ensembles, given the modular potential of this community-based approach. The premiere performance for the musebot platform will occur at the International Conference on Computational Creativity at Park City, Utah, in June 2015.

Managing Quality Control

An open call for works is all very well, but how should quality control be managed? The first thing to note is that in the spirit of openness and transparency, all submissions can be made public. Since the musebot conductor software is also publically available, anyone can draw on the entire public musebot repository to put together his or her own musebot ensemble.

An additional point to this is that, as with our more detailed example, we expect collaborations to form within the community, such that certain agents are designed with other specific agents in mind. Thus, the challenge of making sure agents actually work together is somewhat alleviated by the ongoing process of listening and improving how the agents respond to each other. We envisage that this emergent and collaborative process of design will engender a community-based approach to musical metacreation, based around shared code, open dialogue and modularised musical composition. In this context, over time the practice of musebot design could be expected to develop its own set of accepted methods and practices, with contributing designers building upon and learning from the creations of others in the community, much like other collaborative artistic endeavours.

Conclusion

This paper provides the thinking behind creating a community-driven musebot ensemble, and draws on the literature from a diverse range of computer music research to suggest a best-practice approach to creating the required infrastructure for this project. We refer readers to the ongoing progress of the project via the musebot specification[7] and software repository[8].

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Author Biographies

Ollie Bown is a researcher, programmer and electronic music maker. His research is concerned with creative computing (the tools and programming languages that enable the production of creative outputs), computational creativity (the modeling of creative processes using software) and the social role and evolutionary origins of music.
He creates and performs music as one half of the duo Icarus, and performs regularly as a laptop improviser in electronic and electroacoustic ensembles. Icarus' 2012 album Fake Fish Distribution was released in 1000 unique digital variations, presenting a radical conception of ownership and uniqueness in digital media artefacts. In his research role he was the local co-chair of the 2013 International Conference on Computational Creativity and of the Musical Metacreation Workshop and events series.

Benjamin Carey is a Sydney-based saxophonist, composer and technologist with interests in contemporary classical, interactive, improvised and electro-acoustic music. His recent research and practice incorporates equal parts improvisation, composition and the development of musical software systems. His work has been featured at numerous international festivals and conferences including the dBâle festival of electronic music (Basel), IRCAM Live @ La Gaité Lyrique (Paris), Vivid Live (Sydney), the Australasian Computer Music Conference (Brisbane/Auckland), the Conference on New Interfaces for Musical Expression (Ann Arbor/London), and the International Computer Music Conference (Perth).

Arne Eigenfeldt is a composer of live electroacoustic music, and a researcher into intelligent generative music systems. His music has been performed around the world, and his collaborations range from Persian Tar masters to contemporary dance companies to musical robots. He is a co-director of Metacreation Lab at Simon Fraser University, where he is a Professor of Music and Technology.

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Musical Structure Imitation using Segmentation, and k-Nearest Neighbors (kNN)

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Abstract

Segmenting music is important in academic and commercial settings. Imitating musical structure requires interpretation and generalization of discovered structure. The program shown here is a work in progress that demonstrates an approach to structure imitation using a segmentation algorithm with a look back algorithm based on a probabilistic variant of kNN. A monophonic piece of music is segmented, then kNN is used to generate the structure of a new piece. This work shows that although the problem of structure generation is complex, it is not clear that a solution must be similarly complex.

Keywords

algorithmic music, machine learning, style imitation, segmentation, k nearest neighbors, midi, self similarity, structure, form

Introduction

Discovering the structure of a piece of music is important for academics and commercial music outlets. There are a variety of approaches to the task of melodic segmentation. [1] Still, the structure of music is difficult to quantify because it is a combination of artistic and cultural preferences. It is even more difficult to interpret the structure of a piece and use that information in a generative music algorithm. This requires not only segmenting a piece, but understanding how to create similar segments that can be reconfigured creatively while conforming to the style of the original.

The task of style imitation has been explored by many authors and composers. [2, 3] The work presented here deals with the specific task of structure imitation. This paper presents the prototype of a system for structure imitation using simple machine learning techniques. The data extracted from this preliminary work reveals some interesting insights into the task of structure imitation.

The work presented here is in progress. It does not deal with musical form, which I differentiate from musical structure. Form requires a beginning and an ending while structure only indicates non-random change over time. This work also employs an ad-hoc segmentation technique using a self-similarity matrix. Other segmentation techniques will be inserted into this algorithm as the project continues.

There is a lot of work on melody segmentation. [4] On the specific task of imitating musical structure algorithmically, many composers have published strategies they have used in their own algorithmic pieces. [5, 6]

This work was motivated by a search for a simple algorithm that generates satisfying musical structure in my own algorithmic pieces. In previous experiments, I found that structure could be generated from simple systems. [7] One of the simplest structural algorithms is the look back algorithm. The look back algorithm generates musical structure by repeated previously generated material and optionally transforming it. In this work, I wanted to see if I could implement a probabilistic look back algorithm on a segmented melody to imitate the structure in that melody.

Procedure

This program works in two stages, analysis and generation. In the first stage, the software analyzes a monophonic piece of music in order to build a model of the structure of the piece. In the second stage, that model is used to generate a new piece of music with similar structure.

The analysis stage builds a three tiered model. Each tier contains data at a different structural level. In the lowest tier, each note is an instance containing features such as pitch, start tick in the source midi file, and duration in beats. The next level is the section model. In the section tier, each discovered section is an instance containing features such as note count, mean pitch, and duration in beats. By definition the section tier does not contain a particular type of section. The sections aren't tied to phrases, or sections that a human analyst might discover. The sections are simply designed to hold whatever sections are discovered by the segmenter. The top tier contains pieces, which contain sections. In the current version of the software, only one piece instance is used, but future versions may employ multiple pieces. The piece instance contains features such as pitch mean, pitch mode, duration mean, and duration mode, although these features are not used in the current program.

A significant challenge in the analysis phase is the segmentation of the source midi file. There are many ways to segment a piece of music. [8] The approach used here employs a self-similarity matrix. This technique is loosely based on other self-similarity approaches, but it has been experimentally modified for the current project. [9]

The segmentation algorithm begins by generating a self-similarity matrix based on the distance between notes. The distance between every note is calculated using four features: midi pitch number, pitch name, duration, and start position in measure. In this distance function, one is added to the distance for each non-matching feature. The distance matrix is then normalized and inverted so that zero represents totally dissimilar notes, while one represents maximum similarity. An edge detection algorithm and threshold then reveal the notes where similar sections most commonly begin and end. The threshold is automatically tuned to generate sections that average at least two notes in length.

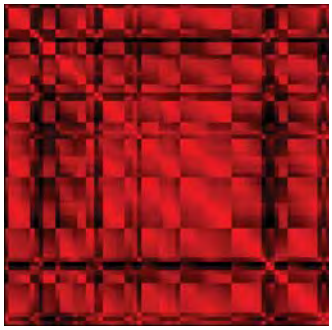

Figure 1. A self-similarity matrix of a short piece of music

The analysis stage ends by calculating the mean, median, mode, and standard deviation on several properties of each section, including the pitch, duration, number of notes, duration, and start position in measure. These are used in the generation section to accept or reject generated sections.

The generation stage relies on a probabilistic version of the k-nearest neighbors (kNN) algorithm that is used for prediction. The kNN algorithm is typically used for classification or regression. In this program, kNN is used to generate new music data. The k nearest neighbors are discovered, then one is chosen randomly. In the trials shown here, k was set to three for both notes and sections. The next instance that is added to the output is whatever comes after the selected neighbor. Random selection is necessary in a procedural content program. If the program always selected the nearest neighbor then it would always generate very similar, repetitive music. The randomness allows it to pick between several options that occurred in the training data.

The probabilistic kNN algorithm is used in two ways. First it is used to pick a model section that determines the features of the section that should come next in the generated piece. Then the section randomly becomes either a look back section, which repeats earlier material, or it is filled with notes picked using the probabilistic kNN algorithm on notes.

Results

The program is not yet optimized to generate the quantity of data necessary to judge its performance in general. In this paper I will simply list the results of small scale test runs. These results may not be predictive of future performance, but the data does shed light on the problem of structure imitation.

In each of these tests I generated three pieces. The piece in column A was generated by randomly selecting notes from the input file. The piece in column B was generated by using the probabilistic kNN algorithm on notes alone, with no attempt to model structure. The piece in column C was generated using the method detailed above.

Each piece was then segmented using the self-similarity algorithm detailed previously. This algorithm only sees the output of the other programs, so it won't necessarily discover the same sections as those that were generated. Then each section was analyzed based on note count, duration, and section start position. This data is intended to show the similarity between the segments in the input music and the segments in the generated music. It's difficult to quantify the structural similarity between two pieces of music. A better method might include human ratings of structural similarity, but that is beyond the means of this research.

In the tables shown here, I chose to look at the results generated from three pieces. The first table shows the results from a run on the first movement of Bach's *Partita for Flute 1*. The second table shows the results from a run on the melody of a folk song called The *Wonderful Crocodile*. The third table shows the results from a run on a short piece of my own composition called *Short Piece 01*. The Bach Partita has very regular phrases that respect measure boundaries. The folk song has slighly less regular phrases. My own piece only rarely bounds phrases based on measures.

First Movement from Partita for Flute 1 by J.S. Bach				
	Source	**A**	**B**	**C**
notes in piece	1024	1024	1024	1047
sections discovered	66	66	64	65
notes per section				
mean	15.5	15.42	15.92	15.98
mode	16	16	16	16
std deviation	2.22	2.12	1.02	0.12
duration (12ths of a beat)				
mean	46.87	47.27	48.0	47.98
mode	48	48	48	48
std deviation	4.87	4.30	4.24	0.12
start position in measure (12ths of a beat)				
mode	0	0	0	0

Table 1. Sections discovered in music based on Partita 1 for Flute by J. S. Bach

The Wonderful Crocodile				
	Source	**A**	**B**	**C**
notes in piece	92	92	92	80
sections discovered	10	10	10	10
notes per section				
mean	9.1	6.6	8.9	6.9
mode	6	3	7	6
std deviation	5.24	3.38	3.75	2.21
duration (12ths of a beat)				
mean	120.0	96.0	120.0	96.0
mode	96	54	96	96
std deviation	53.66	38.23	45.61	30.35
start position in measure (12ths of a beat)				
mode	0	36	0	0

Table 2. Sections discovered in music based on the folk song The Wonderful Crocodile

Short Piece 01 by Evan X. Merz				
	Source	**A**	**B**	**C**
notes in piece	76	76	76	90
sections discovered	13	13	14	17
notes per section				
mean	5.69	5.61	5.28	5.11
mode	2	4	2	2
std deviation	3.53	2.78	3.21	3.21
duration (12ths of a beat)				
mean	48.0	45.0	41.64	42.58
mode	48	32	48	48
std deviation	21.04	24.70	20.55	19.24
start position in measure (12ths of a beat)				
mode	0	1	0	0

Table 3. Sections discovered in music based on Short Piece 01 by Evan X. Merz

Discussion

These data are inconclusive, but they elucidate the problem of generating musical structure in several interesting ways.

In each test, the random music program generated the most chaotic structure, the approach outlined here generated the most regular structure, and the kNN on notes only was somewhere in the middle. This is shown by the standard deviation of the notes per section and duration in twelfths of a beat. The regularity generated by the program outlined here does not necessarily represent the structure that occurs in the source piece, as the discovered sections in the Bach piece are not as regular as the generated ones. This is partially a result of using a note's position in the measure as a feature in the segmentation algorithm.

In the other pieces, this approach clearly generated structure closer to that of the source file than was generated by randomly selecting pitches from the source file. It is not clear that this approach imitated the structure of the source piece any better than the system that generated music using probabilistic kNN on notes alone. This is interesting because it implies that the structure of a piece of music emerges from the notes. This may be obvious from the perspective of a musicologist, but it means that generating musical structure does not absolutely require an approach that models musical structure.

The data tables do not reveal anything about the qualitative experience of listening to the music that was generated with no attempt to model structure versus listening to the music generated by a system that does model structure. The following two images show the structure discovered in Short Piece 01 versus the structure discovered in a piece that was generated by imitating the structure in that piece. The top of each image is the start of the piece. Each line represents the start of a discovered section. These images show the relationship between the internal structure of each piece, with clusters of short sections interspersed with groups of longer sections.

Figure 2. Sections discovered in Short Piece 01

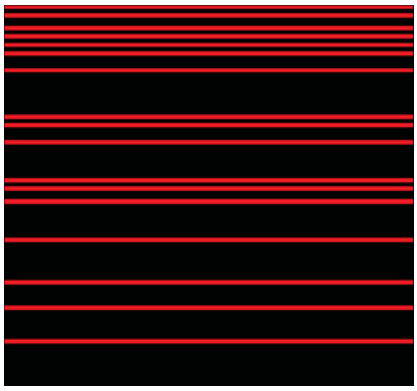

Figure 3. Sections generated using segmentation and kNN

This program is still very limited, and as the data show, it will need significant changes to actually emulate the structure or form of a piece of music. This program does not model beginnings or endings, nor does it have any representation of the large scale flow of sections throughout a piece. It relies on a single piece to infer musical structure, which may be made easier by the use of many pieces. Future versions of this program will compare the results of imitating musical structure using various segmentation algorithms.

Conclusion

The program shown here is a work in progress that uses a machine learning approach to model musical structure. This work shows that although the problem of structure generation is complex, it is not clear that a solution must be similarly complex. Basic structure can be imitated using the look back algorithm and kNN. This work also shows that to some still uncertain degree musical structure can emerge from a model of the note level alone. More work is necessary to determine the general effectiveness of these algorithms, and to disambiguate the idea of musical structure as it relates to musical metacreation.

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Author Biography

Evan X. Merz earned a Master's Degree in electronic music from Northern Illinois University in 2010. He earned a doctorate in algorithmic composition from The University of California at Santa Cruz in 2013. Currently he teaches computer science at San Jose State University.

[Session 32]

Brains in Electronic Arts

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«eskin» - Disruptive Potentials for Trans-Displinary Teams

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Abstract

«eskin» has been influenced by working with researchers in artificial intelligence, neuroscience and wearable computing who examine tactile perception, embodiment and brain plasticity. In this article I trace the inspirations, the challenges and the outcomes of this project with various scientists and technicians on the development of a prototype and the problems that evolved. What happens when the aims of projects are not clearly defined from the beginning of the project or when the funding is not adequate? It seems that experiment building in trans-disciplinary teams can be both, engaging as well as disruptively disengaging for artists and for users. This paper shows how the processes of production itself can either be encouraged by creative user engagement or driven by passions of artistic inquiry or stalled by disciplinary traditions and problems of communication.

Keywords

Visually impaired users, art and science, wearable interfaces, tactile and sound perception.

History of the Project

«eskin» began with my own "artist in residency" at the Artificial Intelligence Lab at the University of Zurich, where researchers have been studying neural networks to understand how an animal's sensory perception and reaction to its environment can contribute to its autonomous behavior. The engineers and programmers there are particularly concerned with bio mimicry, navigation, locomotion and embodied behavior. They develop engineering and software solutions to mimic these functional concerns. These tasks often require the trans-disciplinary collaboration of people from other disciplines. My own interest in our skin and its sensory perception came from my earlier project called Digital Body Automata (1995) at the Media Museum, Centre for Art and Media Technology (ZKM) in Karlsruhe, Germany [1]. In 2002, I discussed collaborating on a similar project with senior researcher Daniel Bisig at the A.I.Lab in Zurich. We originally thought that we might be able to design an embodied tactile system for autonomous mobile robots enabling them to react with skin responses akin to those of humans in foreign environments like on the surface of the moon. Daniel wanted to attempt to understand neural control, morphology and bodily systems by building electronics to mimic the peripheral sensory nerves and motor coordination. We wanted to add the effect of using audio-visual tools on the process of

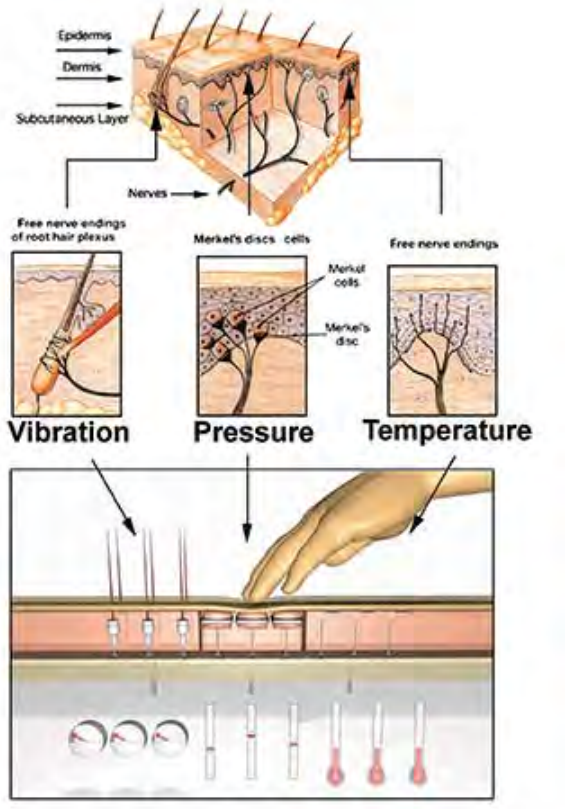

Fig.1 Three of the modalities of touch perception in the human skin: vibration, pressure, temperature and the mimicry of these sensors by electronic means. © Jill Scott, Daniel Bisig (2003)

cross-modal interaction in the somatic cortex. We conducted research into tactile behavior and how it might be mimicked through electronic manipulation. Soon, we found ourselves in the realm of neuroscience: We learnt about how the peripheral sensory nerves pick up the signals of vibration, pressure, temperature and proprioception and translate them into information coded for the central nervous systems, and then how other nerves in the spinal column move this data up to the brain, where it sends back motor reactions to the body. (Fig.1). Your sense of embodiment within your immediate environment is due, in no small part, to healthy skin perception. The phenomenon of cross-modal interaction occurs in the somatic cortex of your brain, where this information is registered and shared

with other cortices. Daniel was interested in the communication between the sound cortex and the somatic cortex and the effect of combining sound and tactile recognition.
By working with Fumiya Iida, an engineer in the Zurich A.I.Lab, we used inexpensive, off-the-shelf sensors to mimic the modalities of human skin perception. This project we called «eskin». The initial aim of «eskin» was to understand the relation ship between touch and sound by developing an intelligent artificial skin. However I strongly believed that the best way to understand the modalities of skin perception or to test the potentials of cross modal interaction, was to build an interface to help augment vision lost by the visually impaired, but not everyone in the team totally agreed with me.

Three Stages of Development

In retrospect it was this disagreement that led to the way that the interface developed. The first stage was an immersive installation with a set of interactive interfaces, the second was a series of workshops for the visually impaired and the third initiative was the design of a wearable prototype.

Stage One. With the help of Andreas Schiffler a computer programnmer and physicist, Daniel and I built three «eskin»-shells with off-the-shelf electronics, which attempted to mimic the modalities of pressure temperature, vibration and proprioception. Also we built a three-screen audio-visual projection to see how the resultant interfaces might be able to trigger animations and sounds in "real time". (Fig.2) The objects used basic wireless portable PICs or programmable micro-controller-based technology, body temperature sensors, piezoelectric vibration sensors and pressure pad sensors. The modality of proprioception was mimicked by infrared tracking technology and tilt sensors imbedded in all three interfaces. These interfaces were linked to a central Linux server and three client Mac computers running Java Scripts. Through these interfaces and clients, the users could trigger parts of three mythologies about skin from Egypt, China and Australia, portrayed with texts and dancers. Each of these creation myths described how the skin of cultural characters created the landscape. Isis, the Egyptian god and Pangu, the Chinese god, were said to create the soil from their skin, while in Aboriginal dreamtime, the Thorny Lizard of legend constructed the landscape by moving through it and pushing it into various 3-dimentional forms whilst shedding his skin pigment for its color. (Fig.3) Through the interfaces viewers were able to manipulate the animation speed of the dancers as well as change the landscape backgrounds and the sound. At this point we went for a grant from a Swiss foundation to further our research but we were unsuccessful. Then we acquired some seed funding from the KTI (Ministry for Innovation and Technology), a funding body supporting Swiss industry developments in collaborations with Swiss universities. which caused a new goal orientation for our project. However before we dismantled stage

Fig.2 Stage One of «eskin»: An interactive platform of smart interfaces. Viewers used them on 3 synchronous screens on a mediated stage. Demonstrated at the Fachhochschule Aarau in Switzerland. © Jill Scott, Daniel Bisig (2004)

Fig. 3 «eskin»: Ancient myths about skin and creation, from China, Australia, Egypt, were interpreted by dancers. The viewers could manipulate the dancers on the mediated stage with temperature, pressure, vibration and motion sensors. © Jill Scott (2004)

one, I invited two visually impaired people to use it. The results proved that sound feedback to tactile response could be a valuable navigation device for these people in combination with other sound information from the surrounding environment.

Stage Two: A year later, I formed another separate team to conduct a series of workshops with people who were visually impaired from the Blindenheim (Home for

the Blind) in Zurich [2]. Could these users shed light on how to develop «eskin» as a wearable device as American neuroscientist Paul Bach y Rita once suggested [3]? Together with Valerie Bugmann, Marille Hahne and the Carambole dance theatre group Zurich, we hoped to explore orientation, cognitive mapping and external audio-visual device control, as well as to convey spatial information through pattern stimulation directly on the human arm [4]. At the outset, the workshop participants expressed their feelings of exclusion from visual culture and theatrical performances and their desire to create cultural events for sighted audiences. As the first step towards this unusual dream, we tested their response to feedback and electro-stimulation on their skin, to improve their communication potentials. We also designed and constructed a crude wearable circuit embedded with micro-sensors, actuators and

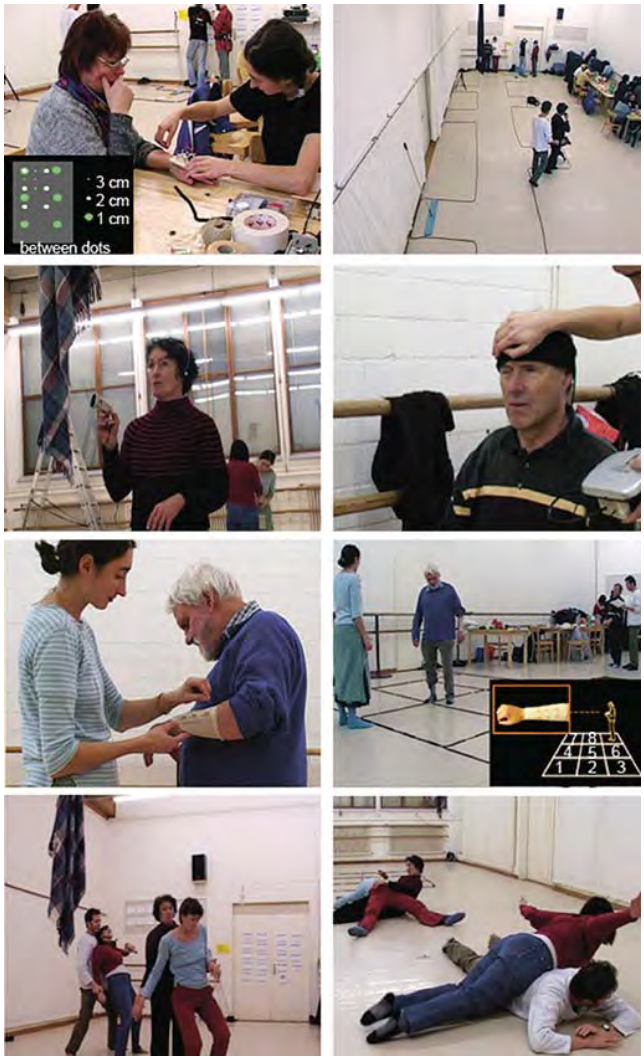

Fig.4 Stage Two of «eskin»: Workshops with visually impaired participants Andrea Kuhn, Freddy Gromme, Diego Metzger, Pascal Leinenbach, Helen Larcher, Claudia Gatti, Martin Meier and Peter Fisler. Tanzhaus Wasserwerk. Zurich. Jill Scott, Valerie Bugmann, Marille Hahne © Jill Scott (2006)

pocketsize computers with wireless connections to sound devices. In addition, we began to design a new mediated platform, which would be customizable in response to wearable tactile and sound feedback. Could «eskin» be attached to their bodies and to other objects on the «eskin»-platform and communicate feedback to the user in the form of sound and tactile data? This question led to five different workshop activities geared toward participants of different levels of visual acuity.

Consequently, we set up as series of workshops. The first was to perform tests with Radio-Frequency Identification (RFID) readers. The aim was to discover how individuals associate sounds with ordinary objects and situations (like the sound of a knife cutting through bread) compared to more abstract associations (like the sound of rain drops while touching a printed Braille matrix). The second task was designed to determine how the participants would react to electro-touch sensitivity and pattern recognition using a micro-array of pins stimulating the skin on their arms. The aim here was to see if they had difficulty recognizing patterns with dots less than 2 cm apart, however we did find that a type of electronic Braille electro-pattern-stimulation, could be easily learnt. A third task was to test for tactile substitution by using a cognitive mapping exercise. Participants wore a grid on their arms and attempted to locate themselves on an associative grid on the floor. These tests proved that tactile stimulation from an interface on the arm could increase their abilities to navigate and orient themselves. In a forth workshop, dancers worked with the participants on improvisation exercises and gesture-based communication. What relationship do the participants have to their own bodies? How can touch help them to communicate to others? The above tasks improved their perceptual faculties, focused their attention and increased their motor abilities! The last task was to determine whether sound transmitted through “bone-phones” transducers on the foreheads of the participants could be an aid in navigation and orientation, a factor that would leaving their ears free for eco-location. After stage two we were left with the realization that there are not many devices that work well, are cost effective, and/or allow for the personal sound cue preferences and sound customization they wanted to create. Non-verbal guidance sounds were considered preferable, because they are so clearly distinguishable from speech. From these five workshops, we concluded that visually impaired participants would like to take control of audio-visual devices through the use of more intuitive electro-tactile responses and replace the rather inadequate HCI (Human Computer Interfaces) that currently exist for them.

Stage Three: So with the advice of the Wearable Computer Lab at the ETHZ, we designed a device to integrate an embroidered circuit that could attach to the arm, and control a mediated stage. The result had to be flexible and portable enough to accommodate pressure, vibration, and temperature sensors and also to support a motion sensor for gesture recognition. We worked with a company to construct a wearable electronic circuit that could act as a sub-

strate base for these sensors. This embroidered circuit consisted of two layers designed to maximize the levels of resistance between them. Temperature feedback transmitted through the skin would be a proximity detector, while pressure pads produced coded messages onto the skin.

This design included integration of this electronic circuit with off the shelf bone phones for sound, compasses for vibration direction, accelerometers for gesture recognition and ultrasound to avert collisions with obstacles. (Fig.5-7)

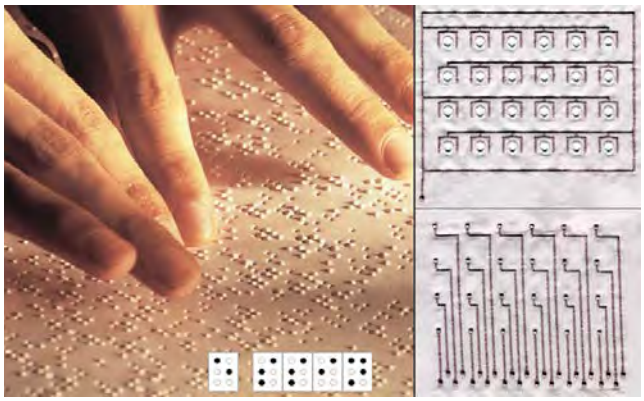

Fig.5 The wearable embroidered circuit inspired by Braille patterns. Designed by Jill Scott, Valerie Bugmann. Constructed by Bischof Textiles, St. Gallen

Fig.6 Stage Three of «eskin»: Mobile wearable armband interface, embroidered circuit, sensors and shoulder pad hooked up to the QBiQ computer from the Wearable Computer Laboratory. Swiss Federal Institute of Technology. Design Jill Scott (2008)

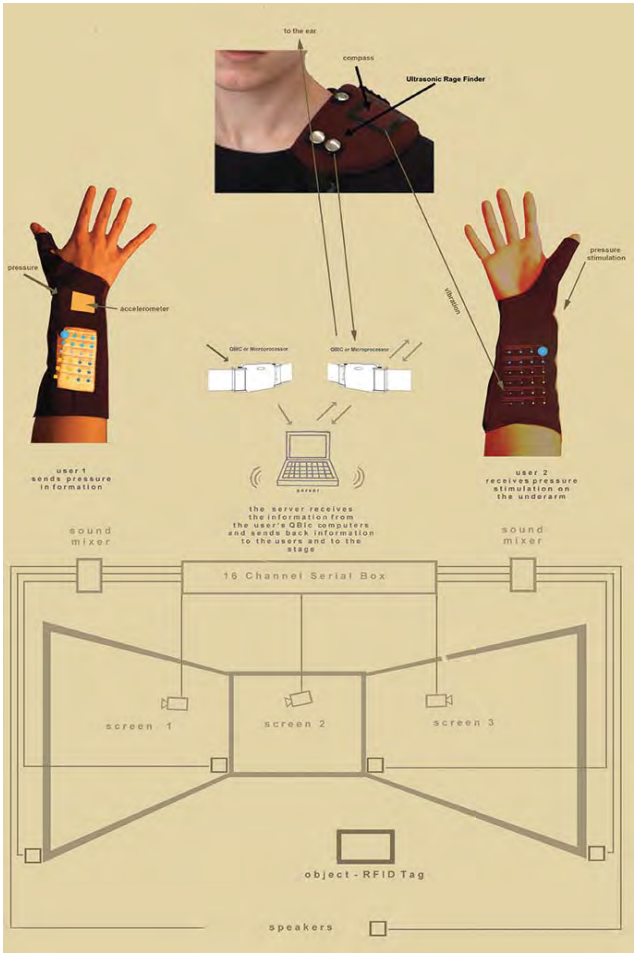

Fig.7 Stage Three of «eskin»: Design diagram for an interactive theatre project, wherein the visually impaired can communicate with each other and the audience. Design: © Jill Scott (2008)

Analysis – Transdisciplinary Collaboration

These three stages have caused related challenges and disruptive reactions. In the first stage, we did find a way to electronically mimic four modalities of the human skin perception, but the question of who this interface was being made for was not clear. I seemed to be the only one who wanted to take into account the creative potentials of the visually disabled and incorporate their expertise and dreams into the design of an interface.

So throughout this period, although I studied more about interactive theatre, disability, cognitive psychology, neuroscience and engineering, the need for us to be part of an even larger trans-disciplinary team became increasingly apparent. We joined up with the Wearable Computer Lab and Prof. Moria Norrie, Global Information Systems Group, ETHZ. When we finally received developing funding from the (KTI) [5] to locate users for the project, we searched for industry partners. Although we all wanted to design «eskin» as a wearable interconnected device, we did not agree about who the wearers should be. The team also

discovered difficulties communicating. While I focused on the visually impaired, the developers tended to think mostly about commercially promising uses, that was, as the basic systems of devices for local map navigation without GPS.

To this aim, we conducted a feasibility study in the form of questionnaires to see if «eskin» could be used by visitors who needed a cognitive map for the Zurich Museum Night and for the Edinburgh Theatre Festival. The results of these surveys did suggest that such an interface could improve navigation and access to information. However, I felt that my research was incomplete. How could the results from stage 2 of «eskin» be fully viable without engaging the opinions of visually impaired people? Meanwhile the engineers who are trained in terms of milestones and work packages wanted to construct an assembly without users' input for the design. From the outset, the engineers were interested to build a microchip, to make «eskin» light and easy to use, and to free it from its reliance on large battery storage. This aim was estimated to require an investment of $500,000, an unheard amount for a project in the arts. We were coming to the project from a different perspective, one of knowledge production rather than the lure of profitable markets for our discoveries. We consistently came up against the same response from potential industry partners, who would not fund such a survey, and could see only a limited number of users and a small market for «eskin»! We were offered the advice, without animosity, that we might instead explore ways in which other larger groups could use such a device and that the visually impaired might instead benefit from the upgrading of existing digital devices such as mobile phones. Alas, with all these difficulties and communication problems we ultimately were confronted the problem of not being able to produce «eskin» for the visually impaired audience I had envisioned [6].

Fig.8 «eskin»-Exhibitions: The Welcome Trust, London UK "Skin". 10.6.10 – 26.9.10 and at Kulturama Zurich 2012. © Jill Scott (2012)

Saddened, we reported this response to our visually impaired research participants, but even so they still wanted to work on better HCI solutions. They were fascinated by «eskin». Their continued, deep investment in its successful outcome came both in the form of the data they generated and in their valuable suggestions for «eskin's» design. Their enthusiasm for the project was heartening and energizing. Recently there has been some more advances in structural skin design by other researchers that would be interesting to re-adapt for «eskin». In this light we would hope that alongside with the direction championed by interaction theorist Paul Dourish, our focus on skin will continue to be on the users levels of "ubiquity, tangibility and most of all, shared awareness, intimacy and emotion".

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Author's Biography

Dr. Jill Scott (www.jillscott.org) is professor for Art and Science Research in the Institute Cultural Studies in the Arts, Zurich University of the Arts (ZhdK), Founder of the Artists-in-Labs Program (www.artistsinlabs.ch) and Vice Director of the Z-Node PHD program on art and science at the University of Plymouth, UK (www.z-node.net). Her recent publications include: Neuromedia: Art and Science Research with Esther Stöckli (2012), The Transdiscourse book series:Vol.1: Mediated Enviroments, (2011), Artists-in-labs: Networking in the Margins (2011) and Artists-in-labs: Processes of Inquiry (2006). All publications are with Springer Press. Her artwork spans 38 years of production about the human body, behaviour and body politics. In the last 10 years she has focused on creative media art experiments about neuroscience, ecology and sensory perception resulting in the construction of interactive mediated sculptures based on studies she has conducted in collaboration with the University of Zurich.

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Imagining Thought in Digital Space

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Abstract

Scientists and artists have attempted to capture thought in the form of images for over a century. In the early twentieth century photographic plates and nitrate film were used by scientists, artists and "spiritualists" to record thoughts or mental energy, including thoughts, feelings and dreams, through the process of making physical contact with fingers or foreheads on light sensitive plates. With the discovery of X-ray photography around the same time, the photographic image played a role in validating claims about the possibility of revealing the invisible. These claims were further extended with the invention of electroencephalography (EEG) in 1924. EEG allowed for new possibilities in the study of neuronal activities and for identifying new patterns of thinking. The formation of these image-making practices, in both art and science, laid the foundations for how we literally and figuratively re-imagine and express images of *thought* in the 21st century.

In this short paper we provide an account of "thoughtography" and how it developed through the twentieth century as a *cultural* artefact. [1] This account provides a framework to consider the recent trend to crowdfund and mass-produce non-invasive mind-machine interfaces for consumers, ready and willing to measure and directly interface cognitive and emotional relationships with and to our work environments and domestic social lives.

Keywords

Thought form, mind-machine interface, thought-photography, thoughtography, science fiction, neuroimaging, neuroheadset, digital thinking

Introduction

> Consumer mass technoculture, fictive figuration of dreams as accessible and objectifiable is merely one part of the background to the unending demand for externalization of one's life into pre-made digital formats. [2]

In the ever-expanding array of digital tools and consumer products designed and created to organise and coordinate our contemporary lives, comes a device that captures and records our raw EEG data, the mind-machine interface (MMI). Of relevance to this paper is the unique situation that wireless MMI headsets can now be purchased and used in the workplace or in our domestic social lives. Developed for interactive neurogaming, these products have been on the market for about a decade and have already been opened up for domestic use. The prices for currently available products start at around $300 (U.S. dollars). The latest gadget soon to be released onto the consumer market is the *Emotiv Insight*, crowdfunded by Kickstarter campaign and raising $1.6 million for its development.

The possibilities for the "do-it-yourself" mind recordings makes it possible to capture and record a persons neuronal responses to everyday stimulus regardless of the activity, from the mundane though to the exhilarating, and irrespective to the environment we are in, from monitoring "performance and emotional metrics" at the workplace or sports institute to the massively multiplayer online game (MMO). [3]

Whilst these devices have recently been developed for a consumer market the devices are not novel per se, they have been instrumental in scientific and medical research to capture patterns of "thought" since 1924. However there is a pre-history to the institutionalization of capturing thought. Arresting and materializing "thought" into pictorial representation has refracted in the scientific imagination vis-à-vis culture and art-making since early photography.

Thought recording

This research sketches out the scientific and artistic pursuits that attempted to capture thought and the residue of thought in the form of images from the mid 19th century to the contemporary landscape. The discoveries and inventions of photographic tools and image making practice that reshaped visual perception by capturing fleeting images of thoughts and expressions was a pursuit shared by converging discourses in medicine, science, art and culture. From the complex atmosphere of French politics circa 1839 [4] through Darwin's photographic collection of human and animal emotion published in *The Expression of Emotion in Man and Animals* [5], then neurologist Jean Martin Charcot's studies on psychiatric patients at the Salpêtrière hospital Paris from 1878 [6], to the discovery of X-rays [7] - photography played a role in validating claims about what the naked eye could not see. The technological developments in and cultural formations of the recording devices during this time enabled us to uncover what was previously

hidden and also allow us to reformulate beliefs about the world.

In a world willing to embrace the objective nature of photography, scientific and specific forms of art photography flourished. [8, 9] Experiments conducted with the camera were controlled and methodologies to validate experiments were repeated.

Some of the earliest known *thought photographs* were created by French psychiatrist Dr Hippolyte Baraduc (1850-1909), in his experiments to capture subtle forms of "mental activity" on light-sensitive materials (figure 1). He pursued a belief that the substance of thoughts could materialize on photographic plates. In a speech in 1896 Baraduc stated:

> If thought is simply fixed in an image, this image of light the luminous clothing of our ideas, will have a sufficiently powerful photochemical action to imprint the gelatinous film, either directly or mediated through glass, and in a manner invisible to the human eye; these are what I have called psychicons, luminous, living images of thought. [10]

Figure 1 Hippolyte Baraduc Photographs His Wife Nadine, 20 Minutes, 1907

The *thought image* has also been documented and visualized in art – by means of line, shape, colour and form. This is clearly illustrated in Annie Besant and Charles Webster Leadbeater's book titled *Thought-Forms.* [11] Both prominent members of the Theosophical Society, Besant and Leadbeater's experimentation and research resulted in modelling various "thought forms". According to the artists, there were three categories of thought forms: those which capture the image of the thinker; those which capture the image of some material object and those which capture a form entirely on its own, expressing its inherent qualities in the matter which it draws around it. [12] Unlike the process of waiting for thought to materialize on photographic plates, thought forms materialized clearly to the artist. These forms were isomorphic to a specific emotion, problem or concept, one that could be hand drawn and illustrated. For example the thought form *The Intention to Know* (figure 2) is located in the "image of the thinker" category. It should be no surprise that these thought images were tainted by the artists' personal perceptions of the world. This is clearly expressed in how they describe their experiences of the world as it materializes for them in *The Intention to Know*:

> This form indicates the determination to solve some problem the intention to know and to understand. Sometimes a theosophical lecturer sees many of these yellow serpentine forms projecting towards him from his audience, and welcomes them as a token that his hearers are following his arguments intelligently, and have an earnest desire to understand and to know more. A form of this kind frequently accompanies a question, and if, as is sometimes unfortunately the case, the question is put less with the genuine desire for knowledge than for the purpose of exhibiting the acumen of the questioner, the form is strongly tinged with the deep orange that indicates conceit. [13]

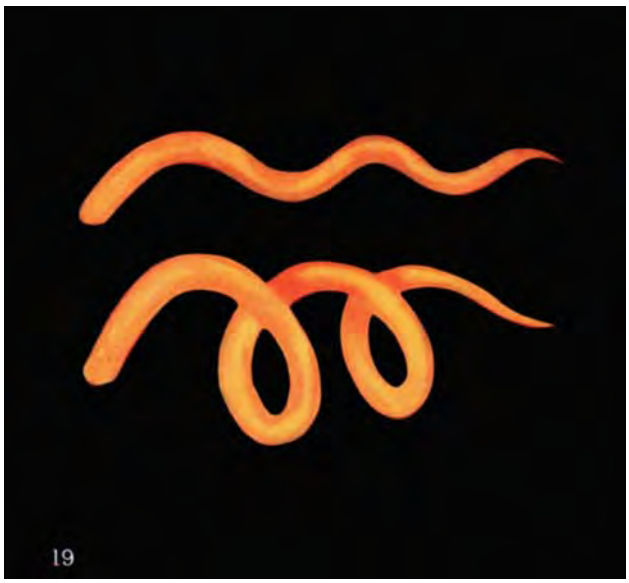

Figure 2 Besant & Leadbeater, *The Intention to Know (no.19)*, 1901

By no account was the visualisation of thought forms the sole domain of Besant and Leadbeater. Rudolf Steiner was appointed to the German/Austrian division of the Theosophical Society in 1904. The similarities between the work of Steiner and Besant & Leadbeater are evidenced through a selection of Steiner's blackboard drawings. [14]

This is most apparent when comparing Besant's *Helpful Thought* (figure 3) and Steiner's blackboard drawing: *What is Thinking?* (figure 4) as they both directly reference the same visual motif. The drawings use similar line, shape, colour and form. There is little evidence of chance in the images as they endeavour to capture the world and *articulate the spirit of the times in symbolic gestures.* Steiner described these works as "thought-pictures" with the purpose of extending thought and capturing something fleeting through form and function.

Besant and Leadbeater attempted to gain scientific acknowledgement for the invisible forms and otherworldly experiences they captured in their illustrations. They did so by referencing Dr Baraduc's photographic images of mental activity in the introduction to *Thought-Forms* describ-

ing Baraduc as the most successful practitioner to have recorded more "scientifically legitimate" and subtle forms of mental activity, as opposed to the work of clairvoyants and spirit photographers of the time. [15]

Figure 3 Besant & Leadbeater, *Helpful Thoughts (no.54)*, 1901

Figure 4 Rudolf Steiner, Blackboard Drawings, *What is Thinking?*, 1923

Not content with distancing themselves to charlatans like spirit photographers, Besant and Leadbeater went further than Baraduc's research. For Baraduc, his recording instruments captured the vibrations of the grey matter in the brain as a result of a thought: not the thought itself but rather the effects it produced. For Besant and Leadbeater they could see the details of the thought and not the effects of it. It was in fact the aim of their little book to show *thoughts as things*.

Mind-machine interfaces

The thought images created by the artists and scientists discussed above were collected then catalogued as a way of recording and storing data from multiple trials of a variety of experiments. The processes created by these scientists and artists informed the development of electroencephalography (EEG) in 1924. It is at this point in the twentieth century that EEG technologies and experimental imaging procedures are institutionalized for use as scientific and medical diagnostic tools. It is not until the late 1970s early 1980s that the metaphorical and material relays of art, culture and science refract through each other again to explore thought imaging and capture thoughts forms.

The mind-machine or brain-computer interface technology regained popular traction in the cultural and artistic imagination in the mid-late twentieth century through films such *as La Jetée* (Chris Marker, 1962), *Brainstorm* (Douglas Trumbull, 1983), and *Until the End of the World* (Wim Wenders, 1991). [16,17,18] In these films mind-machine interfaces capture and record human thoughts, memories and dreams. These ephemeral imaginings are stored then retrieved for later examination.

The refractive relationships between art, culture and science are best exemplified in the film *Until the End of the World*. This film sets out to create a machine that records images blind people can see. The portable camera-like contraption is designed to capture the brain activity of the user experiencing the visual world and the recordings reconstructed in the blind persons visual cortex. The device is soon repurposed to record the user's dreams and the subjects soon become obsessed with their own lost and imagined worlds.

What we witness in contemporary cultural imaginings is replayed in clinical labs. In 2011, UCLA neuroscientists used functional magnetic resonance imaging (fMRI) and EEG to record the brainwave patterns of people watching video. The scientists then convert the images from the recorded data into a video format. [19] A similar experiment conducted by researchers at the Department Neuroinformatics, Japan, created a "dream decoding video". [20] Both these experiments were similar to those imagined in *Until the End of the World* where researchers record the patterns of a patient's synapse activity whilst the patient watches a moving image sequence. The data generated is recompiled then "played back" to reconstruct the images that were watched.

Conclusion: Digital thinking

Recently Mark Amerika reworked humanities obsession with the recording of identity recasting it however from the point of view of the machine in *MetaTourism: Interior Landscapes and Digital Thoughtography* (2001). This work explores "a voice in the machine that begins to speak to itself". The *Digital Thoughtographer* is a central figure/voice in the work that roams the interior landscape. The process of thoughtography here represents the inner voice, observing, reflecting and recording. The thoughtographer, has an inner character that, by its very name, acts to capture the thoughts of the machine through the machine.

Amerika's isolated character resonates with developments not only in "thoughtography" but in artificial intelligence and artificial life. Paul Virilio's observation on the *perceptron* is a cautionary but salient one:

> Once we are definitively removed from the realm of direct or indirect observation of synthetic images created *by the machine for the machine*, instrumental virtual images will be for us the equivalent of what a foreigner's mental pictures already represent: an enigma. [21]

Virilio's bleak assessment too is an echo of Étienne-Jules Marey's prescient account of technologies for automatic inscription and self-recording machines:

> These machines are not only destined to replace the observer, in which case they perform their role with overwhelming supremacy, but they also have their own domain where nothing can replace them. When the eye ceases seeing, the ear hearing and the sense of touch feeling, or when our senses give us deceptive appearances, these machines are like new senses of astounding precision. [22]

It should come as no surprise that mind-machine interface's such as the *Emotiv Insight* or *Emotiv EPOC* resonate in our cultural imagination, the formation of this imagination has figured in and echoed though science for over one-hundred years. What is new is the wide distribution of these technologies into the consumer market so that we may benchmark our cognitive and emotional performances. What remains uncertain is how we might use these performance measurements to eventually compete with artificial intelligent and artificial creative systems that too generate and record their own thoughts and images through the automated "liquid space of informational capitalism". [23]

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Authors Biographies

Kellyann Geurts is a PhD candidate at Monash University and employed at RMIT University, Australia. Through digital imaging, she explores ways to represent thought patterns and mental spaces into two and three-dimensional forms. The project was recently presented at the *Digital Subject III: Temporalities* symposium, University of Paris VIII. Kellyann's Master of Arts degree project: *A Theory of Error* was presented at Goldsmiths College London and University of Amsterdam. Melbourne exhibitions include Dianne Tanzer Gallery; RMIT Gallery and National Neurosciences Facility, Melbourne University.

Mark Guglielmetti has a PhD in Visual Art for examining artificial life as a contemporary artifact in image making and not through the domain of computer science. The culmination of this research built on the artists' studio-led research practice into the digitally mediated reconfiguring human in a Master of Arts degree exploring visual perception, completed in 2004. Guglielmetti has been widely published including in Leonardo, Computers in Entertainment (ACM), and the Philosophy of Photography, and has presented at numerous conferences in Europe, the US and Australia. Guglielmetti's work has been exhibited nationally and internationally including ISEA2011 Istanbul, Ars Electronica 2004, Biennial of Electronic Arts Perth (BEAP) 2004, the Melbourne International Film Festival 2001, and showcased at the Architectural Biennial in Beijing 2004 and in "Australian Screen Culture", at the Barbican in London 2004 and Centre Pompidou in 2003.

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State.Scape: a brain as an experience generator

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Abstract

State.Scape **is an interactive installation in which audio-visuals are generated from users affective states (engagement, excitement, and meditation). The installation relies on a brain-computer interface based virtual environment and sonification, which both served as a platform for the exploration of users' affective states. In this paper, we describe the aims, the system design, and the procedure for interacting with the artifacts and present the user experience gathered during interviews with the participants. Furthermore, we discuss the impact that this environment has on future real-world applications in altering affective states and its potential in meditation practice.**

Keywords

EEG, brain-computer interfaces (BCI), Neurofeedback Art, Virtual Environment, Installation, Affective States, Emotiv EPOC.

Introduction

The attention that brain-computer interfaces (BCI) and biosensors gained in past 10 years steered the development and application of these devices from medical fields towards art and entertainment. Availability of these devices on the market and their recent price decrease encouraged more artists to explore their potential in art applications. Artists, driven by the fascination with the brain and human cognition, are using biometric technological advances in their explorations of art generated by neurofeedback. Unlike other art forms, art generated by data from human brain activity connects the audience member and the art piece on a meta level in which the user's[1] internal affective states and neural activity become an integral part of the piece itself. However, most of these artistic explorations, to our knowledge, seem to stay at the level of mere explorations, without clearly identified goals in regard to the experience, or the exploration process itself.

In this paper, we present *State.Scape*, an artistic exploration of users' affective states in a virtual environment. Affective computing, as an interdisciplinary field is clearing its path towards application in various systems and designs that will allow us to understand and simulate human affect (Picard 1997). This piece takes a form of an audiovisual interactive installation, generated from participants' affective states collected from a brain activity. What we are interested in our work is to find the answer to: Are the users able to make the connection between changes in their brainwaves and the changes in the installation, if they are not given any instruction on how to use the system? This installation is a first step toward a deeper exploration of how inner states could be mapped in virtual space, what the meanings of those mappings are and how these changes are perceived by a user interacting with the system.

Background and Related Work

The first use of brainwaves in art was not until 1965 when the scientist Edwin Dewan introduced Alvin Lucier to brainwave recording. This collaboration resulted in "Music for Solo Performer" (Straebel and Thoben 2014), a piece in which Lucier sonified his brainwaves in real-time on the stage, with the help of John Cage. Although some argue that Grey Walter was the pioneer in brainwaves sonification for performing his "Cerebral Music" in 1961 during a radio interview, there is no recorded evidence to support this claim (Luciana Haill 2014).

Since 1965, artists have been using brainwaves to generate art through various outputs, with the majority working on sonifications of the brainwaves. Some artists are creating more directed performances such as Eduardo Miranda's "Activating Memory" (Miranda 2014) in which each member of a Brain Computer Music Interface (BCMI) quartet was presented with four musical scores on the screen. By gazing at one of the scores for short period of time, the BCMI member was able to select the score that was then sent to the assigned member in the string quartet to perform. On the other side are pieces that are more exploratory and less structured, and in most cases focused on meditation practice and self-reflection. A piece that is representative of this type of works is George Khuts "Theta Lab" (Khut 2014), in which three participants are lying on bed-like pods while exploring their mental states through the sonification of their brainwaves.

After sonifications, the second most mapped by the artists are audio-visuals generated from brain activity. Most of these pieces, to our knowledge, are processing a data stream in real time. Along with the EEG [2] signal, some artists are using

[1] an audience member whose data is collected in the piece

[2] Electroencephalography - the recording of the electrical activity

other bio-data inputs such as galvanic skin response (for measuring stress levels, heart beat rate, breathing rate, etc. For instance, "The Auratic Body" (Dunning, Woodrow, and Hollenberg 2004) falls under a category of multiple input modalities as EEG and GSR data are combined to generate audio and visuals. BCI based audio - visual installations can differ in number of their users, differentiating between single and multi-user pieces. In Mariko Mori's "UFO wave" (Mori 1999), three users were positioned supinely in a egg-shape sculpture while the audio and visuals are generated by their neural activity. We can divide BCI installations into passive or active installations in regard to users' interaction. Active is when users are performing task orientated activities, with pre-determined instructions of how the installation elements work. This approach requires calibration for each user and it is mainly used in BCI games in which users employ their brainwaves to make active choices in navigating through the environment or manipulating the objects. In contrast, more exploratory artworks tend to have a passive approach in which brainwaves and their patterns are mapped to certain events or changes in the installation without a specific task to perform.

Figure 1: Virtual Environment: the detail: a flock of birds

State.Scape: Concept and System Description

The name *State.Scape* comes from the desire to make possible an escape from certain affective states (anxiety, stress, excitement, boredom, etc.) that might have negative or unpleasant impact on us. The concept is inspired by the saying that "you can not escape your skin" which is always related to unpleasant personal feelings and emotions. Even though we cannot escape from our skin, we can escape from our mental states by transforming them. *State.Scape*, designed for a personal and intimate experience, allowing its users to access the representation and explore their inner states through the virtual environment and sonification generated from those states.

As a symbol of states, we elected to use the visual metaphor of birds (see Figure 1). The symbol of flocking birds reminded us of the generation of emotions; the overwhelming feelings that tag along with anxiety, excitement, or stress. As birds are free to fly anywhere, we wanted to let people comfort themselves by letting those birds/thoughts fly freely through the virtual environment. The idea is to map users' inner states to the birds' behavior. Therefore, our virtual environment consists of the flock of birds accompanied with a soundscape, with both being responsive to fluctuations in users affective states.

Like the projects described in the Background and Related work section, *State.Scape* is using real-time EEG data as a mono input and utilizes it in an art context. This work diverges from similar projects in that the sonification was not generated by changes in the virtual environment. Both of these elements, the sonification and the virtual environment were mapped to changes in affective states. The decision to design this piece as a single-user comes from the observation that the presence of others can influence and change the affective state of the user, as well as affect the interaction with the piece. Therefore, we wanted to create an intimate individual experience of exploration. Unlike other pieces that instruct users how to use the artworks, the lack of instruction in our piece was intentional. We wanted users to find their own way of interacting with the installation and experiencing the audio-visual artifacts.

As shown in (Figure 2), the installation consists of a PC running 3D computer-simulated virtual environment (made in Unity 3D) and sonification, a short throw video projector (BenQ W1080ST) and stereo speakers placed in a dark room. Input was provided by a consumer-level EEG system (Emotiv EPOC) with a Bluetooth connection to a PC with installed Emotiv Affective Suite for real-time affect recognition.

Electroencephalography (EEG) Data Acquisition Nowadays BCI devices differ in a number and quality of built-in sensors, hence not all of them can obtain the same spatial and temporal precision in EEG readings. Devices with fewer sensors, depending on where the sensors are placed, are in most cases focusing on only one affective state (such as meditation, for example). Generally, sensors are placed following "10-20 International System of Electrode Placement" (Silva and Niedermeyer 2012) developed by Dr. Herbert Jasper in the 1950's.

EEG signal obtained from the scalp falls under frequency range from 0.5 to 30 Hz. Following the guidelines provided by the International Federation of Electrophysiology and Clinical Neurophysiology (Steriade et al. 1990) all rhythmic activities can be sorted into one of six bands. The brainwave activity can tell us about the current state of the user: Delta (0.5 - 4 Hz) shows that the user is experiencing fatigue, is sleeping or his mental processes are severely slowing; Theta (4 - 7 Hz) is associated with meditation and slowed processes; Alpha (8 - 14 Hz) reveals that the user is in relaxation; Low Beta (15 - 20 Hz) shows intense focus; Medium Beta (20 - 30 Hz) is associated with anxiety; Fast Beta (called Gamma, over 30 Hz) shows hyper-alertness and stress. This knowledge of the relation between states and brainwave activity can be used as a guidance for analyzing particular user

produced by the brain

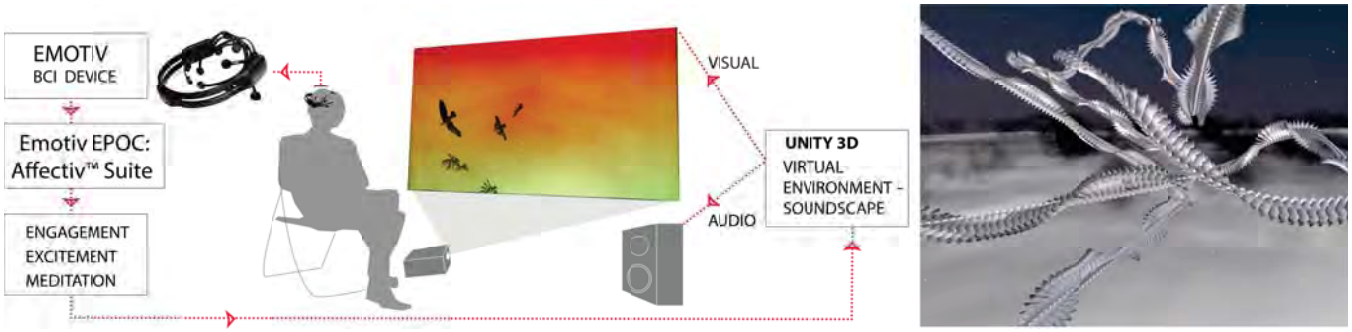

Figure 2: *State.Scape*: system parts (left). The capture of the last scene - a bird glitching (right)

experience.

Emotiv Affective Suite Regarding EEG data acquisition we used Emotive Epoc. This device has 14 EEG channels. Instead of using raw EEG readings (levels of alpha, beta,etc.), we directly used derived affective scores provided by Emotivs Affective Suite (levels of excitement, engagement and meditation). We calibrated the system for each user in order to track changes even if those were small on an absolute scale. To do so, we tracked running minima and maxima for each of the parameters, which allowed us to scale the parameters of the model properly for each new user. For example, if a user's meditation score remained almost constant for the duration of the participation, the system would keep track of this, and make it so that even minor changes in the EEG readings would produce visible responses.

Virtual Model and Mapping

The virtual environment consisted of a flock of birds and environmental background that were purpose-designed using the Unity3D SDK. The birds followed a randomly determined path. We achieved this by mapping birds to follow an invisible pivot point that was randomly positioned in our model. We used three states provided in Emotiv Affective Suite: meditation, engagement and excitement to control the other parameters of the flock. Changes in affective states controlled the flock's position, the birds' speed and the number of birds. The level of the excitement was mapped to control the number of birds. The session would start with only one bird in the scene, but as the user gets more excited, more birds appear in the flock. Similarly, as the excitement level drops, the birds vanish from the scene accordingly. The meditation score controlled the speed of the birds, with more meditative states resulting in slower bird movement. Furthermore, if the user is in a meditative state, her/his excitement levels are low which visually equates to less birds in the flock. The engagement level controlled the height of the flock. The more engaged the user is in the scene the birds would fly higher in the sky.

Apart from controlling the flock properties, affective states were mapped to control the volumes of different audio tracks. The sound aspect to the model, similarly, consisted of three tracks: a deep droning bass track, a mid-high frequency instrumental track and a percussive ambient effect track. The selection of tracks was not determined by rigid criteria in regard to states but it was more of an artistic expression. All three tracks played in a synchronized way, with the volume of each being mapped to a different Emotiv state metric. The bass track's volume was tied to the level of the meditative component; the instrumental track was mapped to engagement, and the percussive effects were mapped to the excitement metric. This way, the spectral qualities of the soundscape constantly changed, reflecting the user's current EEG state through sonification.

Each session consisted of three camera views, each lasting 90 seconds. The first camera view was positioned outside of the flock, capturing the environment (the cloudy sky) and partially the flock as it moves across the scene. In this initial scene, we wanted the user to stay out of the flock in order to become familiarized. In the second scene, the camera was inside the flock, capturing the movement of the flock. By changing the position of the camera, we put the user in the middle of the scene, in order to make her/him part of it. This is the stage where we are symbolically allowing the user to relate to the birds and let inner states fly freely. The third camera was positioned above the flock. This is a closure scene in which user is getting ready to leave the experience and get back to the physical world. In the last scene, only one bird is flying across the model. Then a glitch occurs, and the bird leaves an abstract path made of its contours as it moves across the screen (see Figure 2 (right)). This glitch is a sign to the user that it is time to get back to the physical world, as the screen gets filled with abstract shapes.

Procedure

One user at a time enters a dark room and sits on a chair facing the projection screen. The facilitator restarts the Emotive Affective Suite a priori, and places the Emotiv EPOC Headset on the participant's head. As soon as all the sensors are in the place and connected, the facilitator simply asks the user to explore the system and leaves the room. After five minutes long session, the facilitator enters the room and helps the user to remove the device. After the session, users complete an exit interview.

State.Scape: User Experience

State.Scape was exhibited in April 2014 at the Medium: Play (Installation Art and Contemporary Digital Practices show-

case), organized by the Centre for Digital Media in Vancouver, Canada. The users were simply asked to "explore the system" without any further explanation of how the system works and what exactly they were controlling. Obtained qualitative data demonstrate the distinct connection between changes in birds' behavior and changes in users' mental states. Some of the users assigned meditative qualities to the installation. These users who were exploring meditation during the session reported high levels of control over the system which directly affected their degree of immersion in the environment. Few users reported high level of arousal. This can be due to the anticipation of what is coming the next and what they are supposed to do, caused by the lack of given instructions to the users. Their relaxation, as they described, was interrupted by the curiosity and engagement in understanding how the system was controlled. Additionally, the level of immersion was high, and most of the users found their way to release and explore their inner states.

In addition, we wanted to find out whether users were able to see the difference in VE that was generated by the brainwaves and VE that was generated by random numbers. To do so, we randomly assigned users to two groups, both wearing Emotiv headset, with the only difference that one of these two groups was exposed to the VE that was generated from random numbers. Our post-interview showed that users in "random" group were able to tell that system is behaving independently and that they have little or no control over it. The majority felt that they did not influence the system. However, this was a pilot study and the sample size of users will be expanded in further studies in order to draw stronger conclusions.

Overall, data from the exit interview demonstrated that participants felt calm and more relaxed after the session. The anxious feelings occurred to a few participants as they worried about their brain data being collected. This can be prevented in the future by letting users know about what system can and what cannot do in terms of collecting data.

Conclusion and Future Work

The authors' intention behind the *State.Scape* was to create an exploratory system in form of an installation, in which users will reveal and explore their affective states upon the virtual model. We did not aim to create pleasant nor unpleasant experience. We were curious to know what is the overall experience of the users while interacting with the system.

We recognized the potential of designing effective BCI supported interactive environments in the future. From the overall quality standpoint, the results show the potential of this installation in creating immersive, enjoyable environments that will evoke pleasure and arousal. One of the participants expressed his opinion about this installation by saying that the experience was "calculated sense of complexity being somewhere within a curated elegance".

Insights gained from the interviews will help guide the development towards our long-term goal of creating an interactive installation that not only reads user's states but creates a feedback loop between the user's state (assessed, e.g., via EEG) and the perceived environment. Such system will allow us to shift the user's emotional state in the direction that the user desires (e.g., more relaxed or more engaged states). To this end, we will research how to migrate from virtual to physical spaces, and investigate which aspects of a physical/virtual environment are most effective in steering the emotional state in the desired direction. We are aware of the length of the road that we are taking in pursuing our goal, and we are hoping that with this study and future research we are getting closer to the design of the user personalized experiences.

Authors' Biographies

Mirjana Prpa is a PhD candidate at the School of Interactive Arts Technology (SIAT) at SFU, and a virtual realty enthusiast. She received a Master Degree in architecture from the University of Novi Sad, Serbia, and has worked mainly on ephemeral designs for performance art projects including projects for theaters and open public spaces. Her current research is in user personalized environments that are created based on user's emotional states.

Bernhard E.Riecke is an assistant professor at SIAT,SFU and associate member of the SFU cognitive Science Program. He is one of the leading experts on self-motion illusion and its implementation in immersive Virtual Reality, regard to natural embodied spatial perception, cognition, and behavior. Rieckes scholarship is exemplified by more than 70 peer reviewed papers/book chapters, including four best paper awards (ACM IEEE conferences).

Svetozar Miucin is a PhD student in the School of Computing Science at Simon Fraser University. Aside from his main research path, which is currently oriented to improving memory behaviour of complex software systems, he is interested in the places where computing science meets areas like interactive arts, neuroscience and social studies.

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The Brain As A Hackable Driver

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Abstract

Do our EEG, fMRI and other biometric data contain the essence of who we are and what we think? In the future could this data be used as an identifier for security and thought modification, as well as exploring virtual worlds? If our "brainotypes" or 'brain-finger prints' and concurrent cognitive processes are monitored, how do we prepare for this looming horizon? Though no one is entirely sure, these questions invite both scientific and metaphorical approaches to address these issues. This paper looks at past artistic investigations using the human brain. It then discusses the emergence of technologies, research, and methods on brain datatyping; privacy and its ethical implications; sending and receiving motor commands between two different brains; moving robotic prosthesis through thought; the formation of memory; manipulating memory via frequencies of light; and hacking brain computer interfaces (BCIs) to extract vital information.

Keeping these methods and techniques in mind, this paper then touches upon the author's nascent creation of a 'brain-opera' using both open source and proprietary BCIs. This research, in an early phase of development, will be developed throughout the coming year.

Keywords

surveillance, brain sensors, posthuman, memory, consciousness, brain opera, datatyping, BCI, EEG

Early Experiments

Artists have been working with brain sensors since the 1960s and 70s when modern composers and musicians Alvin Lucier, Richard Teitelbaum and David Rosenboom experimented with control sources of biofeedback and brainwaves producing a number of sonic events derived from brainwaves. Fellow faculty member at Brandeis University physicist Edmund Dewant who was researching alpha brainwaves for the U.S. Air Force approached Lucier and told him, "You should make a piece with brain waves". [1] Lucier discovered brain alpha waves produced sonic cycle sounds very low in tone. He utilized this knowledge to perform the first brainwave music composition using EEG electrodes and conductive paste, *Music for Solo Performer* at the Rose Art Museum. [2] Lucier sent his alpha waves through amplifiers, activating speakers triggering drums, trashcans, piano strings and cardboard boxes. These sounds affected the environment of the performance space, as well as the listeners and the performer. Any time one of these variables changed, it changed the entire event.

In 1967-1968 Teitelbaum used breath, EEG and heartbeats interfaced with a Moog Synthesizer inventing bizarre sonifications of human biofeedback systems as part of the "the American experimental tradition in which the 'idea' is expressed directly in its sonic manifestation. [3] Composer John Cage also embraced the American experimental tradition. He performed David Rosenboom's composition, *Brainwave Feedback* (Cage 1971), and again throughout the 1973 film *Homage to John Cage* by video artist Nam June Paik. [4] But it was Rosenboom who foresaw using the brain, as an instrument would lead to a "large-scale, musical theater or operatic works involving biotelemetric presentation by human and even non-human performers interacting with audiences, other performers, and environments. This could create a synergistic theater, linking participants in a large-scale organism, the ontology of which could provide a script of mythical proportions." [5] These initial experiments validated the brain as a device that could produce music and art, but the idea of the brain as a hackable driver still resided in the realm of science fiction.

Current Practices

In recent years numerous consumer grade BCI devices have inundated the market. The largest EEG driven neuro feedback ride in the world, "The Ascent" by Yehuda Duenyas used a consumer grade EEG reader to allow a participant to controls their own brain waves through focus and meditation. [6] Controlling their focus allowed them to also control the level of their levitation where they were strapped inside a mind-controlled harness that raised or lowered them depending on the level. If they could stay focused until the end of the levitation experience, a music and fireworks display was triggered.

Marina Abramovic's three-month performance at the Museum of Modern Art's *The Artist Is Present* where she sat across the table and gazed at the participants was the inspiration for her neuroscience experiment *The Magic of the Mutual Gaze*. [7] [8] It used an Emotiv wireless headset asking two people to gaze into one another's eyes as their brain activity was displayed real time on a screen behind them. When their brain activity was on the same

wavelength, the images merged into one another. Lisa Park, a composer created *Euonia II* to use her emotions of anger, hate, desire, sadness and happiness coded into sound waves that produced vibrations in pools of water placed atop 48 speakers. [9]

These experiments and performances harness the specific mental states of focus and meditation. When more complex environments and sophisticated brain EEG readers are used, additional mental states are readily accessed, opening up new spheres of inquiry in the performance environment. The implications of these developments hold promise for rehabilitation, medical and gaming uses, and should be viewed with skepticism surrounding issues of brain surveillance, and the ability to manipulate and 'hack' the brain.

How Do I Know You?

Neuroscience researchers at the University of Pennsylvania suggest we are on the cusp of measuring psychological traits and personal information through functional neuroimaging. Instead of using the word 'geneotype' which references the Human Genome project, an international project that mapped all human genes, they refer to this newfound identifier as a 'brainotype.' When pressed to say how realistic this possibility is the researchers stated, "an explicit answer to this question is not available in the literature because published functional neuroimaging research has not been directed toward the measurement of normal psychological traits for the purpose of characterizing individuals." [10]

Suggesting this concern might be ahead of its time, they caution one should not dismiss the prospect of brainotyping outright. The study admits that "a modest degree of brainotyping capability already exists…(it) is not science fiction, but rather a realistic possibility, albeit limited in important ways." Farah raises the question if brain imaging could pose any real or future threat to brain privacy, given how simplistic current analyses of the brain are. She distinguishes between "behavioral privacy," which means one's words and actions, and "brain privacy," which are our inner mental and neural processes. She asks, "under what circumstances can brain privacy be breached? Will we eventually use brain-enabled devices to play in a virtual world? [11] [12]

In the future one could upload their brain data to the cloud in order to increase processing speed and facilitate multi-user access. Security and privacy from hackers and governmental intrusion and monitoring could be problematic using cloud services. What is the proper balance between the rights of the individual to brain privacy and the needs of society"? Farah concludes that current Institutional Review Board guidelines (IRB) are sufficient at this time for protecting the confidentiality of imaging data. [13]

Mind Melding Thoughts

Researchers at the University of Washington produced the first non-invasive human-to-brain interface by asking, "Can information that is available in the brain be transferred directly in the form of the neural code, bypassing language altogether"? [14] The researchers showed "that it is possible to use EEG to decode motor intentions from a ''sender'' brain, and TMS (Transcranial Magnetic Stimulation) to deliver an equivalent motor command to the motor cortex of a ''receiver'' brain, allowing the receiver to perform the hand movement that was initiated by the sender."

The first subject in the experiment wore an EEG cap. He imagined controlling a video game with his right hand. That brain signal was picked up by the EEG cap and sent over the Internet. The second subject had a TMS device placed on top of his head in the area of his left motor cortex, an area that controls the right side of the body. He received the Internet transmitted EEG impulse into his brain (non-invasively) through magnetic stimulation. Subject One in Lab One imagined moving his right hand. Subject Two in Lab Two received that impulse in his left-brain. His right hand involuntarily jerked when he received the impulse.

The experiment, the researchers suggest demonstrated that simple non-invasive technology already exists, and is developed enough to create rudimentary brain-to-brain information transmissions between subjects. They caution that a dialogue should now begin "between ethicists, neuroscientists, and regulatory agencies on the ethical, moral, and societal implications of BBIs (Brain to Brain Interfaces) whose future capabilities may go well beyond the rudimentary type of information transmission the researchers were able to develop." In the future will performers be able to transmit their intention to other performers through such devices? Though it seems unlikely at the present time, these types of experiments show we are on the cusp of such breakthroughs.

This notion is reinforced through the use of "Braingate." A quadriplegic used a Braingate device enabling her to control a robotic arm, grasp a cup, bring it to her lips and sip a drink through a straw. [15] [16] The device was powered solely by *her intention* to move her arm. [17] A tiny neural sensor, the size of a grain of rice had been implanted into her brain. It contained 100 electrodes that recorded activity in her motor cortex. These signals were decoded, and sent to the robotic arm that performed complex tasks when she imagined the movements of her non-functional limbs. As a quadriplegic her muscles could not move, but her neurons still fired at will.

Using EEG braincaps, thoughts and intentionality can now remotely power drones and planes. [18] [19] [20] These devices are being deployed for aerial surveillance and security ATLAS test drills, funded by the US military. [21] If these BCI devices can be hacked remotely then the brain does indeed become a hackable driver.

Memory Manipulated By Light: Optogenetics

What does memory look like as it forms on the spot? Can our memories be manipulated? Scientists at Albert Einstein College of Medicine at Yeshiva University in New York have filmed the molecular basis of memory using fluorescent-tagged neurons of mice. [22] Adina Buxbaum states that over 100 years ago scientists theorized memory had the potential to be stored by changing the shape and strength of synaptic connections between neurons. Up until the research team's experiment no one had been able to prove such changes.

Buxbaum tagged messenger RNA (mRNA) composed of beta-actin protein. mRNA's are a family of RNA, and copy DNA's genetic information translating it into proteins. The researchers stimulated neurons in a mouse's hippocampus in the area where memories develop. They watched fluorescent memory molecules develop deep inside neuron nuclei. From within the nuclei the mRNA molecules slid like a string of beads down dendrites, tree-like branch endings of neurons. Neurons meet at synaptic points that resemble fingers grasping one another. Beta-actin protein strengthens synaptic connections by altering the shape of the dendrite spines. Memories are created when lasting synaptic connections form between dendrites, which might explain the relationship between repetition and memory. Beta-actin, an active compound assembles and disassembles quickly, despite the fact that it assists in creating memory of events in real time. If memory is formed through the action of beta-actin protein, can that memory ultimately be manipulated? Could memory molecules be manipulated and hacked?

The answer to this question seems to be yes. MIT professors used optogenetics, stimulating individual brain cells with light. [23] ""Optogenetic" tools are genetically encoded molecules that, when targeted to specific neurons in the brain, enable their activity to be driven or silenced by light. [24] To test their findings, the scientists placed a special transgenic mouse in a box and shocked it. They used laser light to reach those select areas though optical fibers implanted via special cannulas to alter the genes of the mouse's brain cells in the region of the brain where the shock was administered.

The mouse was moved to a new location. It behaved normally. Researchers then shone a special blue light at the mouse. The blue light activated the genetically manipulated memory cells. The mouse's fear response returned even though there was no threat, and no shock. The mouse's response proved certain types of memory cells can be genetically manipulated, and activated according to specific types of light. The brain then becomes a hackable driver, with memory manipulated, in this case, by light.

Emotiv Cap to Future Spy Surveillance

The Emotiv Cap, a portable EEG device reads changes in electrical activity in the brain. [25] Those changes can be mapped to emotions, facial movements, eye, eyelid and eyebrow positions, smiles, laughter, clenched teeth, smirks, devices and even virtual avatars. It tracks six specific directions in a screen display; left, right, up, down, forward and 'zoom' or depth, as well as six rotations; counter clockwise, left and right, backward and forward, and one interesting one referred to as 'disappear." It takes about eight seconds using Emotiv's software to calibrate the specific contours and fold patterns of an individual's brain. It's a process so unique it is akin to a human fingerprint. Both conscious and non-conscious content has been mapped for accuracy into the software accounting for variations in the brain's multiple folding patterns. Billions of neurons constantly interact with one another emitting tiny electrical impulses. What scientists at Emotiv did was remap those signals back to their source in a specific area of the brain. The Emotiv reads and translates these electrical impulses with a latency of about 150 milliseconds.

The Emotiv could be used for focus group testing, directing a prosthetic, turning on a toaster, or creative arts practices. But there is a darker side. Ivan Martinovic at the University of Oxford notes that BCIs are growing in popularity in the gaming industry. [26] He states "The security risks involved in using consumer-grade BCI devices and the impact of malicious software with access to the device is unexplored," and concludes someone could conceivably use brain data to actually steal a bank PIN number.

His team examined the "P300″ brain "fingerprinting" signal, activated when an individual recognizes an image, sound, or even a smell. They had a 40-60 percent accuracy rate identifying details of where a subject banked, and what their PIN number was just by flashing subliminal photos of bank logos and various numbers while monitoring their subject's P300 responses. This experiment took place in a lab, but the implications for more sophisticated hacking are chilling. Could hackers break into big data banks of gamers playing in the cloud and harvest their thoughts? Could the brain as a game driver be hacked?

Artistic Interventions

All of these experiments point to a nascent potential to track, categorize, manipulate and surveil the human brain. As research on the brain continues throughout this decade and into the next, it raises a multitude of ethical, social, political, scientific, moral, and technical issues. These issues must be addressed by their various disciplines. However I believe it is Rosenboom's vision that is the most appropriate for my own practice when he indicated large scale theater or operas using biotelemetric means by human and non humans interacting with audiences, performers and the entire environment could create a mythical

scale synergistic theater.

In order to realize that vision I am at the early stages of creating a "brain opera." Studying the recently developed open source brain computer interface, OpenBCI, has shaped my ideas. [27] Unlike previous BCIs that have proprietary SDKs (Software Development Kits), OpenBCI is open source. OpenBCI consists of an Arduino-based specially designed EEG capable shield that monitors between eight and sixteen different locations in the brain. The headset can be printed out using a Makerbot 3D portable printing device, and comes with special open-source monitoring software. Wet, or gel enabled contact points enhance the sensitivity of the connections.

Through studying the neuroscience necessary to create a BCI interface, it became apparent that current consumer level BCIs are a useful, if imperfect mechanism for harnessing human thought. [28] However, they do allow for more of an indicator of a range of mental states than previously existed on a consumer level. As of this writing I am in the testing phase of selecting the correct BCI device to use for my short form opera-in-progress titled "Noor," which translates as "light" in Arabic. The opera Noor poses a question, "is there a place in the human brain where surveillance can not go?" Through the use of an "actor" and audience interaction I hope to create a mode of inquiry that an audience can comprehend concerning this critical question.

I endeavor to create a performative work with one or more human actors enacting a multi-layered story inside an immersive, 360-degree, or other type of theater. Images, sounds and spoken words will be trigged by different areas of the subject's brain, derived from multiple databases of these mediums. They will be projected onto screens using the following brain states as drivers: *Relaxation, Engagement* (attention & concentration), either *Focus* (fixed attention on one task related to flow) or *Interest* - strong enjoyment/non enjoyment, and *Stress*. I intend to show live time brain processes of the performer on the screen as part of the event. This part of my research is currently under development while I investigate technologies, techniques, story, and coding options. This paper is a step in that process.

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Designing Nano-Media Across Disciplines: Circular Genealogies and Collaborative Methodologies at the Optical Frontier

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Abstract

This paper draws on a collaboration between scientists, an artist, and a media researcher to produce 'nano-media,' a media surface designed at the nanoscale, to examine the interdisciplinary methodologies and circular genealogies of emerging media. Based on nano-optical structures and optical variable devices, the scientifically innovative technology uses many analog techniques to construct a new kind of material that can produce striking iridescent images and simultaneously store covert information. The first goal of this research was to use these novel optical nanostructures to create a cover for the periodical *PUBLIC*. This paper details the project as it moved from conceptual exploration to the prototype and manufacturing stages, considering the specific hurdles of translation between fields, the production challenges, and the points of intersection that brought the team together. By situating nano-media in 'retro' techniques of image production – including analog cinema and photography – the paper also provides a point of entry for artists and humanists to engage and participate in the imagination and innovation of media built at the nanoscale. Finally, through the lens of nano research, the paper challenges the 'art-sci' moniker to reflect a more fluid and multiple cross-pollination of fields as we design the media of the future.

Keywords

nano-optics, research-creation, art-science, interdisciplinarity, emerging media, nano-media, iridescence, biomimicry, media history, materiality

Introduction

After a full day of meetings discussing nano-media with various curators at Vancouver art galleries, I was crossing the street when a car I had not noticed zipped by me. I jumped back as a man turned my way and said with a chuckle, "What we can't see can't hurt us!" An innocuous statement to be sure, but after spending the week immersed in the world of nano-optics, my mind was attuned to questions of sight and visibility, not to mention the overarching ethical labyrinths of working in the realm of nanotechnology, and I could not help but pause to consider his words. Technologies of the nano, after all, are built at scales invisible to the unassisted human eye, and indeed it remains to be seen if being able to access matter at this scale is boom or bust for humanity. [1] The reason I was in town was an interdisciplinary collaboration in which as a media researcher, I brought together a team of engineers from the Ciber Lab at Simon Fraser University under the helm of Professor Bozena Kaminska,[1] together with the artist Christine Davis,[2] to develop a new kind of media surface and visual experience that combined the optical properties of materials at the nanoscale, the distinct methodology of nano-fabrication, and classical analog photography/cinematic techniques. We called it 'nano-media.'

In the world of nanotechnology, material structures and functional systems are built at the scale of nanometers, or billionths of a meter. Operating at this scale, nanotechnology "dreams of engineering every aspect of our material reality, precisely fashioned and designed at the limits of fabrication, one atom at a time." [2] Specifically, "the radical innovation" of nanotechnology (and nanoscience) is the ability to examine the properties of matter at the nanoscale, where "surface phenomena rather than mass properties govern the chemical and biological behavior of objects," meaning that, once we reach the nanoscale, materials have different properties – chemical, electric, magnetic, mechanical, and optical – than those of bulk materials. [3]

Colin Milburn has described the visualization of the molecular landscape as "nanovision," which is made possible through powerful scanning probe instruments like the scanning tunneling microscope (STM), scanning electron microscope (SEM), or atomic force microscope (AFM), that sense, feel, and map the atoms of the surface to create topographical images based on the data gathered through the "haptic encounter" of the scanning process. [4] Much of what has been called nano-art so far has been engaged with the nanosurface through these kinds of images, renderings, or (re)presentations, which provide ways to understand the invisible dimensions and scales of the nanoworld by using the sense of touch to explore the joined concepts of scale and surface. [5] This 'vision,' made possible through touch and tactility, is an example of nanotechnology research as "fundamentally an aesthetic endeavor in that it depends upon the production of new sensory experienc-

[1] The scientific team included postdoctoral fellow Dr. Hao Jiang, graduate students Reza Qarehbaghi and Mohamad Rezaei, and undergraduate student Mohammad Naghshineh.
[2] http://www.christinedavis.com

es" in which "the appearance of new kinds of vision and visual metaphors was key." [6][3]

While the STEM disciplines have taken to nano by storm, every day yielding new discoveries with the potential for radical change, there has so far been little access for those outside of the sciences to respond and engage with these developments in sustained and informed ways.[4] The aesthetic of the surface is in many ways an entry point for humanists and artists into nanotechnology, as it renders the nano visible and thus accessible. So far, however, there has been limited attention paid in the arts to the particular optical experiences that can be created using nanomaterials,[5] and the building of the surface, the making of materials that use the knowledge of nanovision, has been largely restricted to scientists, with some notable exceptions, such as Frederik de Wilde's *Hostage* (2010), Julian Melchiorri's *Cocoon* (2014), or Kimsooja's *Needle Woman: Galaxy was a Memory, Earth is a Souvenir* (2014). Indeed, artists and media scholarship – a field that should be most intrigued by the creation of new kinds of surfaces – have so far engaged rather tentatively with these new matters and their distinctive properties as materials and media. It is with this in mind that I formed an interdisciplinary team to creatively explore nano research and innovation of surfaces, specifically in the realm of nano-optics. The goal of our collaboration was not to access the surfaces of nature, to touch or image existing materials, but to in fact build a surface, one that would use the properties of materials and light as they interact at the nanoscale. We imagined a new kind of interface, a medium that would harness our ability to manipulate and design matter at the nanoscale to create novel visual experiences.

Driving the collaboration was an inquiry into the emerging possibilities of nano-optics that combined new scientific discoveries, experimental research and practical considerations, and the methodologies, questions, and particular knowledge (historical, material, aesthetic) of the artist and media researcher. As a first step in the partnership we decided to produce a cover for the fiftieth issue of the Canadian periodical *PUBLIC Art/Culture/Ideas*,[6] which was to launch on November 26, 2014 at the Art Gallery of Ontario in Toronto. The deadline for the project was therefore firm. What follows is an account of this first project, including scientific breakthroughs, practical challenges, and exploratory reflections on the methodologies and genealogies that emerged in the collaborative making of nanomedia.

Morpho Butterflies and Nano-Optics

The technology of nano-optics, or the field that is concerned with the properties of materials and light at the nanoscale, has so far been predominantly applied in the domains of security and authentication. One oft-referenced inspiration in this field is the blue morpho butterfly, whose wings appear blue to the human eye even though they contain no pigment and are transparent. This effect is due to the way the light diffracts from billions of nano-sized structures that constitute the wing. [7] (Fig. 1a) A number of natural organisms, from butterflies to beetles and minerals, have such iridescent properties, and scientists have been working to emulate them through the design of optical nanostructures, called optical variable devices (OVDs). These do not use color inks or dyes but, like the morpho butterfly, generate structural color through the light defraction from nano-sized slits or holes in a given material, such as a polymer or metal. (Fig. 1b) These can be very specifically designed to produce particular ultra-high resolution iridescent visual effects. [8] B. Kaminska and the Ciber Lab had been developing groundbreaking OVDs for a number of years already, including creating OVD nano-images embedded and reproduced in a variety of polymers, for use in banknotes, for example. [9] (Fig. 2a) This technology was commercialized, and the lab was moving forward with new ideas to further improve their designs as well as their fabrication and manufacturing methods. They were also looking for new applications outside of the realm of security.

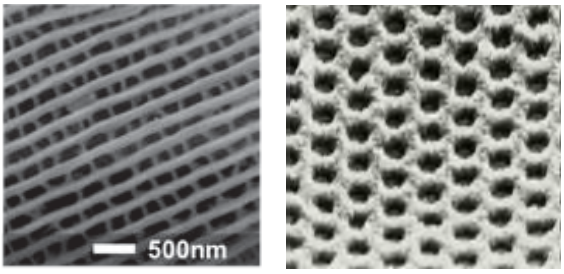

Figure 1a (left). Scanning electron microscope (SEM) image of morpho butterfly wing; Figure 1b (right). SEM image of nano-OVD produced by the Ciber Lab, also 500nm.

Independently of this, Davis too had been inspired by the properties of the morpho butterfly's wings. In her project *Who's Afraid of Red, Yellow, and Blue* (2008), she projected filtered light onto its wings to display not the familiar iridescent blue, but distinct color patterns. (Fig. 2b) The wings became a projection screen, a display of Davis' longstanding attention to the material properties of the projection process, experimenting with the materiality

[3] Victoria Vesna and James Gimzewski's *Blue Morph* (2007–), for example, is one such pioneering work that used the AFM and SEM to record sounds and images of an organic surface (wings of the morpho butterfly) to produce new aesthetic and sensory encounters with the nanoscale. http://artsci.ucla.edu/BlueMorph/

[4] This can be in part be attributed to the complexity of the technology, the speed at which it is developing, as well as the difficulty in gaining access to the newest developments. Experts in nano-optics (and particularly OVDs), for example, which are currently predominantly used for security applications, are reluctant to make their knowledge open to the public.

[5] For examples see Paul Thomas, Chapter 4, "Matter, Measurement and Light" in *Nano Art*, pp. 87–104.

[6] Christine Davis is the co-founder of *PUBLIC* and I am the current Managing Editor. See: http://www.publicjournal.ca/

Figure 2a (left). Nanostructures (OVDs) by the Ciber Lab; Figure 2b (right). Davis' *Who's Afraid of Red, Yellow, and Blue*.

and haptic nature of the screen, and developing interactions between projected light and organic surfaces to produce modulated images. In *Who's Afraid*, the slide projected is a close up of a Wonder Bread package, echoing a relationship between biomimicry and evolution.

The scientists' primary goal was to create new nanostructures with increasingly better colors and manufacturing processes. They strived to produce larger and customizable images, to reduce cost in the production methods, and to improve resolution and storage capabilities. Davis meanwhile was intrigued by the ultra-precise manipulability of light and the way colors were generated, by the brightly iridescent properties of the OVDs, and the possibility of integrating pixels of OVDs in a variety of materials and art contexts. Though coming from entirely different disciplines, the common interest in playing with light and color through the manipulation of materials rooted the project in a shared curiosity and placed the emphasis on process and research. Together we wondered how media innovation would take shape in the context of such interdisciplinary inquiry.

The Science of Nano-Media

Nano-media is the next step in nano-OVD innovation produced by the scientists in our team. [10] It is built by combining a pixelated pre-fabricated nanosubstrate with an image. The image is located in the intensity control layer (ICL), which can be produced either through photochemical exposure, laser writing, or as a black-and-white photomask that is then precisely aligned with, or imprinted on, the substrate. The nanosubstrate and ICL together produce a colored image. (Fig. 3) The scientists early on compared this superimposition of two layers to the early twentieth century process of Dufay color film, which used color filters based on a regular mesh of red, blue, and green lines on the film base, along with black-and-white photographic emulsion, to produce color images. In nano-media the film becomes a nanosubstrate, but the principle remains the same. One can say that nano-media brings together biomimicry (through the 'imitation' of the morpho butterfly) and 'retro' – analog, material – techniques of image production (such as those of Dufay color film).

The substrate is made up of nano-sized holes (nano-hole arrays, or NHAs) or slits/graves, that create pixels, with approximately one billion holes in a square centi-

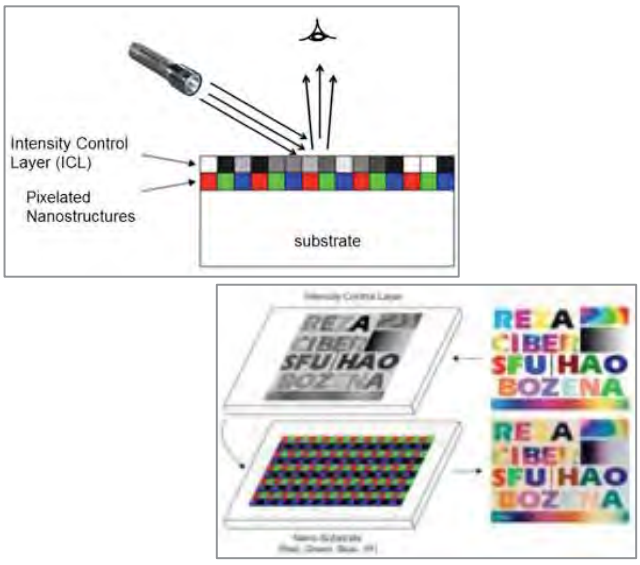

Figure 3. Diagrams of ICL creation and alignment on nano-substrate to create a nano-media.

meter of nanosubstrate. Each pixel is made of four sub-pixels: R (red), G (green), B (blue), and IR (infrared), with the dimensions of each pixel changing depending on the production method, and thus producing different color resolutions. (Fig. 4a) Depending on the pixel size, nano-media can produce images ranging from 1,270 pixels-per-inch (PPI) to 12,700 PPI. This is equivalent to a range between 36,830 dots-per-inch (DPI) to 368,300 DPI. The smaller the sub-pixels the higher the resolution. [11]

The substrate material fabricated with pixels is built using nano-fabrication tools like focused ion beam lithography (FIB) and e-beam lithography (EBL). It can be made with a variety of materials, including metals, polymers, paper, tissue/fabric, or glass. Nano-holes with a thin layer of metal (ex. gold, silver) in particular produce an extraordinary optical transmission (EOT) and display intense visual colors across the visible spectrum. [12] These are referred to as plasmonics, and are used in OVDs, sensing, and other areas.

The RGB pixels can be tuned to produce any color with the ICL, while the IR pixel is used for non-visible information (storage). There are a number of techniques to produce the ICL, which can offer different resolutions

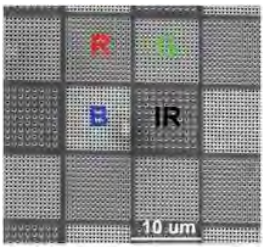

Figure 4a (left). SEM image of the fabricated nanosubstrate showing the structure of the sub-pixels; Figure 4b (right). The first prototype of an ultra-high resolution color image stored on nanosubstrate, with 36,830 DPI (2 x 1.5cm).

when combined with the appropriate pre-fabricated substrate. The final resolution of nano-media therefore depends on both the sub-pixel size and the ICL. High resolution can be achieved through a photochemical method, while lower resolution can be achieved using a photomask. In the photochemical process, a silver halide emulsion is exposed, or the ICL is written, for example using a laser. Using a photomask, a 'negative' of the image is produced and then aligned with, or imprinted on, the nanosubstrate. In both cases the technology functions much like photography, and the team initially described the technology as nano-photography, or nanography. Ongoing comparisons to analog versus digital methods became increasingly apparent and useful in the collaboration (more on this below), and the scientific team continues to explore new ways that analog methods can be adopted for the development of nano-optical materials and surfaces.

For a long time there have been limitations with using nano-optical structures, such as the need to generate a costly stamp for each (very small) image (a stamp is a 'form' made of nanostructures embedded with an image that is used for high volume reproduction), and this is reflected in the kinds of applications that use them, such as banknotes. [9][10] Indeed, while the visual quality of nano-images is continuously improved, [13] there had not yet been a solution for fabricating images without the use of stamps, limiting the expansion of the technology.

With the *PUBLIC* project in mind, the scientific team developed the techniques of nano-media, producing image prototypes of around 2 x 2cm. (Fig. 4b) The elimination of the stamp meant that larger images could be made more easily: rather than building each image from nanostructures to make a stamp, the image was now located on the ICL and 'transferred' to the pre-fabricated nanosubstrate. Moreover, the development of the substrate to include the IR sub-pixel meant that these nano-optical structures could concurrently store a variety of information into the visible image on the various layers of the infrared spectrum (digital binary information, a bar code, a 2D QR code, a grey-scale image, etc.). The result, nano-media, was an extremely thin 'film' that could both display and store a variety of information, and could be produced incomparably faster to the stamp-only methods. [11] The question to be resolved was how to transfer the process used for the prototype to the production of 1,000 issues in a period of roughly eight months.

Collaboration and the Evolution of an Idea

Davis and I, both based in Toronto, travelled to Vancouver in April and August 2014. We did preparatory research on nano-optics and on the work produced by the lab, which was sent to us in advance. A few things quickly became apparent:

1. The Analog, the Material

In considering the production of nano-media, we pinpointed early on numerous analogies to analog processes: Dufay color film's two-layered process, photography's use of emulsions, exposures, and negatives, as well as physical methods of printing like lithography and mezzotinting. This ongoing return to analog techniques was a way for us, the non-scientists, to access the innovations of nano-optics and nano-media. Moreover, Davis' background as an analog photographer, her knowledge of emulsions, and of photographic processes in general, proved helpful to the engineering team, who was unaccustomed with working in this increasingly obsolete 'mode.' This, alongside her experience working across media, armed her with much more practical and material understanding than the scientists expected, which laid the foundation for a fruitful collaboration. While the scientists were searching the world for emulsions, Davis' familiarity with, for example, DIY methods, showed the scientists a new way of approaching the problem, not as scientists, but as an artist searching for, if not making, her materials.

Understanding nano-media in a set of development and fabrication processes allows us to contextualize it as material and therefore to situate it within a larger media history. First, the physicality of the holes in the substrate is not unlike that of early computing technologies, where punched cards or microforms, for instance, carried data through a system of holes.[7] The difference, broadly, is in the size of the holes and material used. Then there is the nano-media itself, a foil-like material that, when produced in large quantities through a roll-to-roll manufacturing industrial process, has a materiality akin to film. Giuliana Bruno describes film as a kind of surface, "a thin skin, a membrane," and, writing about Tacita Dean's film *Kodak* (2006), makes an observation, about the making of celluloid film, that resonates equally with 'nano-film,' as "intimately dependent on being touched and transformed by light, in time, and taking time." [14]. The concept of the surface as a way of thinking across media becomes increasingly useful with nano materials. As Silvia Casini notes, when "we discuss visibility and invisibility…we cannot avoid talking about the surface." [15]

Turning to analog practices provided more than useful analogies, as nano-media itself can be understood as a digital-analog hybrid technology. While it is digital in the design of the substrate structures and ICL, the analog techniques, such as that of exposure, the ability to 'transfer' or 'imprint' any analog image directly into a substrate (i.e., without converting it to a digital file), as well as the physical material of the foil, open the door to interesting connections that cast a light on the circular genealogies of visual media and information technologies. This ability to draw on the history of materials and processes is helpful not only for humanists entering the realm of nano research, but for finding commonality across disciplines.

[7] I presented a paper on this topic, "Nanotechnology, Media Studies, and the Punched Card," at the Canadian Communication Association conference at Brock University in 2014.

2. Innovation and the Disruptive Experience

Nano-media has the unique capacity to store covert information in the IR layer. Though it is one of its defining features, we quickly discovered the challenges of applying it in the *PUBLIC* project. While some were practical (we had a short timeframe and were already working with so much that was new), there was also a conceptual difficulty surrounding the user experience. How do we show the ability to store data in nano-media in a way that the viewer could *experience* as something different, unfamiliar, and novel? We eventually decided against the idea of using a reader (e.g., smartphone) to scan the information since, without being given any explanation, a user would not engage with this technology any differently than scanning a QR code or using an AR application. In other words, as soon as the reader was introduced and the data had to be read, decoded, and viewed on a separate screen, the very fact that the information was stored in the material (hardware) and not the software would be difficult to convey, and probably lost. Moreover, we decided that convincing *PUBLIC*'s readers to download a new application would be difficult, not to mention the additional work of producing the software (work for which we would have to find a specialist outside of the current team). Some ideas we had to resolve this issue included: using filters that would show the data stored in the IR layer; encoding the data only in certain sections of the cover; encoding different data on different sets of covers; integrating the data with pressure or biomedical sensors; storing sound which could be played though the cover. While these challenges could be solved in an installation or exhibition setting – for example with special lighting conditions that used filters that would allow access to the IR – they were unrealistic in the *PUBLIC* project. We could not, with our time and budgets constraints, find an appropriate design and manufacturing solution that would create a disruption of user experience. After weeks of deliberation, we decided that though it was a feature that should be showcased, we would proceed for the cover without IR data storage. This was a very unexpected outcome for the scientific team, an example of the aesthetic and media experience taking precedence over the 'scientific method.'[8]

3. "In my world"; Optics Across Fields

Interdisciplinary collaborations, especially across the arts, humanities, and sciences, have long been described as a meeting of, and translation between, cultures. [16] Currents in transdisciplinary collaborations mostly focus on the coming together of arts and sciences, but technologies, argued Cornelius Borck, act as the "communicating vessels," an idea that shifts the notion of fields from distinct to overlapping. Indeed, the binary moniker 'art-sci' proves all the more insufficient as collaborations work towards new kinds of technologies and emerging materials, surfaces, and media. It is a false dichotomy that produces an illusion of clarity that neatly, if only in terminology, joins two 'worlds' when worlds are messy and many. In the diverse context of nano research, which itself blurs the lines between science and technology by bringing together, among others, biologists, chemists, physicists, and engineers, [17] it is not enough to speak only of a meeting between 'art' and 'science.' While Borck locates technology as "the communicator, the missing link and material linkage between art and science," [18] Robert Root-Bernstein also adds media as one such often overlooked communicator. In his integral tetrahedron model – what he describes as the "universe of innovation" – he brings together sciences, technologies, media, and aesthetics, to describe the "pathways between arts and sciences" as "two-way streets mediated by media and aesthetics." [19] He does not here articulate how he differentiates between science and technology, and technology and media, which are particularly muddled categories in the field of nano research. However, his point about the influence of media and aesthetics back onto science and technology is significant: new technologies that explicitly work to converge our materialities, the matter of the world, into information and into media [20] generate new aesthetics, but, conversely, new aesthetic approaches must also influence the materials (media, technologies) produced. For this, the spaces of scientific and technological innovation need a sustained rapport with the knowledge and methodologies of the arts and humanities, allowing 'art-sci' to better reflect the fluid and varied cross-pollination of fields possible in transdisciplinary research.

In this particular project, searching for points of contact between our fields resulted in exploratory conversations that often began with, "In my world…." In the earliest stages, the very scale of the nano at which the scientists were working seemed "incomprehensible" [21] to Davis and I, a feeling that, as Victoria Vesna and James Gimzewski have put it, "our minds short circuit" when confronting the scale of nanotechnology. [22] To get a better sense of working at this scale, we toured the sterile environment of the clean room where the scientists worked. The meticulously regulated process of suiting up was like a confirmation into another, usually inaccessible to us, 'world,' and the affective experience gave us an entirely different outlook on the physically demanding labor of working at this scale.

There were a few unexpected hurdles of translation, some larger than others. For example, the realization that while the artist was using DPI as a measurement for resolution, the scientists were using PPI. While these were the standards in their fields, calculating the conversion and understanding their relationship, though relatively straightforward, was a crucial step in making sure everyone was visualizing the same level of resolution. Another such example arose with color. While Davis would be giving the scientists an image file produced through Ado-

[8] See Robert Root-Bernstein's argument that scientists must "abandon our reliance on a 'scientific method'" to embrace the kinds of knowledge that come from the artist. In "Aesthetics, Media, Sciences, and Technologies," 276.

be Illustrator, the scientists would convert this using an in-house software to produce the ICL. But how does color translate from the Adobe software to nano-media? Put differently, how does the structural color produced through nano-media, translate into that of a software like Illustrator? Here the scientists had to familiarize themselves with the artist's tools, while she had to make sense of the software they were using. While color systems like RGB, CMYK (cyan-magenta-yellow-black), and HSL (hue, saturation, lightness) have been established for pigment-based color printing, "color systems have not been established for plasmonic-based color." [23] Slowly we understood how to produce the best colors through the different stages of production, allowing Davis to better imagine the final nano-media result of her Adobe file.

From Craft to Automation

Over the course of the summer, the scientists faced one seemingly insurmountable hurdle after another, each step of the process to scale up the fabrication a challenge. In effect, they were scaling up a technology extremely rapidly, moving from the prototype stage to the production of 1,000+ copies, along with their integration into the publishing process, in just a few months. All the while they continued to develop new ideas, working to find solutions and alternative approaches to unforeseen problems. For example, if using an alignment method, the substrate and ICL had to be juxtaposed with an accuracy of 5 microns but current available machines could only do it at 100 microns. A misalignment of that scale, because we are dealing with nano-sized structures, would ruin the entire visual effect. So, while the scientists proved this could be done by hand, producing very high-resolution images (Fig. 5), the labor-intensive nature of the work made it impossible to do for so many copies.

As for any scaling-up endeavor, the challenge was in how to transfer the innovations of a manual process to one that was automated, in moving something akin to craft, to an industrial set-up using sheet-to-sheet or roll-to-roll fabrication. The biggest challenges were the production of the ICL and deciding how the image would be produced: through photochemical exposure, laser writing, or the alignment or imprinting of a photomask, each of which has particular advantages and restrictions.

Figure 5. Nano-media image (3 x 5cm) produced by manual alignment.

At the start of the project, guided by the 'scientific method,' we had been aiming to achieve the highest possible resolution, and thus strived to develop the ICL using the photochemical process. The scientific team went on an international search for the right materials, emulsions and lasers. Concurrently, to be on the safe side, they kept refining the photomask approach with different resolutions, using different polymers, coatings, bonding layers, and alignment methods. Finally, by September, with just over two months remaining, it was decided we had to use the relatively reliable photomask imprinting technique, as the time and labor involved for the other more innovative processes were above-and-beyond our capacities for this project, and also too risky.

For Davis this was not a significant change of plan, as the resolution using the photomask was still incredibly high. Whereas for her the 'less advanced' method was perfectly suitable for the purposes of the *PUBLIC* project, the scientists' were not used to thinking of their technologies in this way, where a 'less optimal' solution was perhaps better and sufficient. For this project, where the goal was not just a technological showcase but also an aesthetic exploration, we could work with 'less.'

Once this decision was made, we proceeded with as much testing as possible before ordering the final roll of nano-media foil (the combined nanosubstrate and ICL) from ITW Covid.[9] In one such test, when a metalized polymer on a sample *PUBLIC* cover produced problematic results, the decision was quickly made to change to a transparent foil. Even if the visual effect would be diminished (since there would be no metal to enhance the color's brightness), it could be superimposed on top of a cover, and in those places where there was no image the foil would simply be see-through, rather than opaque due to the metal. Time was running out.

Designing the Cover

By early fall it was also time to make a final decision on the cover image. Alongside the ongoing scientific progress, Davis had continuously been looking for ways to play with the themes of (in)visibility, perception, nature, light, and color. With the assistance of fellow artist Scott Lyall,[10] and as the theme of this *PUBLIC* issue was *The Retreat* (based on a visual arts residency at the Banff Centre), they produced an image of a dark and shadowy forest. This would be the cover printed on paper with inks as per usual. Based on the decision to go with the mask method, Davis would superimpose this printed layer with sections of nano-media, an array of sparkling iridescent colors emanating from the cover. The light structures would flicker from the forest and also retreat, a reflection on the hidden depths of nature and the moments of illumination that shine from he darkness of invisibility or the unknown. (Fig. 6)

[9] A professional company that became an essential collaborator.
[10] As well as her assistants Polina Teif and Vlad Lunin.

Figure 6. Test of final design of the cover with nano-media manually superimposed.

Armed with a design plan, the scientific team proceeded to design the necessary nano-media components and sending them to ITW for roll-to-roll fabrication.

Troubles at the 11th Hour

From the start we followed the instruction from *PUBLIC's* printer, located in Québec, who indicated the kind of paper and lamination usually used. We had decided that it would be best to print the cover and assemble it with the nano-media layer in Vancouver, before shipping the ready-to-bind product to our Québec printer, who would print the interior of the issue as usual. Their soft deadline for receiving the cover was November 1. After receiving the nano-media foils from ITW, and with a bundle of printed test covers, the team set out to a lamination company in Vancouver. While some lamination tests had been done before this stage to ensure that covering the foil wouldn't dampen the effects too drastically, a last minute decision to coat the foil in an extra reflexive coating (to compensate for the switch from metal to transparent foil), was not tested, and the result, when everything was put together – cover, nano-media foil, lamination – fell flat. The light reflected too much from the entire surface, while the specific colors of the image were not easy to distinguish, dampened drastically by lamination. It was now November 3, 23 days before the *PUBLIC* launch.

The next few days were frenzied. We enlisted the help of *PUBLIC*'s designer and printer to help us find a solution and salvage the hundreds of meters of foil. After much deliberation, we opted to put the foil inside the journal as a rectangular insert with a round cut out where the foil could be placed. In a true spirit of teamwork, the entire Vancouver team set up a production assembly line to produce the inserts, which were delivered to Québec on November 20. (Fig. 7a) Davis and Lyall produced a revised cover that included the image of what the nano-media would have been. They printed a 'shadow' of the nano-media, with the solid ink functioning as a 'fixing' of the variable optical version within. A special shipment of

Figure 7a (top). Assembly of nano-media insert; Figure 7b (bottom). Final results in *PUBLIC*. [11]

the issue with nano-media insert included, arrived in Toronto on Nov. 24, two days before the to launch. (Fig. 7b)

Outcomes, Debrief, and Next Steps

The project did not turn out the way it was initially conceived, with difficulties in scaling up the nano-media prototype, with all of its features, and the last minute move from the cover to an insert. But, since artistic and scientific projects face similar challenges as they move from speculation to production, the team navigated the difficulties with flexibility and creativity. In hindsight, under the circumstances of the firm deadline, our goals were set too ambitiously. But the collaboration was still successful in developing interdisciplinary methodologies for technological exploration, research, and innovation. Moreover, the furious pace of the project lead to numerous innovations, which, though they could not be incorporated into *PUBLIC,* have already produced new patent applications [24] and partnerships, and are the foundations for new ideas and ongoing research.

Continuing their collaboration, the team is now working on an installation for Davis, exploring the possibilities of thread embedded with nano-media pixels, drawing on the histories of weaving and looms. The entirely different conditions of the installation allow for a process that can develop organically through singular objects, leaving time for technological and aesthetic exploration through trials, feedback, and observation. The possibilities for nano-media are vast, and if we give artists and humanists access to these technologies, we might start seeing things very differently.

[11] The final product in motion: https://vimeo.com/112849671

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Frozen: Exploring creativity and the process of making using photogrammetry.

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Abstract

The ability to capture, remake, reinterpret, is fundamental to the process of making. The physical act of drawing repositions ideas thus enabling us to re-imagine them and move forward with new concepts. Translating what we see into a new medium gives us a fresh insight.

Another way of taking a fresh look is through sampling. This has existed for some time in 2D image making, and more recently digitisation of audio has created a new genre of music making.

The physicality of 3D objects presents a different challenge. 3D printing is becoming commonplace; yet there is little discussion about where data for these objects comes from. Technologies for capturing 3D data are primarily expensive, slow and require detailed calibration, but one emergent technology which could change this is photogrammetry, which has roots as old as photography itself. Also known as remote sensing, photogrammetry allows objects to be measured without being touched. Cloud based technology has removed the limitations of desktop computing, simultaneously increasing the scope of objects which can be captured, and democratising the process.

Using open software and capture mechanisms I explore the nature of ownership and the role of the maker when 3D capture becomes commonplace.

Keywords

3D printing, sampling, craft, making, photogrammetry, CNC machining, prototyping, design, copyright, authorship

Introduction

The history of making is invariably bound with the notion of craft. The combination both of human motor skills, whether mediated through mark making or the tactile manipulation of materials, and imagination has shaped our comprehension of value in finished artefacts. Traditionally this is an iterative process, mediated by practical research and visualisation in the mind of the maker, but when augmented by technology a new form of practice emerges through sampling. The notion of sampling is not new, nor is the technology used to mediate the work. From the knives and scissors used in collage and decoupage, to the many new genres of music that have emerged with the advent of digital audio sampling, there is evidence to suggest that capturing and refashioning existing material stimulates creativity.

The emergence of the maker movement has seen many technologies appropriated through physical exploration and experimentation. FabLabs and hackerspaces have brought together makers and provided a platform to raise the public profile of tools such 3D printers and drones, and microprocessors such as Arduino and Raspberry Pi. The rise in popularity of 3D printing can largely be attributed to MakerBot Industries, who launched Thing-O-Matic at the Maker Faire in New York 2010 [1]. Their first machine, Cupcake released in 2009, used electronics from an open source project at Bath University called RepRap. The RepRap project led by Dr Adrian Bowyer (Bowyer et al 2006) demonstrated how a suitably designed 3D printer could be capable of printing the parts required to create a copy of itself [2]. This early democratisation of the 3D printing process enabled exploration by anyone with sufficient workshop knowledge, and access to the 3D printer, to replicate it from open source data.

The potential of 3D printing has been explored by many craft makers and designers. Ron Arad's work Bouncing Vase (Arad 2000), utilised the properties of the process to create forms difficult to create through other media [3]. This focus on the act of manufacture as the key benefit of the digitisation of craft was demonstrated clearly in the Power of Making exhibition at Victoria & Albert Museum, London in 2011 created in collaboration with the Crafts Council (UK), and in the accompanying publication (Charny 2011), which highlighted a growing use of digital manufacturing technologies [4]. These works however still remain focused on production, and require 3D data for the printers to work with. Unless you are proficient with, and have access to, Computer Aided Design (CAD) software where does this information come from?

Sampling in the creative process

Drawing or working with raw materials is often perceived as the essence of creativity, suggesting that somehow the craft of the practitioner conjuring up an inner force to make something anew. The process of sketching or making is reflective, observations made during the process create new interpretations and reinterpretation is the basis of sampling. In the visual arts Richard Hamilton's collage for an exhibition catalogue, "Just what is it that makes today's homes so different, so appealing?" (Hamilton 1956), is filled with reused images of desirable objects representative of contemporary living. The piece is now recognised as a formative work in the genre of Pop Art in which the use of found imagery to create new works is acceptable [5].

Yet the borderline between derivative and transformative can sometimes be unclear. When a photograph of Barack Obama by Mannie Garcia in 2006 was used by artist Shepard Fairey as the basis for the HOPE poster (Fairey 2008), the resultant legal action took five years to resolve [6]. When Paula Scher used Herbert Matter's original poster for the Swiss Tourism industry to promote Swatch she did so with clear intent, and agreement to reinterpret the original (Scher 1984) [7].

This discourse about originality and ownership has often been driven by technologies that enable sampling to couple with those that enable reproduction and distribution. The combination of digital audio sampling and software to allow remixing, together with the internet as a distribution channel, has forced change in the music industry.

The commercial and intellectual boundaries developed to enable the distribution of physical artefacts are being similarly challenged as data files permit wide distribution and 3D printing develops as a process to realise the objects in physical materials. The absence of mass market understanding of facilities to digitise physical objects has so far limited the opportunity for sampling to impact the market for consumer goods.

Inspiration from observation

> "*To me, photography is an art of observation. It's about finding something interesting in an ordinary place. I've found it has little to do with the things you see and everything to do with the way you see them.*" Elliott Erwitt (Erwitt 2011) [8].

Photography can reveal new ways of seeing. An example of this, from a series titled Long Exposure by artist Geoffrey Mann, captured the motion of a moth around a light bulb. The resultant trails were translated into digitally sculpted work "Nocturne" (Mann 2009) [9]. Surprisingly, although captured through photography, the artwork is not a direct result of an image from a camera but was created using CAD software.

Photogrammetry is a process of deriving information about a surface from photographs of that surface. A series of images, taken from known positions, can be analysed to reveal information about the relative heights of points on the surface.

Using photogrammetry, the process at the heart of the software 123D Catch from AutoDesk Inc., I realised that I could easily and quickly construct physical objects directly from images. Using digital cameras to sample objects and create detailed 3D data files became a new starting point for the development of new forms, permitting shapes to be captured and readily converted into new objects through familiar processes such as casting, forming and machining.

Starting with small pieces such as sculptures, I quickly realised the photographic nature of photogrammetry permits the capture of soft objects, objects at a distance, objects in motion and transient moments. Experiments with constructing contoured surfaces from tangible and intangible surfaces; such as flowing fabrics, and a series of images of clouds taken in a flight from London to Florida, yielded unexpected abstract results over which I had little control other than selecting the subject (fig 1).

Figure 1. Clouds, 5 frame series © Neil Glen

Traditionally craft makers respond to tactile materials, and exploit the properties of those materials. If I could consider a cloud as a material could I exert control over this in some way? I began to question if a material could be considered independently of working methods; for example could a potter use throwing skills to form molten metal or other material, and how would this change their approach?

Methodology

To explore this concept I worked with an ice cream maker, who creates custom ice cream for festivals and corporate events, and a potter with many years of experience, to develop an experiment. We combined traditional clay throwing with hand made ice-cream, which had been frozen with liquid nitrogen, to allow a pot to be thrown in an unfamiliar material but ultimately realised in ceramic.

Manufacturing the ice cream in the studio and transferring it directly to the potters wheel allowed us to determine a suitable working consistency to permit the potter to transfer his skills in working with clay to ice cream, and to throw a pot (fig 2).

Figure 2. Throwing the pot in ice-cream © Neil Glen

Although there are similarities between clay and ice cream the structure of the changes more rapidly as the ice cream melts, requiring the potter to respond to this, and altering the forms which could be achieved. Refreezing the ice cream with liquid nitrogen whilst on the wheel allowed the material to be reworked and thus emerged a new language for a thrown pot.

The resultant object could not be handled without destroying it, indeed it was difficult to make detailed observations since the form and detail changed as a consequence of the ice-cream softening and melting. Photogrammetry offered a means to capture the form of the ice cream pot without touching it. Setting out an array of cameras around the pot permitted the images required to construct the 3D data to be simultaneously taken from multiple points of view.

The 3D data file generated from these images was of sufficient integrity to allow a master object to be machined and used to cast mould for a slip cast porcelain object to be made.

Method

To ensure the images used to construct the 3D model were consistent 20 identical cameras were used; Nikon D90 DX format DSLR with CMOS sensor 23.6 x 15.8 mm fitted with 18-70mm f3.5-4.5 zoom set to 50mm and exposure set to ISO200 1/15th sec f16 capturing at 4288 x 2848 pixels. A Nikon ML-L3 remote was used to trigger the cameras, previous testing determined that four remotes, triggered by two people, were sufficient to actuate all of the cameras simultaneously.

20 cameras were spaced at 18 degree intervals to photograph the ice cream pot simultaneously from 20 positions (fig 3) and careful note was taken of the frame counter after each set of images to account for any camera that may not have taken a shot.

Figure 3. Camera rig, © Neil Glen

To ensure the software could more effectively determine the relationship between the images the top of the plinth was included in the photographs (fig 4).

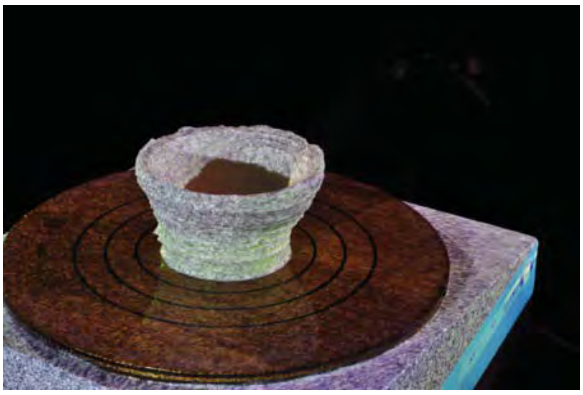

Figure 4. Ice Cream Bowl, frame 19 of 20 © Neil Glen

Previous work had revealed that the software was unable to determine surface variations on surfaces without

patterns. To capture of the surface detail of the ice cream pot it was illuminated using three data projectors, positioned equally around the object at a spacing of 120 degrees, each projecting a white noise pattern.

The images were imported into and published to a 123 Catch account for download as an a STL file. This was opened in Roland SRP Player software connected to a Roland MDX-40a desktop CNC machine equipped with a ZCL-40A rotary axis unit. The master was machined in polyurethane model board with a density of 580kg/m³ without alteration to the files. This master was durable enough to enable plaster moulds to be cast and used to slip cast porcelain to create the final outcome; a porcelain bowl (fig 5).

Figure 5. Ice Cream Bowl, slip cast porcelain © Neil Glen

Conclusion

The machined master of a single object in 360 degrees revealed that the external surface had a wealth of detail, both the fine marks made by the potters fingers and the softness of dripping ice-cream.

Thus we have an object which is a synthesis of two materials, a direct tactile response to working the ice-cream as if it were clay translated back into a ceramic. Also the natural evolution of the melting ice-cream adding it's own signature, frozen in time.

The continued development of 3D printing will ultimately offer the means to reproduce practical and useful objects. Just as analogue home taping evolved into digital CD burning, which became MP3 file sharing, 3D printing will mature to allow physical objects to be shared and repurposed. The ability to capture forms and surfaces, rescale and remake them in a range of materials will enable designers and makers to face the challenges this presents to our established ideas of authorship and authenticity.

With this will come new types of creativity, new ways of working across materials and new forms of collaboration. As a designer with a passion for photography I have found new medium for expressing creativity; a new freedom, to observe capture and remake from the world around me in the tradition of the designer makers.

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Neil is interested in the relationship between ubiquitous technologies and the process of design and learning; questioning and re-defining how such technologies can be used to explore and develop our sense of place. Working with academics and technical staff on the use of technology to enhance the learning experience, with researchers and industry developing new facilities and with industry in the development of new products and services.

Collaborators

David Jones: Ceramic Artist, Corsham.
Charlie Harry Francis: Ice Cream Artist, lickmeimdelicious.com

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Incorporation of Shape Memory Polymers in Interactive Design

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Abstract

This paper seeks to explore the question of how to incorporate smart materials into a design to aesthetically demonstrate science and engineering concepts in an interactive way. This work introduces the development of interactive artworks using a shape memory polymer (SMP) material that changes shape based on an external thermal stimulus. In this paper we explore how interdisciplinary work between engineering and science is needed to create an artwork that mimics natural phenomena around us. This paper discusses fabrication and electronic implementation challenges associated with utilizing the shape memory properties of the material. Specifically, the paper explores some ways to obtain different geometric shapes of the SMP and to utilize different sources of thermal stimulus to create a shape memory effect (SME) in artworks.

Keywords

smart materials, shape memory polymer, interactive artwork, interdisciplinary collaboration

Introduction

Creating artistic models that allow children to experience science, technology, engineering, and mathematics (STEM) fields, may increase their propensity towards choosing these fields to career paths. Smart materials provide a unique medium to present scientific information, because they are materials that exhibit a change based on an applied stimulus. Some examples of smart materials are shape memory alloys (SMAs), shape memory polymers, thermo-chromatic powders and photo-chromatic powders. Solar Color Dust is a brand of thermo-chromatic and photo-chromatic powders that change from a given color to a white color with heat, body temperature, or light stimulus [1].

SMAs and SMPs exhibit what is known as the SME, the ability to hold a temporary structure and geometric configuration until a stimulus reverses it structure back to its original configuration. For SMAs, this effect is due to a phase change in the metal. This phase change is a change in the crystal lattice structure from a low temperature phase called martensite to a high temperature phase called austenite. By holding a desired shape at a high temperature, called the Austenite finish temperature, A_f, and then quenching it to a low temperature called the Martensite finish temperature, M_f, a shape may be trained into the material to create the SME [2]. Once an SMA is trained, SME occurs by applying force to the metal it in the lower temperature martensitic phase causing a shifting in the cubic lattice structure that results in macroscopic deformation of the object. Afterwards, the force is removed and the material is heated to above A_f. At this temperature the metal returns to the austenitic cubic structure which causes it to return to its trained shape [3]. Once, the SMA is cooled again, it can be deformed again to another shape.

SMPs that have a shape change from a thermal stimulus are of interest to this paper. In general polymers have different properties above and below a temperature known as the glass transition temperature or T_g. Below this temperature the material is described as stiff or rubbery, and above it is is described as glassy. Polymers are made of networks of chains of molecules, that are connected at points. Typically the chains within an SMP are described as either frozen segments or switching segments and the connection between these two types of segments is called a "netpoint" [4] [5]. When heated above the T_g, the switching segments are able to move to create a new shape, while the frozen segments remain rigid. If force is applied at $T > T_g$ then the switching segments move to accommodate the force, creating a new shape. If the temperature is lowered to $T < T_g$, the switching segments are frozen in their new configuration and the new deformed shape is held. If the temperature is again raised to $T > T_g$ the switching segments move back to the original shape. This can be seen in Figure 1.

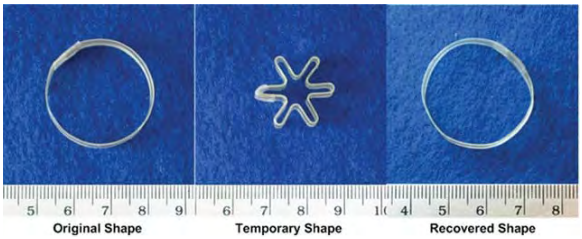

Figure 1: Shape Memory Cycle in an SMP: The temporary shape is formed by applying heat plus mechanical deformation and rapidly cooling it. The original shape is recovered by applying heat again. [6]

Prior Artworks

Artists have explored the area of using smart materials as a medium. Elaine Ng Yan Ling is a textile artist creating designs she describes a "naturology" the combination of nature and technology. Her work incorporates shape memory polymer and alloys and wood [7]. Among her pieces she has created a Living Furnishing Fabric with uses shape-memory polymer to allow the textile to respond to humidity. Also, a shape memory polymer and wood veneer piece for seasonal depression disorder. This work is designed to allow light during the winter months a projects interact shadows indoors in response to heat [8]. Other artists include Jie Qi whose main focus is on creating activation and movement of origami using SMAs. Among some of her projects she has tested how making origami cranes with incorporated SMA can be used as an educational tool with children ages 9-15 [9]. Charolette Lelieveld investigate the use of smart materials for an adaptive architecture concept. She investigated SMA embedded into SMP composite system on a small scale to prototype for larger shape morphing building applications. With her prototype she created a structure which exhibited a wrinkled appearance when activated by heat. These wrinkles occurred because when the SMA was heated it changed shape, and the SMP became rubbery to accommodate the force of the SMA. Her work noted some possible drawbacks of work with SMAs and SMPs including fatigue of the SMA and issues related to environmental heating of the system [10]. Yvonne Y.F. Chan Vili has done work in incorporating SMAs and SMPs into smart textile applications to enhance their appearance. She created SMA and SMP yarns for woven applications. Chan created interesting aesthetics by weaving the shape memory yarns into patterns to create a 3D surface effect. Her work provides a proof of concept for extending the shape memory yarns to create window treatments, partitions, or wall hangings to chance the essence and function of a space [11]. The Texas Institute for Intelligent Materials and Structures (TiiMS) at Texas A&M University have installed a 'Pop-Op' which is a shape memory alloy wall installation composed of resin and C-glass fiber. The installation contains several components like flowers and flaps that are actuated by SMA and controlled by an Arduino [12].

Fabrication of Shape Memory Polymer

The polymer used in this study is based on the work of Xie and Rosseau [13]. This polymer consists of three components, diglycidyl ether bisphenol A epoxy (Epon 826), poly(propylene glycol) bis(2-aminopropyl) ether (Jeffamine D-230), and neopentyl glycol diglycol ether (NGDE). The SME is created due to the chemical structural differences and reactivity of NGDE and Epon 826. Jeffamine D-230 is the cross-linking agent in this structure, meaning its amine groups, $-NH_2$, react with the epoxide groups of Epon 826 and NGDE to create the structure. This reaction creates the cross-links in the polymer, which are the connection points between the chains called "netpoints." Attached to these "netpoints" are either the NGDE chains or the Epon 826 chains. The NGDE chains are considered the switching segments because it is a flexible aliphatic diepoxide, meaning it contains carbon atoms forming open chains as its backbone. The Epon 826 are the frozen segments because it is a rigid aromatic epoxide, meaning it contains carbon rings on its backbone. Therefore, the shape memory in this polymer occurs because when the polymer is heated, above the T_g, the NGDE segments become flexible and bendable [13]. These segments are able to be rotated around their cross-links to form a new shape. Once, the shape deformed and cooled to below the T_g, the new shape is set. If the material is heated again, the shape will return to its pre-deformed shape.

The polymers used in this study were fabricated according to the Xie and Rosseau formulations given in Table 1. To mix the samples initially, some of the Epon 826 was placed in a glass vile and heated on a hot plate until the viscosity was reduced and there was no appearance of bubbles in the mixture. The Solar Color Dust was weighed based on the appropriate amount for the recommended mix ratio of 10 g powder to 1 pint of solution [1]. This dust was placed in a glass jar. The amount of Jeffamine D-230 for the desired T_g was measured with a graduated cylinder and placed into the same glass jar. This mixture was then sonicated. The NGDE was then measured and added to the Jeffamine and the mixture was again sonicated. After the Epon 826 was sufficiently heated, it was measured and then added to the mixture, stirred, and sonicated. The mixture was vacuumed with a for approximately 20 minutes and then placed in a silicone rubber mold. Then the mixture was cured for 1.5 hours at $100°\mathrm{C}$ and post-cured for 1 hour at $130°\mathrm{C}$ [13].

Table 1: Shape Memory Polymer Volumetric Mix Ratios [13]

Samples	Epon 826 (ml)	Jeffamine D-230 (ml)	NGDE (ml)	T_g (°C)
1	4.7	2.43	1	60-80
2	3.14	2.43	2.08	40-60
3	1.57	2.43	3.12	20-40
4	0	2.43	4.15	0-10

Working with Shape Memory Polymer

Creating interactive artworks using shape memory polymers provides some challenging components. However, it pushes the boundary of material aesthetics and helps us to focus on interactions with the material. Since, additional thermal energy is needed to cure the polymer, the temperature of the oven make it difficult to incorporate electronic components or sensors into the polymer itself. Also, the shape memory polymer must be heated and deformed at a high temperature and then cooled quickly. Therefore, the environment for an installation should be considered when determining which T_g is appropriate. Molding of a SMP can also require time to obtain the correct mold for the artistic structure desired. To make the mold, first a plastic female mold is made with a 3D printer, then a silicone rubber male mold is cast from the 3D printed mold. This silicone mold is used to cast the SMP. Therefore, it can be time consuming to create new shapes with the SMP. Also, incorporation internal heating means, such as wires, can create a stress concentration, which causes the material

to break at the interface when deformed. As mentioned previously, the artworks focus on scientific concepts in our daily life.

Auxesis

This work was made to help describe the mechanism in which chameleons change color. Chameleons change color to send visual signals to other animals regarding their mood, aggression, territorial instincts, or for mating purposes. The change of color in a chameleon occurs at the microscopic level based on cells called chromatophores. These chromatophores behave as flexible bags of color that are either stretched out to cover a large flat area or retracted back to a small, retracted point [14]. Each chromatophore is attached to radial muscle fibers at various points along its edge controlled by a nerve fiber. When a nerve impulse is sent, it causes these muscles to contract and expand the chromatophore. When the muscles relax, the chromatophore returns to a small, compact shape, thus reducing its area and making the pigmented area shrink [14].

Figure 2: Contraction of Chiral Structure: Expanded (*left*)and Compressed States (*right*)

This art piece explored the use of SMP materials to mimic the cells of the chameleon. In order to accomplish this task, the SMP was molded into a rectangular mold and then laser cutter was used to explore different shapes. Through trial and error a chiral shape with is a type of auxetic shape, meaning the shape has a negative Poisson's ratio (the lateral width increases when stretched from either end), was chosen. The idea of SMP based that utilizes the geometry of the auxetic shape was based on the work of Rossiter *et. al.* [15]. A picture of the chiral shape in the curled and uncurled states are given in Figure 2.

In laser-cutting the chiral shape, several iterations are done in order to maintain the correct thickness for the struts of the chiral to avoid breaking the chiral. Also, the heat from the CO_2 laser resulted in a gummy polymer, if the T_g of the polymer was lower. The polymer performed better during laser cutting if it was taped and place in a freezer prior to laser-cutting.

In order to mimic the color expansion and retraction of chromatophores, Solar Color Dust and Castin' Craft dye was incorporated into the SMP matrix and fabric was added to the inside of the SMP chirals. Photos of these color and fabric chirals are given in Figure 3.

These shapes were mounted on a canvas and attached to servo motors. A Lilypad thermal sensor was placed in close proximity to the shape. Once the thermal sensor detected a

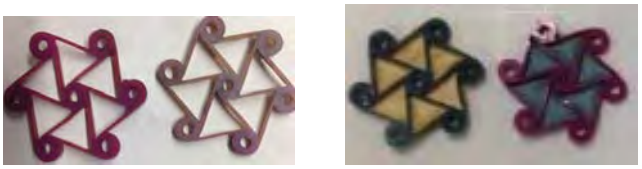

Figure 3: *Left:* Chiral changes from purple to blue based on heat stimulus, *Right:* Colored Shape Memory Chirals with Fabric Incorporated

sufficient temperature change, above the T_g, due to the hair dryer stimulus a command was sent from the Arduino to rotate the servo motor. The motor curled in the SMP chirals until the thermal sensor detected that the temperature was reduced to below T_g. Then the motors were told to release their hold on the SMP chirals. The chirals remained in the deformed until the temperature raised to return them back to their original shape. The artwork is named "Auxesis" which is from the Greek meaning growth, which describes the mechanism of the chromatophore and the structure that the chromatophore uses. A depiction of the artwork is given in Figure 4.

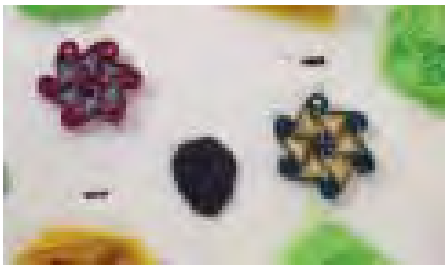

Figure 4: Front of "Auxesis" contains the color changing components

The Secret Garden

This artwork seeks create a piece where the observer can reveal the beauty in nature. The artwork contains three components that can be revealed based on thermal stimulus the components utilize SMP and Solar Color Dust. The first of which is the blossoming of a flower. The hidden flower concept is inspired by the Chinese flowering tea, which is created by needle tea leaves being wrapped and compressed around a flower into a small ball. When the tea is heat the ball is opened to reveal a beautiful flower. To mimic the revealing of the flower, a shape memory polymer was laser-cut from a 2D sheet into the shape of a flower. The behavior of the flowering shape in hot water is given in Figure 5. In an installation setting, the observer will place the flowers in clear bowl of water on a hot plate to open the flower.

The other two aspects of the artwork are the revealing of hidden properties, beneath the surface. Specifically, moss is cast with clear resin and Solar Color Dust. When the material is cool only some parts of visible to the observer, however as it is heated the viewer can see the intricate structure of the moss. From experimentation with different thicknesses of the

Figure 5: *Left:* SMP Flower Before Exposed to Hot Water, *Right:* SMP Flower After Exposed to Hot Water

resin with the moss, it was found that a thin layer of resin provided the most ideal aesthetic, allowing the user to view more of the intricate details of the structure and requiring less thermal energy to heat to reveal the moss. The third aspect of the artwork focuses on the changing of the leaves with the seasons. This aspect utilizes Solar Color Dust, clear resin, and heat pad. The leaves are coated with a black thermochromatic powder in a medium are cast into a clear epoxy resin. When the heat source is applied, the beautiful colors of fall appear. Initially, conductive thread was used as the heat source, however the thread only heats a small area around the thread, so for more through heating, a larger source is needed.

Conclusion and Future Work

SMP materials provide a unique challenge for interactive artwork due to the nature how the SME must be activated. Some of the issues in working with this specific SMP include, difficulty in testing new shapes. Even though, the laser-cutter provides a much faster method to test out new geometries, the heat from the CO_2 laser does induce some thermal residual stress by breaking cross-links in the polymer and weakening the material. In the laser-cut chiral structure, often the struts of the structure broke down due to thermal stress concentrations. Future work will explore the direct casting of the chiral shape. Also, some current work has been done on machining the SMP using a drill press. When measuring the hole created by drilling the size of the hole and the size of the tool are approximately the same size. This result, could mean that there is some mild thermal residual stress due to covalent cross-links in the SMP breaking by the drilling action and causing open chains of NGDE to reconfigure at the high temperature. From the qualitative preliminary testing, it appears that machining provides a lower stress on the SMP than laser-cutting, resulting in a better end-product. Exploring the pros and cons of machining, casting, and laser-cutting will provide valuable information on effective ways to create new shapes. Also, for the "Auxesis" work, a restructuring of the visual aesthetics to greater visualize the action of the SMP would create a work that is a better representation of the chromatophores movement.

For "The Secret Garden" piece, experimentation with a more complex layered 3D flowering shape is required. Also, the method of casting the hidden moss into thin sheets needs to be modified to create a consistent thin size of the cast. Further testing with a heating pad is needed on the changing leave aspect of this work.

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Transient Materialization: Ephemeral Material-oriented Digital Fabrication

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Abstract

This paper introduces the notion of transient materialization through an exploration of the relationship between digital and material-based digital fabrication. The research was inspired by direct observations of nature's beauty in the form of thin films. The building block of the experiment is an n-hedron structure composed mainly of soap foam, which is blown, through a mixture of air and helium (used to control the physical properties), into a foam structure. The paper questions this structure's materiality, examines its physical performance and ephemeral characteristics, and expands on its meaning through an experiment in digital fabrication. Specifically, in this paper, we demonstrate the first phase of this technology and achieve a programmable foam structure. The experiment presents various configurations of dynamic and transformable foam structures on a large scale of fabrication. The fabrication interacts with the algorithm, which involves a mixture of air and helium (controlled by pneumatic valves) and additive chemical and food substances, all of which exist in a certain space and time. The aim of the project is to take architecture beyond the creation of static forms and into the design of dynamic, transformable and ephemeral material experimental processes.

Keywords

Ephemeral material; digital fabrication; foam structure; dynamic and transformable; algorithm; chemical substances and thickening agents

Background

The development of computer-aided designs (CADs) from two-dimensional systems to three-dimensional modelling has enabled architects to digitally simulate and visualise different geometric models in a Cartesian coordinate system. Moreover, with the recent emergence of parametric design modelling, the methodology of generating architectural forms has shifted from the traditional geometric modelling system to associative design modelling. [1] Through the use of this digital and adaptive system, the development of digital fabrication technologies in architecture has been greatly enriched and improved. Data, materials, and construction can be interwoven within this system, which allows architects to control and adjust the process of fabrication.

Digital fabrication technologies, such as large-scale 3D printing, are rapidly becoming common practice in architecture, and such technologies are currently being experimented with for the development of prototypes and pavilions. As a result, a discussion regarding how this technology can be used in architectural practice has arisen. However, though determining how these techniques can be applied to the large scale of buildings is a useful pursuit, the more important challenge may be investigating innovative and novel technology in order to influence design and architectural thinking.

Introduction

This research pursues the notion of transient materialization to investigate the new design approach of digital fabrication. The notion of transient materialisation proposes immaterial architecture as a trigger for investigating a new possibility and cognition of morphology in architecture through space and time. In addition, the definition of immaterial architecture does not dichotomize architecture as either material or immaterial; [2] rather, it emphasises the invention of an ephemeral, dynamic, and adaptive form, generated as a result of the capacity of a machine or the properties of materials, information, or external environments. Thus, to address the challenge of this novel design in digital fabrication, this process involves experimenting with the physical and chemical properties of materials, in combination with digital tools and machines. The potential of material, combined with environmental conditions, determines the existential path of the shape, from its transformation to its disappearance. In other words, the architectural form is no longer considered static; instead, it becomes transformable, its complexity developed by contexts composed of materials' properties, machines' capacities, data, and the corresponding space and time.

This experiment was inspired by the spherical membrane of the soap bubble: a thin film of soapy water that usually has a lifespan of only a few seconds. In losing its spherical geometry, a soap bubble forms a foam based on n-hedron structures joined together. Through an understanding of the properties of soap foam bubbles, the

first phase of machine was invented to generate a moving, transient, and ever-changing three-dimensional foam structure controlled by a mixture of detergent, chemical additives, thickening agents, and gas, facilitate by the mechanism and digital information. The dynamic foam structure follows two principles: 1) the shape output is computationally controllable through pneumatics and a pre-defined structure; 2) the real-time transformation and disappearance of its form is determined by the intrinsic properties of the material, the chemical and food substances, and the environment.

This paper first describes the existing works that inspired this experiment. Second, it explains the focal system, including a technical and mechanical overview, the consideration of additive chemical and food substances, the dynamic and physical experimentation with the foam structure, and the current results of test. The following are the contributions of this project:

1) a description of transient materialization, which may trigger the pursuit of new possibilities in digital fabrication;
2) the creation of first prototyping machine for programmable foam structures; and
3) the development of a framework for developing and testing the materials, mechanisms, foam fabrication processes, and control systems needed to generate a foam structure.

Context and Previous Experiments

Several previous works have focused on the notion of transient materialisation. The *Pepsi Pavilion* built by Billy Klűver and E.A.T. in the 1960s; Diller and Scofidio's *Blur Building* of 2002; *Cloudscapes* by Tetsuo Kondo Architects and Transsolar in 2010; and *Waterfall Swing* by Dash 7, in collaboration with Mike O'Toole, Andrew Ratcliff, Ian Charnas and Andrew Witte, in 2011, all show the influence of immaterial architecture. The *Pepsi Pavilion* was perhaps the first collaboration among artists, architects, engineers, and scientists to produce an experience of virtual illusion. The outside of the dome was covered in a water vapor cloud sculpture by Fujiko Nakaya. The system monitors humidity and wind, using nozzles to produce a volume of cloud with a low-handing effect. The *Blur Building* is another instance of a dematerialized architectural achievement combining architecture and technology. In this project, mist nozzles were used to construct a pavilion whose appearance could be changed by the weather. For example, the mist tends to spread out to the surrounding environment if the weather is hot and humid. When the day is less humid, low-hanging smoke appears and follows the direction of the wind. On a cool day, the fog ascends into the sky and evaporates. *Cloudscapes* also used fog to create an artificial cloud at a certain height in space, offering different atmospheres through which visitors can travel in the space of a spiral stairway. Finally, *Waterfall Swing* developed differently patterned walls of water, which were computer-generated and operated by multiple independently controlled solenoid valves at the top of structure.

Many of the projects described above envisage new possibilities for an architecture that is flexible, dynamic and transformable, utilizing cross-disciplinary collaboration to develop more responsive spaces for living. Inspired by these projects and perspectives, this paper explores transient materialization to propose that the complexity and diversity of architecture can be grounded in the idea of immaterial architecture—an idea that can be explored through the integration of various material potentialities and through examinations of their physical behaviours, of machines, of digital information and of space.

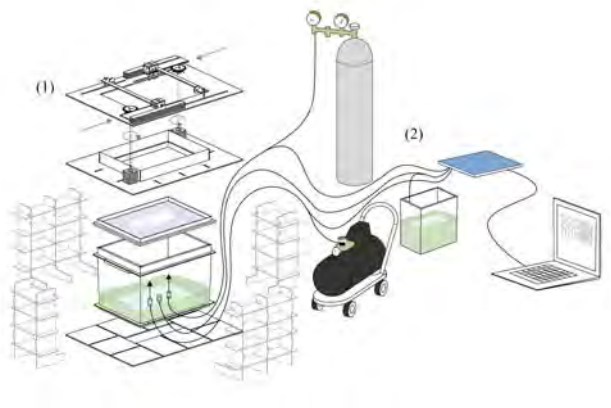

Figure 1. (1) Foam-generating machine (2) Mass supply

System

The Deisgn Process and Technical Choice

The system consists of two main components: a foam-generating machine and a mass supply (Figure 1). The foam-generating machine comprises a container for filling with liquid, two input openings in the bottom for solenoid valves, a fabric to determine the initial phase of bubble size, a sculpture mechanism, and a shell to support the container and sculpture device. The mass supply includes a helium bottle, an air compressor, a liquid distributor (i.e., a detergent with chemical and food substances and a pump machine), and control circuits. In this experiment, the control system is composed of an Arduino, solenoid valves, stepper motor driver boards (Big Easy Driver), stepper motors, DC motors, and a water pump. Solenoid valves are used mainly for the adjustment of air and helium, while the sculpture machine with two stepper

motors, two DC motors, and two sharpeners are used to adjust the appearance of the foam.

Through the integration of two components, the following are generated through the process of the foam structure within this system: In the initial phase, the foam-generating machine is filled with detergent from an external liquid container. The additional chemical and food substances, which are thicker, as well as the humectant, are added to strengthen the bubbles and decrease the evaporation of soapy water. After the first step, a growing and successive foam structure is produced through the mixture of air and helium, which can be regulated and adjusted by pneumatic control valves. The two solenoid valves are installed in the bottom of machine. The diameter of passage for the pneumatic valves are 1.6 mm, and the maximum work pressures are 4 bars. The values for the parameters of air and helium solenoid valves are determined by predefined shapes. However, due to the sensitivity of the soap bubbles to different environmental conditions, these valves are adapted to reach the same results. Furthermore, the appearance of the foam can also be slightly altered through the sculpture mechanism, which consists of two sharpeners, while the foam grows upward.

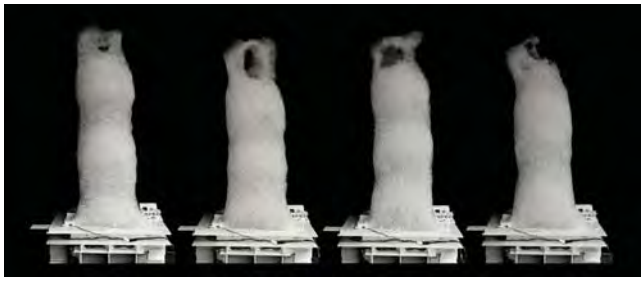

Figure 2. The explosion of bubbles during the generation process.

The Substrate: Chemistry Considerations

The foam structure is composed of soap bubbles, which can be rapidly dehydrated and disappear into dry air. Thus, for the sake of preventing the explosion of the bubbles during the generation process and in order to prolong the life span of bubbles, this project experimented with a mixture of chemical additives and thickening agent, including as glycerol (C3H8O3), corn starch, and detergents (Figure 2). Glycerol (also called glycerin) usually is used for skin moisturizing lotions and is highly hydroscopic, which means that it has the ability to attract and hold onto water molecules to prevent the evaporation of water. [3] In addition, corn starch as a ingredient in liquid-based foods, such as soup, and it is able to create a thick and viscous soap that allows for blowing long-lasting bubbles. [4]

The Mechanical Devices

For the purpose of maintaining the contour of the foam structure and preventing redundant bubbles from accumulating on the top of machine, this project developed a mechanism that slightly sculptured the appearance of foam during the process of growth. This device is installed on the top of the machine and consists of stepper motors, DC motors, sharpeners, and a supporting structure (Figure 3). The stepper motors are used to control the degree of a set of gears, which determine the width of the foam structure. The sharpeners are driven by the DC motors to engrave the foam. According to the properties of soap bubbles, a higher degree of stepper motors may affect the stability of the foam structure and cause a splitting effect while the foam grows upward.

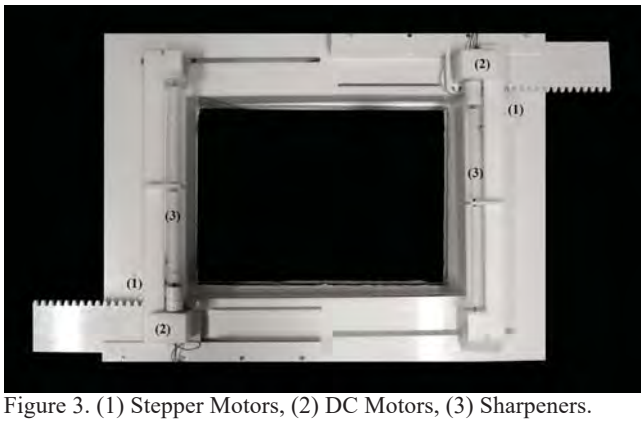

Figure 3. (1) Stepper Motors, (2) DC Motors, (3) Sharpeners.

Dynamics and Physics of Overall Experimentation

This experimental work developed various shapes of foam structures and presented a strategy for increasing the lifespan of foam and balancing its structure in a real-world environment. In addition, through a series of trial-and-error laboratory tests, this experiment found the adjustment of helium and air solenoid valves to be a key point in determining the various growth patterns of the foam structure. Furthermore, we designed an appropriate chemistry to improve the stability and average life span of the bubbles. Specifically, two possible shapes—a straight foam structure and an arc foam structure—were shown as pilot experiments that took these factors into account.

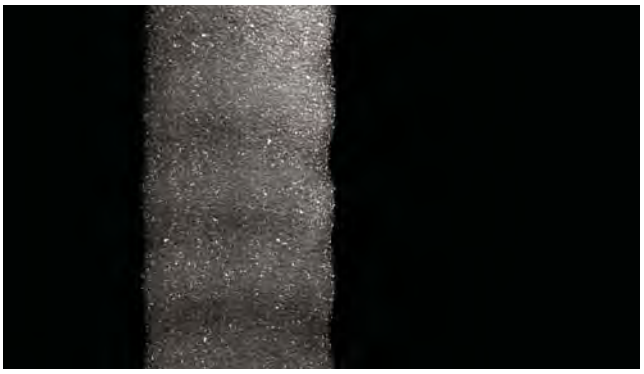

Figure 4. Straight foam structure

The straight foam structure is balanced mostly by the switch controlling the air or the helium solenoid valve during the iteration process (Figure 4). In this control system, there are four parameters (i.e., the counters for generating helium and air in a specific time period and the output values of helium and air) that need to be adapted automatically throughout the iteration. The switch between the helium valve and the air valve is constrained by the parameter of the counters. Moreover, in order to build a higher structure, after reaching the maximum number of counters, the output values and time periods of helium and air are gradually decreased for each iteration. The additional chemical and food substances (i.e., glycerol and corn starch) are added to the detergent to prevent the explosion of the bubbles, which could interfere with the performance of the foam structure.

Figure 5. Arc foam structure

The method of generating the arc foam structure was developed through previous experiments with the straight structure and through a new method that allows for the manipulation of the direction of growth (Figure 5). The difference between two modes results from an adjustment to the helium and air valves. Within the iteration, the first time period produces only air in the machine, and then switches to the next step, which delivers both helium and air at the same time. The reason the foam structure grows to the left (per this picture) is that the air valve is installed in the bottom left side of machine, with the helium valve on the opposite side. The bubble on the left side, which contain more air, are heavier than the bubbles on the right side. In order to complete the whole shape, the method of producing the straight foam structure is immediately followed by the first phase.

Result

This project presents two programmable types of foam structure (Figure 6). From this experiment, it was determined that both structures can exist for approximately fifteen to eighteen minutes in space (Figure 7). Moreover, in this experiment, the maximum height of this structure was found to be approximately 1.5 meters (Figure 8). Finally, the deformation of the curvature, which appears in the second type of arc shape, is due to the vanishing of the bubbles containing helium.

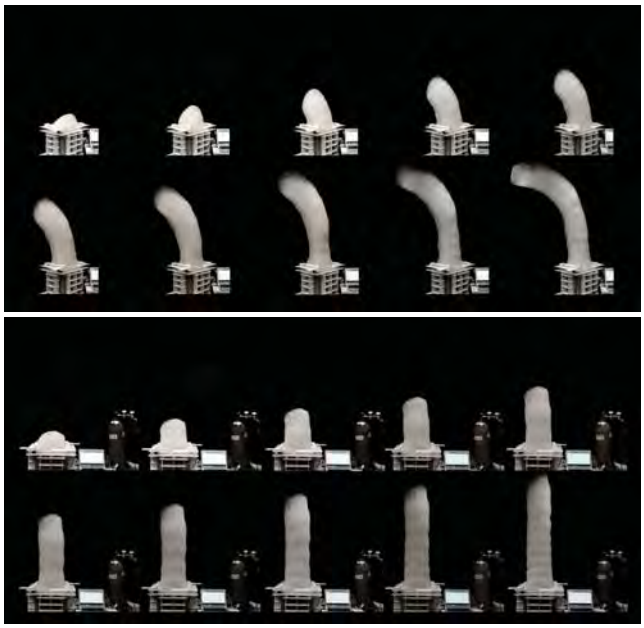

Figure 6. The generating process of straight and arcfoam structure

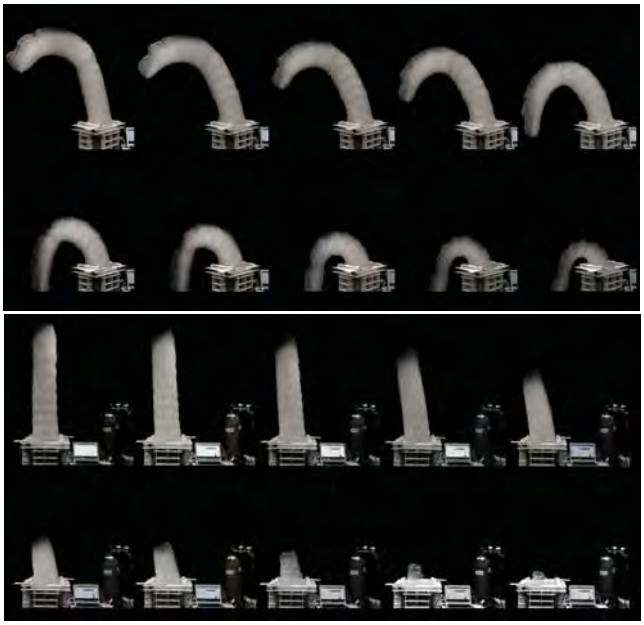

Figure 7. The disappearing process of straight and arc foam structure

Conclusion and Further Step

The aim of this paper was to introduce transient materialisation as an approach for designing dynamic, transformable, ephemeral and material-based digital fabrication. The purpose of this novel design approach is to argue that an architectural work is not simply a retinal image [5]; instead, architecture coordinates materials that are both embodied and spiritual in essence, ultimately creating a perceptive experience of space. In this project,

the foam structure, as an architectural object, is generated by the machine. Moreover, due to the intrinsic nature of the material, the structure acts as an organism: moving, transforming, responding and disappearing according to its surroundings, the time and the user. In this way, the floating, uncertain and blurred object of the foam structure induces and enhances the perceptive experience of body in space and time. Through this interaction among object, user and space, architecture may exist between rationality and sensitivity, thus becoming open to an interpretative creation of the conception of space.

In this paper, the project contributes and demonstrates how and why the system works for generating foam structures, although the current machine only can create two types of shapes. The further research of this project will be the re-consideration of new chemical substances in order to increase the lifespan of bubbles. In addition, the different type of foam structures, such as curve, will also be further investigated in the next step. Finally, after finalizing all steps above, several machines will be developed for generating different foam structures in space.

Figure 8. Arc foam structure

Acknowledgements

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[Session 34]

Interacting with Visual Art and Graphic Design

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Diving into Infinity: A Motion-Based, Immersive Interface for M.C. Escher's Works

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Abstract

We describe a Kinect-based interface for navigating M.C. Escher's works. Our interface is based on the Kuatro, a framework for developing motion-based interactive virtual environments. Kuatro utilizes the Model-View Controller (MVC) architecture and Open Sound Control (OSC) to provide an expandable environment for motion-sensor based installations for composers, artists, and interaction designers. We present a case study based on "Print Gallery", an intriguing, self-similar work created by M.C. Escher in 1956. Our interaction design involves a Kinect sensor, a video projector, a Kuatro server, and a screen; it allows a user to zoom in and out, as well as rotate the image to reveal its self-similarity, by navigating prerecorded video material. This material is based on previous mathematical analyses of "Print Gallery" to reveal / explain the artist's depiction of infinity. We discuss adapting this approach to other M.C. Escher works involving infinity.

Keywords

Interactive art, motion-based interaction, M.C. Escher, video animation, Kinect-based interface, art installation, human-computer interaction.

Introduction

We present "Diving into Infinity", a motion-based, immersive interface for exploring M.C. Escher's works involving use of infinity and self-similarity (see Figure 1). Our system is built using the Kuatro, a framework for developing motion-based interactive installations for composers, artists, and interaction designers [1].[1]

In this paper, we focus on M.C. Escher's "Print Gallery" ("Prentententoonstelling"), an intriguing lithograph involving infinity through recursion, created by the Dutch artist in 1956 (see Figure 2). While Escher was not a trained mathematician, he had strong mathematical intuitions, which he was able to depict through his artwork.

In Escher's own words, the depiction of infinity in "Print Gallery" is experienced as follows:

> "Through a doorway" (see Figure 2, bottom right), "we enter a picture gallery. … We first meet a visitor with

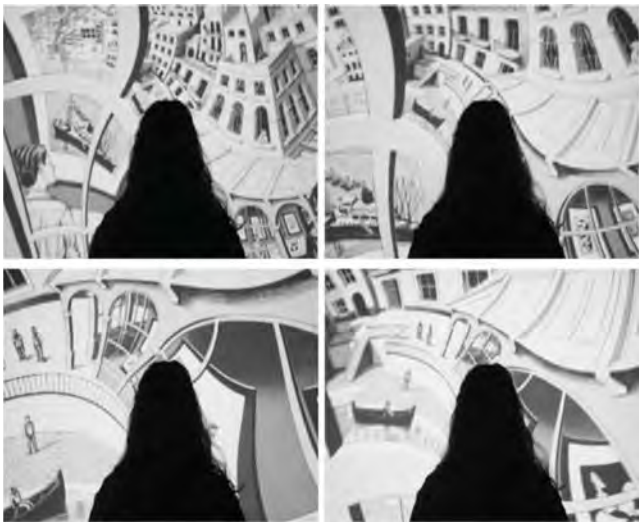

Figure 1. One of the authors demonstrating a prototype of the Kinect-based interface.

Figure 2. M.C. Escher's original "Print Gallery" (notice the blank center).

[1] This work has been partially funded by the US National Science Foundation (grant DUE-1323605).

his hands on his back and then a young man who is about four times taller. … He looks at the last row of prints hanging on the wall. He sees the ship, the sea, and the houses of a town. … In one of the houses a woman is looking out of an open window. She is also a detail of the print that the young man contemplates, just like the sloping roof below her, under which the gallery is housed." [2, p. 67]

So, we can enter the print gallery again, through that doorway, … and continue going around, and around the blank center, endlessly, as described by Escher above.

The center in Figure 2 is of particular importance. It is believed that Escher left it blank on purpose. In order for that center to be filled, it would have to contain the complete "Print Gallery" image again and again, in a never-ending inward spiral, getting smaller and smaller towards the infinitesimal.

Escher was quite capable of drawing in extremely small scale, using a magnifying glass. His ability to conceive and draw images with "inward size reduction", as he called it, can be seen in other works involving the infinite. One example is "Smaller and Smaller (1956). In this image (see Figure 3), in his own words:

"[t]he components continuously halve themselves. In this woodcut I have consistently and almost maniacally continued the reduction down to the limit of practical execution. I was dependent on four factors: the quality of my wood material, the sharpness of my tool, the steadiness of my hand, and especially my keen-sightedness, aided by a twelve-times-enlarging magnifying glass." [2, p. 41].

In "Print Gallery", however, Escher chose to draw only one level of the infinite inward reduction. It is clear, he was aware of the blank center's significance. Perhaps, it is not an accident that he chose to place his signature there.

In our project (see Figure 1), the blank center is filled with visual material generated by Dutch mathematicians Bart de Smit and Hendrik Lenstra [3]. They discovered that, by rotating the image about 157.64 degrees and shrinking it by a factor of about 22.58%, they can automatically generate the inward reduction – and thus fill the blank center infinitely.

Looking through the four images (Figure 1) from our prototype clockwise, the infinite drawing is unfolding in a spiral motion. This creates an effect of immersion into the infinite inward reduction (recursion) of the image, hence the title of our project "Diving into Infinity". Additional controls allow the user to experience the picture-within-picture (also known as the Droste effect) of the original, unwarped scene. The animations controlled through our interface were produced for the M.C. Escher exhibit "Infinite Universes" [4].

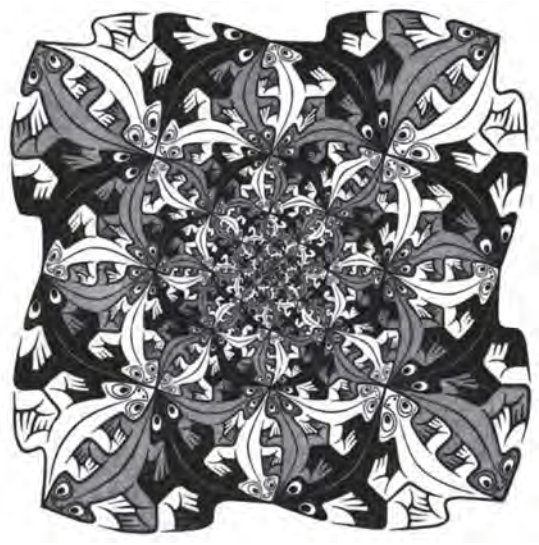

Figure 3. M.C. Escher's "Smaller and Smaller" (notice the ever-increasing detail in the center).

Our system consists of a Kinect sensor, a video projector, a computer running the Kuatro environment, and a projection screen. The Kinect captures user movement, and passes it to the Kuatro environment. This allows the user to control the rotation and shrinking of the image through movement, enhancing the immersion effect.

To the best of our knowledge, this is the first project to explore motion-based, interactive ways to experience the mathematical beauty of M.C. Escher works.

Background

In terms of technology, this project is a continuation of an interactive art exhibit, called Time Jitters. *Time Jitters* is a four-projector interactive installation designed by Los Angeles-based artist Jody Zellen for the Halsey Institute of Contemporary Art in Charleston, SC, USA [1]. The exhibit design includes two walls displaying looping video animation, and two walls with interactive elements. The concept is to create an immersive experience, which confronts participants with a bombardment of visual and sound elements (e.g., see Figure 4 and **http://goo.gl/TIfpPl**).

Time Jitters was instrumental in developing the Kuatro framework used in this project. "Diving into Infinity", is similar to Time Jitters, as it also provides looping video animation and interactive elements. However, in this project, the two (video animation and interactive elements) have been combined, with the interactive elements controlling the visual unfolding and exploration of different strange loops included in "Print Gallery". The interaction design is explained more in a later section.

M.C. Escher

Maurits Cornelis (M.C.) Escher (1898–1972) was a Dutch graphic artist who created numerous mathematically inspired works. As mentioned earlier, Escher did not have formal mathematical training, however he was able to intuitively grasp and visually express significant mathematical concepts involving use of polyhedra, recursion, and geometric distortions. His trip to the Alhambra Palace, in Granada, Spain in 1922, was very influential, as it marked a departure from earlier, flatter works towards works using geometric grids, symmetry, and periodicity.

Escher's newer works are characterized by explorations of infinity through tessellations (special tilings), as well as the use of paradox, illusion, and double meaning [5, 6]. *Tessellation* is the division of a plane using one or more geometric shapes, called tiles. To construct a tessellation, tiles are repeated, and may be warped, rotated, and shrunk, in a periodic way, to fill a plane with no overlaps and no gaps. Escher explored tessellations, graphical metamorphoses, architecture, and infinity – the latter of which intrigued him the most.

Mathematician and Escher scholar, Doris Schattschneider discusses how Escher invokes depictions of infinity to try and answer the "otherwise unanswerable questions" [7]. Infinity "permeates human thought, yet defies human understanding." Through his works, Escher invites us in a never-ending journey to begin experiencing infinity, and expand our understanding. In Escher's own words:

> "Deep, deep infinity! Rest, dreaming removed from the nervous tensions over a calm sea, on the bow of a ship, toward a horizon that always recedes; staring at waves that go by and listening to their monotonous, soft murmuring; dreaming away toward unconsciousness. …" [2, p. 124]

Strange Loops

Cognitive scientist, Douglas Hofstadter introduces the concept of Strange Loops to describe works by Escher, Bach, and Gödel [6]. A *Strange Loop* occurs when "by moving upwards (or downwards) through the levels of some hierarchical system, we unexpectedly find ourselves back where we started" (ibid, p. 10). This is related to the notion of self-reference, recursion, and self-similarity found in various natural artifacts and phenomena and explored in the field of Fractal Geometry [8].

Escher produced many works containing Strange Loops, including but not limited to "Hand with Reflecting Globe" (1935), "Drawing Hands" (1948), "Print Gallery" (1956), "Ascending and Descending" (1960), and "Waterfall" (1961). However, according to Hofstadter, "Print Gallery" is the most significant of these works:

Figure 4. The Time Jitters exhibit includes two walls with interactive elements controlled by user movement captured through Kinect sensors [1].

> "[This is] a picture of a picture which contains self. Or is it a picture of a gallery which contains itself? Or a town which contains itself? Or a young man who contains himself? … Implicit in the concept of a Strange Loop is the concept of infinity, since what else is a loop but a way of representing an endless process in a finite way?" ([6], p. 15)

Interactive Art

In "The Language of New Media" new media theorist, Lev Manovich argues that all art should be considered interactive, as it requires some level of audience participation [9]. For example, visual arts require the user to fill in information of missing details or sculptures may require the user to move around the object to gain a full understanding. Cornock and Edmonds help to clarify forms of interaction by classifying the types of interaction into three categories: static, dynamic-passive, and dynamic-interactive [10].

Static art systems are works, such as paintings or sculptures, which do not change, but require the participant to cognitively engage with the art object to gain full understanding.

Dynamic-passive art systems are like static works, however some elements of the art object change over time, such as kinetic art.

Dynamic-interactive art systems are built upon the other two categories; however, in this case, the art object changes directly through audience participation.

This project, "Diving Into Infinity", transforms M.C. Escher's "Print Gallery" from a static piece of art into a dynamic-interactive piece of art. This offers an opportunity for the audience to immerse themselves into the mental/conceptual model of the artist, before it was rendered onto the flat, static 2D drawing. Also, it begs the question of what type of art Escher would have produced, if he had

access to the powerful interactive media technology of today.

When Art Meets Human-Computer Interaction

In the context of human-computer interaction, the term interactive art encompasses works that require the interaction of a user, via presence, movement, sound, touch, and more, to create a cohesive artistic experience.

Traditionally, artists tend to avoid custom-tailoring their material to please or conform to a wider audience – "selling out" being one term used to characterize this. However, in the context of interactive art, artists need to take into account the end-user in a more formative way, when designing, evaluating, and refining the interaction design. This is not because the audience might use a different context to decode the artist's work (as explored by reception theory), but mainly because, when interaction is involved, the design needs to connect user tasks and actions, as perceived by the audience, with the artist's concept and objectives. Otherwise, artists run the risk that their aesthetic concept and objectives may not be understood or experienced by the audience as intended.

In the context of interactive art, audience members become users, and thus may be considered an integral part of the artwork, as they directly control the experience and the articulation / expression / materialization of the artist's aesthetic statement.

In human-computer interaction it is understood that, in the eyes of the user, *the user interface is the system* [11]. So, perhaps, in the minds of the audience, *the user interface is the artwork*. This possibility can be seen in the earlier demo of the Time Jitters exhibit, where members of the audience spend their time exploring the interaction language, as part of their aesthetic experience with the artwork (see **http://goo.gl/TIfpPl**).

Related Work

This section describes some prior work related to this project. Jacob, et al. present SwarmArt, an environment where user interaction controls the behavior of a swarm-based system [12]. SwarmArt uses a video camera connected to a video-processing server, which determines user movements. The server distributes data via XML providing information about users' positions. In one exhibit, swarms follow users as they move through the space: they move downward as users get closer, and follow the users' left-to-right movement.

Rui Nóbrega, et al. present a framework within which a project such as a ours may exist, namely public space interaction for digital buildings and cities [13]. They discuss environments where people interact through public displays, location-based applications via smartphone sensors, and augmented reality systems. The prototype presented herein could easily become a component in a digital building (as interactive wall art), or in a citywide environment.

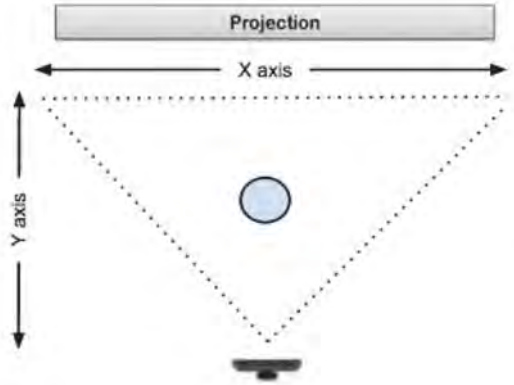

Figure 5. Diagram of the "Diving into Infinity" installation. The designated circular area in the center corresponds to a virtual button.

Kortbek and Grønbæk present four interaction design principles for designing interactive systems to communicate art in museums. These four design principles are:

1. gentle audio augmentation of art works,
2. conceptual affinity of art works and interactive installations,
3. using the body as an interaction device, and
4. consistent audio-visual cues for interaction opportunities.

These proposed interaction design principles are meant to minimize the disruption that may be caused by introducing new technologies into a museum atmosphere. Using these principles, a number of interactive experiences have been designed, as part of a Mariko Mori Exhibition at the ARoS Aarhus Kunstmuseum art museum in Denmark.

Three of these installations, namely "Esoteric Cosmos", "UFO", and "Oneness", were "contemplation installations" – they were used to augment the original artworks with information about the artists' inspiration and sources. These installations make use of audience movement / positions in the installation space (as per design principle 3) to present and update the augmenting information [14].

The Kuatro Framework

The Kuatro framework is a development environment for building dynamic-interactive music and art installations using motion sensors such as the Kinect, Asus Xtion Pro and Leap Motion.

Edmonds et al. suggest building environments that help artists access lower levels of the computer, i.e., "environments for building environments" [15]. The Kuatro has been designed accordingly to facilitate interaction design, thus allowing artists / designers to focus on their aesthetic objectives. The Kuatro does this by providing a simple framework for building motion-based installation spaces,

while abstracting technological components and hiding complex implementation details of the underlying sensors.

The Kuatro employs a Model-View-Controller (MVC) architecture, combined with Open Sound Control (OSC) for communication between components. The MVC architecture helps hide complex implementation details within the Model and the Controller.

The Kinect sensor data is processed by a Kuatro Client application running on a workstation (the controller component of the MVC architecture). The client sends sensor data to the Kuatro Server (which maintains the model component of the MVC architecture – an XY virtual world representation of the installation space). The server broadcasts the user's virtual world location to one or more Kuatro View applications (the view component of the system). The views are specific to a given installation and support the various user tasks and actions. The view for this project is discussed in the next section.

Through this architecture, artists / designers only have to learn the OSC messages sent to View modules, as described in [1]. By using OSC to communicate user movement data, a view can be implemented in any language or environment that an artist / designer is familiar with, as long as it supports receiving OSC messages. Such environments include, but are not limited to Processing, Max/MSP, Iannix, and Abeton Live.

Kuatro has been developed in JythonMusic, a development environment for computing in the arts applications based on Python syntax [16]. JythonMusic includes Music and GUI libraries, among other functionality, providing artists an easy to learn API and language to create View modules.

For the more technically advanced artists or designers, the Kuatro framework allows users to create their own controllers by using the OSC protocol for Controller-to-Model communication, as described in [1]. For instance, early prototypes for this installation explored using a mouse controller and a smartphone gyro (pitch/yaw/roll) sensor.

The following section describes the interaction language for a Kinect-only interface. This interface was selected due to its simpler setup (i.e., less technology to configure) and naturalness of user actions (i.e., exploring involves only walking around and stepping onto a virtual button on the floor). Earlier prototypes were more cumbersome (harder to discover / learn) in terms of user actions, as they involved various combinations of walking and navigating through wrist movements or finger gestures, while holding a smartphone, and/or using a graphical user interface on a smartphone or tablet.

Interaction Design

The "Diving to Infinity" installation requires a Kinect, a projector, and a computer connecting the two. The Kinect and the projector are both placed behind the user (see Figure 5). In terms of dimensions, the environment consists of a 20' x 14' (6.1m x 4.3m) space approximately, with one projector displaying content on a wall / projection screen on the other side of the space. The projector and the Kinect are co-located, possibly on the same stand, which is tall enough to avoid shadow obstruction by the user interacting with the space.

The interaction design supports the following user tasks:

- **Task 0**: Begin interaction.
- **Task 1**: Explore original "Print Gallery" (magnify it for more detail, or see it from afar).
- **Task 2**: Unfold the "mysterious" warping of Escher's original to produce a flat drawing (see Figure 6).
- **Task 3**: Explore the picture-within-a-picture effect in the flat drawing (see Figure 7).
- **Task 4**: Re-warp the flat drawing to generate Escher's original.
- **Task 5**: Explore the picture-within-a-picture effect in Escher's original (see Figure 1).
- **Task 6**: End interaction.

The following section describes how these user tasks are mapped to low-level user actions (involving body movement).

Mapping User Tasks to Actions

This section describes the interaction language used to map the above user tasks to low-level user actions. These actions involve walking around the installation space, and stepping onto the virtual button.

As mentioned earlier, the user's location is tracked using one Kinect. The Kinect's triangular sensing area is mapped to an XY plane overlapping the overhead view of the installation space (see Figure 5). The Kinect sensor data is processed and sent to a view application, which implements the interaction language described herein. This interaction language consists of the following user interface states and corresponding state transitions.

State Transition Diagram

The "Diving into Infinity" user interface (UI) supports the following states, and transitions between states (also, see Figure 8):

- **State 0**: When there is no user inside the installation space, the system is in State 0. In this state, the UI displays a small, original "Print Gallery" (shown in Figure 2). This indicates the system is ready to start. As soon as the user enters the space (see Task 0), the system switches to State 1. The system always returns to State 0, when the user exits the installation space, from any other state (see Task 6).
- **State 1**: When the user enters the space, the system switches to this state. In this state, the UI allows the

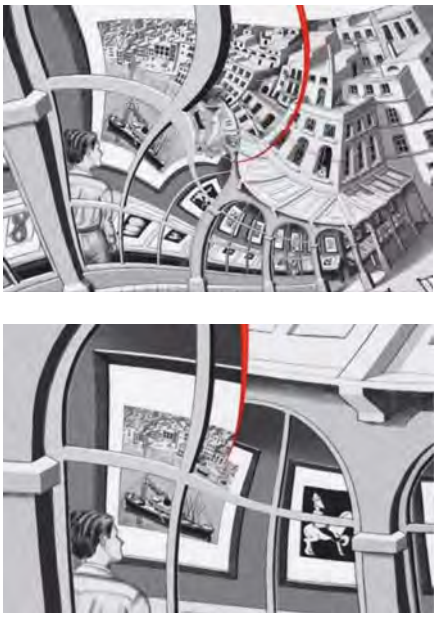

Figure 6. Two instances of the original scene being unwarped to produce a flat version of Escher's "Print Gallery".

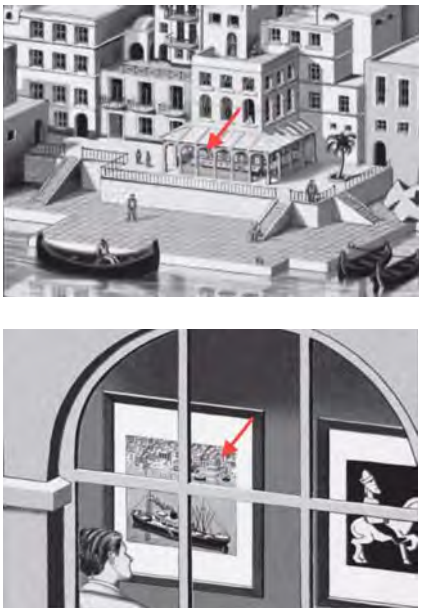

Figure 7. Two instances of the unwarped image demonstrating the picture-within-a-picture effect (see arrows). One may zoom in/out infinitely from one to the other.

user to explore the original "Print Gallery" (see Task 1). This is accomplished by mapping user movement along the X-axis to image position on the screen (i.e., the image becomes "sticky" – it follows the user's lateral movement). Also, the UI maps user movement along the Y-axis to image size (i.e., the closer the user to the projection screen, the larger the image).

- **State 2:** This state is entered when the user steps on the floor button (see Figure 5). Standing in this specially designated area, for a preset number of seconds, activates the button. In this state, the system unwarps the original "Print Gallery" to the "natural", flat version of the image (see Task 2). Also during this time the button becomes inactive, in effect, making the unwarping an atomic (undivided, modal) user action (i.e., it cannot be disturbed once started).
- **State 3:** This state is entered automatically when the unwarping from state 2 is finished. In this state, the UI displays the "natural" (unwarped) version of the video (see Figure 7), which continuously zooms into the unwarped image, revealing the infinite regression (picture-within-a-picture effect) hidden in it (see Task 3). Similarly to state 1, the UI maps user movement along the X-axis to video position on the screen (i.e., the video animation follows the user's lateral movement). Also, the UI maps user movement along the Y-axis to video size (i.e., the closer the user to the projection screen, the larger the video animation).
- **State 4:** Similarly to state 2, this state is entered when the user steps on the floor button. In this state, the system re-warps the "natural", flat version of the image back to the original "Print Gallery" (see Task 4). This action is also atomic (undivided, modal), i.e., it cannot be disturbed once started.
- **State 5:** This state is entered automatically when the unwarping from state 4 is finished. In this state, the UI displays the original version of the video (see Figure 1), which continuously zooms (swirls) into itself, revealing the infinite regression (the picture-within-a-picture effect) hidden in it (see Task 5). Similarly to state 1, the UI maps user movement along the X-axis to video position, and user movement along the Y-axis to video size.

Any time the user decides to exit the space, the system (upon sensing the user is gone) returns to state 0.

This interaction design has evolved through several prototypes and usability tests with different users. We feel that this is still a work-in-progress, as there are many different ways to connect user actions to experiencing and navigating the infinity in "Print Gallery" (and related Escher works). A demo of the system is available here: **http://goo.gl/FZnrbN** .

As mentioned earlier, our system reuses video material produced for the M.C. Escher "Infinite Universes" exhibit at the Parque de las Ciencias (Science Park) at the Alhambra, in Granada, Spain [4].

Conclusion

"Diving into Infinity" is a project for developing interactive experiences of M.C. Escher's depiction of infinity in his works. The prototype described focuses on the artist's 1956 work "Print Gallery".

Our system provides one way to navigate Escher's depictions of infinity, by utilizing the Kinect sensor, a video projector, a computer running the Kuatro environment, and a projection screen. The Kinect sensor captures user movement, passes it to the Kuatro environment. This allows the user to control various aspects of the inward size reduction and rotation characterizing "Print Gallery". This control through movement enhances the immersion effect, and introduces a new way to experience Escher's works – a way that was not possible with the technology available to the artist.

Our interaction framework can be adapted to develop interfaces for other M.C. Escher works that use a similar construction approach, such as "Smaller and Smaller" (see Figure 3) and "Fishes and Scales" (1959), among others. We intend to develop interaction designs for other Escher images as future work.

To the best of our knowledge, this is the first project that explores motion-based, interactive ways to experience the mathematical beauty and depiction of infinity in M.C. Escher works. In the artist's own words:

"When one dives into endlessness, in both time and space, farther and farther without stopping, one needs fixed points or milestones past which one speeds. Without these one's movement does not differ from standing still. There must be stars along which one shoots, beacons from which one can measure the road covered." [2, p. 124]

We hope that our work provides a new way to experience this "diving into endlessness", which is possibly consistent with what the artist himself would have designed had he had access to our technology.

Acknowledgements

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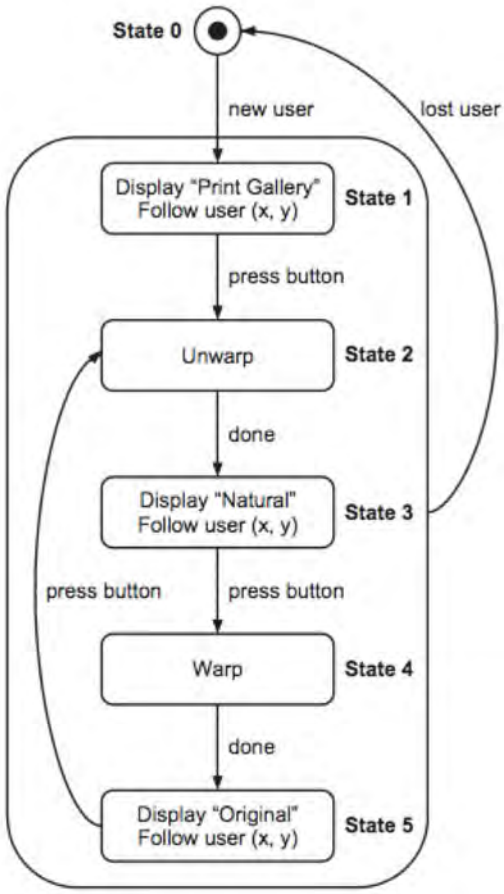

Figure 8. State transition diagram for the UI of "Diving into Infinity".

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Drawing_in_the_Media_Stream

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Abstract

Drawing_in_the_Media_Stream, a hybrid media installation, negotiates the collision between traditional forms of perceptual drawing and machine vision. Drawing provides a way to offer more lasting personalized and collective memories of the short-term presence of media images. By way of Paul Virilio's arguments put forth in *The Vision Machine,* we critique and disrupt the production and packaging of sanctioned images as the result of visionics, supersynthetic machine-generated vision, and present alternatives to the resultant loss of short and long-term visual memory.

Keywords

Paul Virilio, drawing, visionics, media stream, memory, images, machine vision, accelerationist

Introduction

"Now objects perceive me." --Paul Klee

Drawing_in_the_Media_Stream is a hybrid installation that integrates small-scale drawings on disposable pieces of cardboard and newspaper, large-scale drawings on gallery walls, and ephemeral digital drawings and projections. The drawings are responses to sanctioned mass media images found on the Internet, newspapers and television. The installation functions in two steps: one being an immediate response to breaking news story images through the dense accumulation of drawings in a three dimensional space while the next step is a rendering of highly selective images in charcoal on the gallery walls.

The process of creating the drawings for this installation critique and disrupt the compulsive production of virtual images that are fed 24/7 into the global media stream. The installation has two primary aspects: 1) the critique of the loss of short and long-term visual memory; and 2) the disruption of the production and packaging of sanctioned images as the result of visionics, of which breaking news stories from major media conglomerates are one example. Visionics is Paul Virilio's term for techno-culture's new visuality grounded in synthetic, machine-generated vision, automated perception and contemplation. [1]

The Critique of the Loss of Short and Long-Term Memory

News writing and photo aggregation are part of this system of visionics, wherein the computer analyzes and compiles the images and produces an unexamined database relatively devoid of human evaluation. It is "artificial contemplation". [2]

> "After all, aren't they talking about producing a 'vision machine' in the near future, a machine that would be capable not only of recognizing the contours of shapes, but also of completely interpreting the visual field, of staging a complex environment close-up or at a distance? Aren't they also talking about the new technology of 'visionics': the possibility of achieving *sightless vision* whereby the video camera would be controlled by a computer? The computer would be responsible for the machine's - rather than the televiewer's - capacity to analyze the ambient environment and automatically interpret the meaning of events." [3]

The loss of personal visual memories that this virtual glut of transient, machine-based images produces comes at a cost, the alienation of the individual from the culture at large. The author Marita Sturken has written extensively about the relationship of personal memory and cultural memory, and how images work to formulate these. Certain images create a shared memory of an event, such as images from 911, or images of torture from Abu Ghraib, or other national, traumatic images. Individuals relate to those events with personal memory, but the image can also instigate a shared memory within a nation or culture. [4] However, we are aware that visionics, as a form of implicit censorship, algorithmically controls and hyper-objectively sanctions images of what we are allowed to see and how we see it, and therefore how we remember the event—if we even remember the event in the torrent at all.

While in the glare and glut of these images, we are compelled to question what an image is, and by extension, the function of representation and its reception. We ask ourselves the question, how can any meaningful represen-

tation be created from the extremely temporary representations produced by the 24/7 global media stream? Our notion of what an image is has been profoundly transformed by the invention of a series of mass media technologies, such as the printing press in the 14th century, still and moving image cameras during the industrial revolution, video in the mid twentieth century, and on up to augmented reality in the present digital age. Today, an image is no longer a static, analogue, one of a kind object with one point of reception, but rather, it is dynamic, navigable digital data that can be viewed simultaneously in thousands upon thousands of discrete points of reception around the globe. In essence, an image is no longer an object but an event, the meaning of which is not static, but is also dynamic, mutable, ever changing. To restate Virilio's description of the transformation of the image, the perspective of space is being replaced by the perspective of time.

The marks that make up a machine made image have been dematerialized. In the digital realm, marks are no longer discrete traces on a stable surface, but rather, are infinitely mutable bits of data with no stable location in time or space. In the relativistic realm of the bitmapped or vectorized images, marks and the surfaces they are presented on are more akin to the transitory light and shadows that make up the moving images of video and computer-based simulations, animations and motion graphics. The visible marks that momentarily coalesce on screen are part of a hyper-ephemeral representation that never comes to rest in the comfort of our conventional senses of representation or realism. The analogue and virtual drawings in Drawing_in_the_Media_Stream create a fusion of space-time representations that nimbly respond to the urgent news story images. This fusion ultimately forms more lasting visual memories than those created by the extremely ephemeral media mirages.

With the status of the image now being primarily event-based, its function in the formation of historical and personal memory has undergone a radical transformation as well. Virilio frankly points out that the ultra objective, high speed vision machines have thrown serious doubt on the veracity of human vision and memory making. In the strategic militarization of sightless vision, the vision machine sees autonomously. There is no one behind it looking. The violence implicit in statistical vision extends even to Virilio's critique of the mobile phone. Although a seemingly less destructive machine, he condemns the ubiquity of hand held communications in their ability to take up every moment through constant contact creating a "collectivized affect" that is quite different from the way that personal and cultural memory is formed. But how do we come to terms with the "epidemic of cooperation" delivered through mobile phones and the personalized activity of visual memorization? When visionics is replaced by human perception, then what does it mean for artist to do the looking for others? We propose that this form of intimate contact and reproduction through drawing can create a space for the artist and the viewer to engage in "prolonged introspection" that is currently "monopolized by the outsourcing of our once immediate sensations." [5]

Virilio refers to this as statistical intoxication, "a blurring of perception that affects the real as much as the figurative, as though our society were sinking into the darkness of a voluntary blindness, its will to digital power finally contaminating the horizon of sight as well as knowledge." [6] The drawings we produce in our hybrid installation attempt to reclaim and integrate human vision and visual memory making with visionics, techno culture's headlong plunge into machine-based, sightless vision and image making. The drawings are not a rejection of the "industrialization of vision". [7] They are hybrid representations, visual memories created from immediate personal perception combined with perceptions of the new super synthetic vision machines. In the installation we integrate slow and accelerated media in our efforts to reclaim short and long term memory.

It is in this tenuous but compelling space and time of doubt and questioning that we are now drawing and thus memorizing our way through the media stream. This installation is an attempt to draw in the liminal space between object and event in order to regain our relationship to the image during this loss of personal and lasting visual memories of our times. As media artists, drawing is an integral part of our artistic process that allows for the reinstatement of visual memory making into the personal and public realm of contemplation.

The Disruption of Sanctioned Images

Corporate content providers of the global media stream use visionics and "artificial contemplation" to efficiently sanction and virally distribute the meaning of breaking news story images. These meanings are taken at face value as they momentarily flash on our screens because we have almost no time to contemplate their meaning and truthfulness before the torrent of the media stream swallows them up and washes them downstream to be forgotten. Over the duration of the installation we counter this by drawing everyday in the gallery space, tapping into the media stream and closely examining these unexamined meanings as they algorithmically go viral throughout the day. Ideally, our drawings disrupt the image torrent to create a more lasting personal and collective memory of these events.

The high speed aggregation, packaging and viral distribution of these breaking news story images does not allow for a prolonged introspection or particularization of individual lives. An example of how the gluttonous 24/7 global media stream creates a loss of extended contemplation and our critique of this can be seen in our installation. One of the videos and some of the drawings for the installation are based on photographs and text from a New York Times article of 2008 detailing how the U.S. had reached a

deadly milestone of 500 troops who had died in Afghanistan. In the article, troops were represented by a statistical bar graph. [8] The article also related the story of a mother whose son, Matthew D. Blaskowski, was killed by a sniper. After his death, she received an email from a television journalist who had inadvertently recorded a video of him at the moment of his death. The mother watched it compulsively, to see "how it – the bullet—found him." We combined her text with video and portrait drawings we did of the specific troops, disturbing the shorthand of statistical graphic representation, in an attempt to particularize this soldier's death, rather than see it as a machine-made abstract sign of loss.

The hardware and software that have coalesced in the cell phone have, for the first time, afforded millions of individuals around the globe the ability to capture, freeze and send an image in real time of an event. For the first time these maximally efficient vision machines give people agency at street level to send and receive images. Putting aside the human vision versus machine vision issue, an analogy can be made between these crowd-sourced, machine-made visual memories and the graphically reinterpreted images in our drawings in that they step outside of the system of sanctioned images.

The drawings we physically produce on the walls of the gallery, on cardboard and on daily newspapers provide a slow media, physical location to contemplate a tiny sector of the database that was formerly bereft of in-depth human contemplation and evaluation. By choosing particular images from the daily media stream to draw and thus re-remember, we are simultaneously questioning the truthfulness and meaning of these images, while at the same time we are augmenting the meaning of the vision machines' images. While we were creating the first iteration of the installation in San Diego in the summer of 2008, there were several mega media events happening that generated many viral images and memes to examine: the protests in Iran over the rigged re-election of Ahmadinejad, the Olympics in Beijing, Obama's campaigning in Europe and the supreme court's ruling that the major telecom companies could not be sued by US citizens for handing over their personal data to the US government after 911. We created two very large opposing wall drawings, one of the AT&T logo and the other of Donald Rumsfeld, Dick Cheney and George Bush. In our drawing process we made a connection between these two seemingly unrelated media stories, by revealing AT&T's hypocritical sponsoring of the Olympics in Beijing and the Supreme Court's ruling to absolve the major telecom companies of any wrong doing in their data mining of U.S. citizens' personal data. (Figures 1, 2)

The juxtaposition of these two drawings question the truth-branding of a media image and generate a commentary through political references and irony. By producing drawings of familiar, but fleeting, images from the global media stream we disrupt and interrupt the sanctioned reading of these images. We make an incision in the media stream and extract the images through drawing to isolate and magnify the content, then refocus it through recombination.

Figure 1. Installation view, "AT&T", charcoal wall drawing, 16' x 12', Southwestern College, USA, 2008

Figure 2. Installation view, "Vision Verified", charcoal wall drawing, 16' x 12', Southwestern College, USA, 2008

Capitalism's accelerationist mania for maintaining the steady surplus of a commodifiable novelty serves as the background on which mass media operates. As Steven Shaviro writes, "In such a climate, nothing is more prized than excess. The further out you go, the more there is to accumulate and capitalize upon." [9] The result is that media spectacles as a form of surplus novelty are consumed and forgotten. We approach the gluttonous 24/7 global media stream by conscientiously appropriating the accelerationist techniques and esthetics of image accumulation. However, we short circuit the nullifying effects of excess by extracting specific images and then begin a deep contemplation of the images by re-drawing them. (Figure 3)

Figure 3. Screen Shot, digital drawing, Belfast, Northern Ireland, 2009

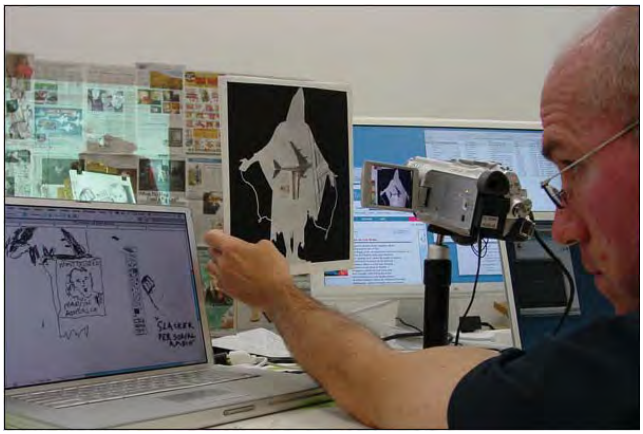
Figure 4. Tony Allard digitally drawing, Belfast, Northern Ireland, 2009

Through the use of slow media, such as drawing on a gallery wall with charcoal, we disrupt the loss of short and long-term memory that results from the ultra entropic accelerationist siphoning off of any appreciable meanings in breaking news story images. Literally slowing down to the speed of a static, one-of-a-kind image, affords the viewer the option to step outside the torrent and, anachronistically, sit still with the re-drawn and re-remembered breaking news story images. Drawings in the installation create a local site where the public can share with us in the formation of more long-term memories of these breaking news story images that normally flash on our short-term memory and are then washed downstream and forgotten.

In Virilio's critique of synthetic perception he asks us to ethically consider the "philosophical question of the *splitting of viewpoint,* the sharing of perception of the environment between the animate (the living subject) and the inanimate (the object, the seeing machine)." [10] Even before the advent of what is referred to as the "post-photographic" era of digital art, performance and installation artists since the1960's have negotiated the ethical and political territory of the techno-phenomenological meshing of the body with the machine, later to be positioned as post-humanism. [11] We are refusing exclusion from the "automatic-perception prosthesis" by uniting digital drawing and its ephemeral manifestation in screen based art with physical mark making in the immersive environment of the installation space. (Figure 4) While we maintain the conventionally embodied practice of drawing, our corresponding production of dematerialized, mutable images plays a role in how human sensorial aggregation "enframes" digital information. [12] Continued future iterations of Drawing_in_the_Media_Stream will allow us to ethically engage, critique and disrupt the dichotomy between animate and inanimate, human vision and machine vision.

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From *A-ha* to *Oh Shit*, from Graphic Design to Glitch Design

– Jonathan Hanahan

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As media platforms shift towards more dynamic interfaces, the separation between user and content grows infinitely. While advertised as thin, light, and seamless, these platforms mask a thick and complicated space in which society must navigate. This is what I call the *Thick Interface*. The *Thick Interface* is the space between user and content. It is a space that has grown vast, complicated, and consequential through the evolution of society and technology. This space began its growth at the infancy of design practice, the Gutenberg press, but has grown exponentially in recent years to encompass a space that is occupied and lived in. Starting at the Gutenberg press reveals that the practice of graphic design was born out of and is married to technological advancement. While this growth in scale and complexity may affect all professions and all of society, I would argue that it affects graphic design on a deeper level. After all, it is designer's role to sculpt society's relationship with content and to narrate and disseminate the information used to guide us through our complex environments. When we design interfaces—books, posters, artifacts, websites, mobile applications, etc.—this thickening space is not only vital, but also a powerful communication tool worth utilizing as a means to understand and relate to the complexity of these engagements.

As this space continues to grow, designers much grow with it. More than just evolving to new platforms, the methodologies designers execute must also adapt to new forms of narrative and experience. Traditionally, the graphic designer has been tasked with hiding, masking, and distracting from errors. It was formerly designer's job to clean up content, provide a happy, productive, and inspiring experience with it. This was an interaction devoid of distraction, disturbance, and clutter. Yet in todays media landscape, designers must also consider how to not only explain content, but also explain the complexity of the experience the content represents. As the space within the *Thick Interface* becomes increasingly more extensive, confusing and disorienting, the steps designers take to hide the thickness also grow. We are using new softwares, technologies, languages, etc. as a means to encourage an audience to forget this space exists. What happens if we stop trying to hide the errors and

embrace them? As we seek to visualize the complexity, I argue that the most important tool of the contemporary graphic designer is not photoshop, indesign, processing, or html; it is the glitch.

The Oxford English Dictionary defines a glitch as, "a sudden short-lived irregularity in behavior." The glitch has traditionally been viewed as a computer problem, when a machine makes a mistake. While often glitches are cumbersome burdens—considering they represent an undesired outcome, usually at the most impromptu time—glitches also have an aesthetic within the art and design community which many are fascinated. They are pixelated, noisy, and nostalgic. They are dynamic, unexpected, and edgy. These formal qualities are what Curt Cloninger and Nick Briz call an 'a-ha' moment in our interaction with technology.[1] An 'a-ha' moment is when an expected visual responds in an unexpected way. For example, Kenneth Goldsmith—in his book Uncreative Writing—tells a great story about how during a transatlantic flight his seat-back monitor shifted from visualizing a map of the plane over the ocean, to a sea of computer code, only to return to the map after a DOS re-boot[2]. In this instance, the glitch reveals a mild unexpected and unplanned interruption. The viewer is momentarily aware of the underlying system that supports the map and the glitch provides a momentary access point into the *Thick Interface*, revealing its inner structure. These glitches, opposed to the forced glitch typically associated with Glitch Art, are possibly the most intriguing digital glitch in the reveal of the Thick Interface. They take place in the worst possible situations: airports, signage systems, ATM machines, etc. These are spaces dictated by a very specific agenda, usually one dependent on time and money. Here, the glitch disrupts our goals and compounds distress. Yet the heart of a glitch is its temporality. It always retreats from this 'a-ha' moment back to the expected experience. If we step back and evaluate this narrative; the glitch becomes a gift. It is an opportunity to understand and digest the reality of thickness of our interfaces right in front of us. Obviously, these examples are unintended moments. These interfaces were designed to work seamlessly and these reveals were never intended to be seen. As designers, we so often fear the glitch. But this experience of appreciation sheds light on their potential. Designers should be utilizing the narrative potential of the glitch in our everyday experiences to not only translate information, but also comment on the experience.

The glitch is not necessarily new in graphic design. Grunge typography, among other disruptive typographic experiments throughout history, are close cousins to the contemporary idea of the glitch. Popularized in the 1990's by the likes of graphic designers

David Carson and Neville Brody, this form of typographic expression followed a similar trajectory to other examples of graphic design innovation. It was a direct result of technological advancement. More importantly, it signaled graphic design's potential to not only simplify content, but to participate in the conversation of that content; to open up the content even more, and to comment on the world in which the content resides. Here, the interface is no longer invisible, but increasingly material, both formally and conceptually.

Grunge typography was as much about its time in history as it was about the technology. The nineties were a world of anger, resentment, and confusion following the end of the Cold War. As Carlos Segura put it, "Grunge typography came in as a backlash, very much like how punk music came in. It was almost like a societal complaint...everything was getting too clean."[3] These stylistic moves added layers of disruption to the reading experience. David Carson's most famous example is his treatment of a *Raygun* article about Brian Ferry which he set entirely in Zapf Dingbats, rendering the text completely illegible. Here, Carson politicizes his work as a means to alter the expected experience of a reader and a magazine.

More than twenty years later, the glitch resides in a similar situation. The world of today is formally similar yet exponentially more complicated to that of the ninties. The complication exists in the invisible systems and networks surrounding our urban existence. What has changed since the days of grunge is that designers have become far better at cleaning up the edges and surfaces of contemporary complexity, and the containers we design in are deeply more magical. In the nineties, the interface, while thickening, was still relatively thin. Today, that interface is vastly thicker and the glitch is the tool which serves the role that grunge type once did, activating the content, while also experimenting with the technology. The glitch is not only an access point to the *Thick Interface*, but also a potential statement about societies position within it regarding privacy, security, power, etc.. Yet still, grunge is only a cousin of the glitch because—for the most part—it is still purely a stylistic move. Grunge typography is more closely related to glitch art than glitch design, where the aesthetic of error is utilized to formally make statements. The glitch I argue for has far more reach than the visual splendor of anxiety. It has an opportunity to alter the experience and the perception of an audience as they participate in the world. It takes into consideration more than just the visual spectrum, but time, tactility, sound, and space.

Unfortunatly, in the expansion of complexity and the *Thick*

Interface, graphic designers have—more often than not—retreated back to the role of stylist or technician of these new interfaces. We do not clean up the thickness itself, but rather the container it lives in. In this model, society need not concern itself with what is under the hood and how it works. This is very much dictated by a client driven business model. Clients want—and pay for—work that promotes a specific agenda to their audiences. The stereotype of error negates and interferes with a curated strategy. But if we stop thinking about glitches as simply computer problems to solve but as opportunities to disrupt expected experiences, the narrative potential of the glitch is infinite.

Sure, the works of glitch typographers, artist/designers, and even contemporary practitioners like OKFocus, Metahaven, etc. have experimented with disruption and glitch in traditional graphic design practice. I still feel we have only scratched the surface of the potential of interference in design methodology. Where the intrigue of the glitch has the potential to go further is embedded in the growing thickness of our interfaces. Here, the physical and digital are intertwined and the glitch is no longer simply a physical disruption to digital systems but digital systems also invading our physical environments. These glitches are no longer one-way systems and two-dimensional visuals. When the digital invades the physical glitches shift to experiential, participatory, and interactive moments in our everyday environments.

This brings us to Cloninger and Briz's second glitch moment; the 'oh shit' moment. Here, they point out that the glitch is not a computer problem but a human problem. They state, "Computers don't make mistakes, people do. If all variables remain the same, given the same input, a computer will always render the same output; however, often times a programmer slips...These slips result in entirely predictable, yet unexpected output. We tend to place the onus on the computer and call this moment a glitch."[(4)] This statement points to the glitch as something we can control and utilize, not simply something to which we are subjected. They go on to say, "A glitch is experienced when a human mis-expects one thing and winds up with something else. Without hope, anticipation, and expectation, without a sense of rightness and the way things are supposed to be, there is no glitch."[(5)]

Hope and expectation drive our everyday lives. We expect our technology to work as advertised. We expect it to help and to enhance our lives. Since the glitch is so dependent and so effective in these moments when expectations are high, designing disruptions are an

enticing opportunity in the toolkit of the contemporary designer. The glitch can start to shape, frame, and alter the way we experience complex content. The glitch provides the designer the opportunity to not only reveal the thickness, but to explain it in new, relatable, and memorable ways. Additionally, when we remove the glitch's tie to its formal stereotype of pixels, shifts, and error on a screen, it can become anything—physical, digital, both, or neither—which momentarily disrupts an expected experience. It is this rupture that provides the graphic designer great opportunities for how we tell contemporary stories.

It is no longer the task of the contemporary graphic designer to simply beautify the edges of our complex contents and societies. The job now includes thoroughly explaining the systems themselves. The glitch becomes the access point to chronicle these complexities; through time, space, and experience. Cloninger and Briz often define this as the 'glitch event'[6] which prefaces that the glitch is an interactive and participatory entity. The designed glitch takes us from the playful and surface 'a-ha' moment, to the deep, rich, engrained, and sometimes terrifying, 'oh shit' realization of what our experiences in the *Thick Interface* actually imply. As graphic designers continue to attack more complex and consequential problems, the glitch opens up our interfaces, not by simplifying, but by providing a vantage point to understanding and a new lens to observe and evaluate our evolving media landscapes. Designers should evolve from stylists to interfaces in their own right, not be trying to mask 'a-ha' moments, we should be intentionally creating 'ah-shit' moments. Evolving from graphic designers to glitch designers.

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TARA COOK

The Image Compressed

Introduction

In this presentation I attend to the compressed image in relation to contemporary discussions on digital aesthetics. If compression constantly redefines visual information as it enables data to travel through digital infrastructures, the key question then is- what is this redefinition? I examine the way data compression translates information in an act of productive reduction that obscures, marks and folds the image. It draws from David Joselit's *After Art* and Hito Steyerl's *In defense of the poor image* to argue, not for its possible mass dissemination and re-presentation, but for the ontological potentials and dangers of the image itself. Alongside this discussion images and video of my practice are presented. Compression and loss are incorporated as an artistic strategy in my practice whereby hybrid digitally and physically compressed works form encounters with trace, difference and loss.

Compression

Digital images seem to proliferate independently through the cables and servers that disseminate them, but they are absolutely reliant on processes of compression. The digital file is continuously compressed and decompressed, each time carrying the indexes of the process of its formation, memories of its state changes; its traces are passed on in digital events where its content and the material commodity of matter is not. Abstracted from its context, compression becomes almost a universal principle of digital dissemination. It seems that in a world suffused with generated images, an understanding of compression perhaps allows an opportunity to reflect on these worlds of images, the ways they are reproduced, received and represented.

I define compression as the action of pressing together as well as the condition of the pressed together. That which has been pressed together by force becomes under the condition of being pressed together, and that which is under the condition of being pressed together gives sensible form to the event of the pressing together.

Compression's etymological root is located in the verb "compress," meaning to put under pressure and further in the Latin work "press" denoting crowding. Compression acts, and its action forces things into less; things become shortened, constricted, abbreviated, squashed, flattened, crushed, crammed, jammed, stuffed, wedged, packed, shaped and compacted. The imperative of compression is to respond to the problem of limiting a mass of something within finiteness. It expresses a desire to contain more within less. While expansion releases things into more; they become enlarged, extended, elongated, allowed, inflated, lengthened, broadened and opened. The imperative of expansion responds to the problem of unfixing something to a limited space. It expresses a desire to allow more into more. If expansion can free things from pressure or a forceful ordering, then compression binds, enslaves and encrypts them. Alongside with the compressed we may consider the suppressed, repressed and the depressed, all states that signify a forceful or an entrapping presence of control on persons, things and information.

In a digital context, the term compression is used to describe data that has been fed through a compression algorithm. Data compression encodes files into smaller information-bearing units, to enable these files to travel faster and take up less storage space. This compression, which is formally named "source-coding", rearranges the relations inside and between the data of files through means such as reordering, scaling, reduction and decomposition.

The transformative act of compression condenses a density of data, compacting it to be contained into a different file type or size. These processes of containment, condensation and compaction reconfigure the information and image. They bring about a decomposition of the file and a resultant obscuration of the image. The image becomes effaced of its previous level of detail while at the same time becomes marked with the traces of the translation. The absence of detail in combination with the presence of trace fragments obscures the image and abstracts it from readability. The image's transformation goes from detailed clarity and quality towards distortion and abstraction, eventually leading to the loss of an image completely as the file becomes corrupt and unreadable. The compressed image folds and collapses into and out of itself, meaning falls to the void.

Dissemination

Artist and writer Hito Steyerl's article *In Defense of the Poor Image* explicitly confronts the aesthetic conditions of such low-resolution digital images, addresses these images as copies in motion that migrate across a network. Through an analysis of the exchangeability of the copy as well as its process of dispersion, Steyerl explores the relations between an image's resolution, its ability to travel and its output. Hito Steyerl draws from Walter Benjamin's *The Work of Art in the Age of Mechanical Reproduction* to offer an alternate perspective on the copy as one that not only allows reproduction but the ability of the audience to represent information. The text celebrates low-resolution images for being widely used, socially useful and non-authoritative. Hito defines the poor image as having inherently oppositional qualities that resist the realism and verisimilitude that is demanded of its representations. Rather than effacing, it makes visible its mediated nature. The poor digital image has been copied and renamed until it becomes unreadable and without a context of origin or intent. Like the poor image, compressed images force the viewer into a heightened awareness that what they are experiencing is a digital representation. The aesthetic affect of digital images stands in metonymically for the networks they navigate and the means by which those networks are exposed. They are a profile of the network. The compressed image brings into view the concept that networked space itself is a medium, that it is both a container and marker.

Art theorist David Joselit continues the discussion of network aesthetics, of art under the condition of big data. He argues that what counts "is not the nature of the material acted upon…but the generation of form through action…. Such substitutions mark a shift from the manipulation of material to the management of populations of persons and/or pictures."[i] He is interested in a shift toward network aesthetics, in artists working in modes where "the single image and the network are visible at once."[ii] In these works, the image contains the indexical history and marks of the network. He argues that mediums are now best considered as configurations of force; provisional structures that aggregate and channel content, establishing patterns of links or connections between images. "I think there has been a gain of information through transmission: Significance is accumulated through the re-enactment and relocation of the "same" image in different places and times."[iii]

While Steyerl's and Joselit's theories on the disseminated image are centred on understanding the affect of the image, its relational qualities and productive output, I am focused on the image itself, it's process of becoming and what it can tell us about the systems that surround and inform it. I seek to pause upon this image to see its ontological position, its situation of lossfulness, to be present in the violence of impermanence, this tragedy of time and our impossible project of memory.

Loss

If compression redefines information engendering images with loss, what is this loss? Loss can be defined as the state of being deprived of something that was one once had. Derived from the Old Norse and Old English term "los", meaning destruction, looseness or a breaking up. When thinking of loss, one thinks of a

company's profit loss, the hair loss of baldness, the memory loss that comes from age, the loss of a loved one, being a loser when one loses at a game, being at a total loss, lost in the world, and then perhaps cutting your losses and breaking loose.

Loss is a heavy term, full of the pain and misfortune of someone or something being lesser or without. While losslessness represents a utopian vision, a perfect idea in which things remain and remain unchanged. It is not just information that is lost with these images, but our ability to perceive them; it is our translation of them that is becoming difficult. When we speak of the forms and processes of compression in terms of loss, we speak also of our fear of loss and desire for losslessness. We are trying to grasp the world around us, but it is rapidly transforming through digitization and there is a growing mass of data, both of which are beyond my comprehension. Jean Baudrillard suggests that we do not know the reality of things, that "we live in a world where there is more and more information, and less and less meaning."[iv] For Baudrillard, the distinctions between representation and reality break down to only simulacra. While Lev Manovich outlines in his *The Language of New Media*, that the machine or medium, at every instant of interaction, reminds the user of its existence, in a sense, adding information. It is in this play between an awareness of structures and an embrace of the processes that perhaps these images become poetic to us.

Philosopher Georges Didi-Huberman contemplates the problematic of trusting the cultural archive to be stored in volatile media, musing "it is extraordinary that men have entrusted so many images, so many affects, so many constructions, such beauty to a medium so close, ontologically, to its own ruin."[v]

Storage

A hard drive fails in an instant and with it goes a collection of memories. The somewhat volatile medium of the digital is expressed as irrecoverable loss and leads to an obvious lack of trust. Without trust one enters into a tenuous relationship. There is an anxiety inherent to the impending possibility of a sudden end. At the same time digitisation offers older mediums the promise of overcoming their own physical degradation. Cultural works from the history find themselves uploaded to digital storage networks by the millions of libraries and archives across the world. Does one volatility supplant another? Recently cloud storage, or stratification, has become a more prevalent storage option. The promise of the Internet found its genesis in the avoidance of loss. If digital storage fails in one place, at least it may be resurrected in another. To spread something across the network for an assumed archival posterity became an inadvertent step toward peer-to-peer sharing. For as soon as anything entered the network, encrypted or not, it had become accessible to another. Storing personal information in international locations, some of which are subject to corporate ownership, has become the normative response to this lack of trust that one has towards their own personal storage devices. At this negotiation the historically private begins to enter gated public domains. Here the personal enters into a state of forced transparencies replete with all manner of promises to ensure these locations are secure and trusted. Yet security online is much like it is in any other place, promised but vulnerable, a trade-off is struck. Files stored locally are likely to perish without recovery. Files stored globally are likely to be kept, but are also likely to be used. Because the likelihood for failure is lowered, what enters the network often stays there. A chain of associations and pathways, alterations, enhancements and degradations become possible. A scattered history is kept, only perforated by broken linkages and pathways that no longer point to new locations.

The other fragility of the digital medium that leads to its volatility - is actually predicated on the behaviour of the subatomic particles that pulse through the current of its circuitry, the solder that binds its connections. Heat and other physical issues cause things to behave in ways that are not optimal to their performance. This is why your computer has "character". The computer crash does not always come from the code, but from the physical architecture of its transmissions and those of the network to which it is connected. In this way the material nature of the digital is constantly asserting itself. Materiality lurks - latent to all digital efforts. To be

clear, there is nothing virtual about the digital or the network. In 2006, when a 75 year old woman in Georgia accidentally put her spade through a cable in the ground the entire neighbouring community of Armenia lost its Internet connection for five hours. I propose that there is no such thing as the cloud. More accurately, there are pipes. They connect to buildings. In the buildings are machines and people. They are sitting in their local environment. Digital space is as delicate and finite as any other, and particularly any other that exists within a global ecology. Uploading a new set of photos is not committal to an infinite space: it means a new server rack in a new room somewhere for some period of time. The aggregate of these connections in time and space is the formation of a shifting and inflating archival network – the cloud. This brain cloud is a tapestry of indexes, an embroidery of voids, a constellation of simulation, a technological fold and just "a bunch of patterns being fed to us as we stand around within the space-time cube."

My practice of moving and still digital images are abstract simulations approached from the vantage point of an already abstract experience within a simulated environment. My practice attempts to undermine any supposition that there can be a world in which all of this mass of pixels, big data and processes of compression is reconciled. Instead the works present lossy images as an ineffable element of the everyday but with the plenipotentiary to create encounters and speculations on the intangibility an incomprehensibility of this world.

Closing

Data compression enables a mass of data to be shared and stored efficiently but at the trade-off of quality. Compression is the product of a compromise – it is both a desperate and inspired incorporation through which the lossful image and its process of becoming are together entwined or encrypted. Reduced to a cipher, and occupying the threshold between exchangeability and readability, the folded remnants of trace give rise to a proliferation of phantasms — shards of meaning and memory – fragments of aesthetic experience — that, untethered from their original context, are given over to a delirium that only the act of contemplated composition can temporarily arrest. I feel melancholic.

Perhaps compression has a dual function - both the edifying cultural emancipation that is described by Steyerl and Joselit, as well as a shock of the abyss that returns the conceptual and sensual gaze to the nature of an image itself. To understand the compressed image is not to attain certitude about an image, but to know the radical incompleteness of representation and experience. I see the compressed image as one that forces us to confront loss and difference, and their function in the ideation of being.

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[Session 35]

Evaluation and Valuation

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Experiments in art and value: burning Bitcoins to buy Ai Weiwei

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Abstract

Critical new media art is based on research-based art practice. It is both research- and process-oriented, so that the final result is not "completed" works (products) but rather process artifacts. This paper describes the artistic research and development of the art-group "Artistic Bokeh", which is developing new documentation formats, and conducting experiments about the value of artistic practice and labor.

Keywords

Artistic Research, Bitcoin, Performance, Media Arts, Artistic Bokeh, Bitcoincloud, Community Practice, Artistic Capital

Introduction

"The human gaze has the power of making things precious; though it's true that they become more costly too." Ludwig Wittgenstein [1]

How many seconds do you need to stand in front of a work of art, staring either blankly or attentively at it before it has served its function? Before it has served you? How can the attention an artwork receives be measured? Would it be useful to place a little red button next to each work so that the gallery audience could press it and 'like' the work?

In 2012, I became aware that a photograph of one my installations had been doing the rounds on Tumblr. It was the first work of mine that was ever exhibited for sale at a commercial gallery. This one never sold. Yet I was strangely satisfied that despite this particular failure in the art market, it found a home online. Being re-blogged 3000 times by teenagers on Tumblr meant that it had been seen. This multi-channel video installation found its biggest audience not as an art object inside the gallery, but outside the artworld, as a still image distributed within the fragmentations of the network society.

No market?

According to Geert Lovink, "there was—and still is—no market [for media art], no galleries, few curators and critics, and no audience." [2] There is a need for new distributed forms of attention and presentation for art, new markets for the new economies that are emerging, this sharing economy, that conceptual economy or the ever-pervasive attention economy. We find ourselves in an age of capitalism that fuels itself with the effigies of knowledge, creativity, individuality, openness and the social. The artist should be well placed to supply the increasing demand for these resources, and they often do, once they are extracted from the artworld and integrated into the creative industries.

But what of the work of art? What role does it have in this world of Joshua Simon's neomaterialism? [3] A world where art prices go up: not when the whole of society becomes wealthier, but when income inequality increases. [4] It's only when the rich get richer and the poor get poorer that the work of art increases in value, at least in quantifiable terms, which are the only terms that seem to matter in this rational realm of the knowledge economy.

I had been working through these ideas in my performance practice with the works "The Old In Out, Dancing in his bedroom (It was a waste of time anyway)" and "Comings and Goings" when I was first approached to participate in the Viennese group *Artistic Bokeh*. My performance works dealt with the generation of conceptual capital as a form of 'value adding' within the knowledge economy. Conceptual capital is the 'value added' to the viewer of the work of art, a sort of upgrade to the viewer's perception of the world, and an increased capacity to manufacture meaning in and from the world. *Artistic Bokeh* had been exploring similar questions of art and value within the networked society, so I joined the group to continue to develop their experimental practice [5] that slips in and out of the art world, working with them to perform "The Old In Out" for the Austrian Chamber of Labour's symposium on knowledge work, and most notably continuing the development of BitcoinCloud. [6]

Figure 1. Artistic Bokeh, Bitcoin Cloud v3.1 (Installation view at Museum of Applied Arts Vienna), 2013, modified LED fans, custom built Bitcoin mining rig, pyro-electric sensors, custom hardware, software and circuits ©Artistic Bokeh.

Bitcoincloud

Hovering above your head are a few hundred computer fans spinning and glowing, reacting to your movement through the exhibition space. Your presence, your attendance to this artwork, is generating Bitcoin. Therefore your attention to the artwork accords the artwork real monetary value. At your feet are several computers, you hear the noise of the fans power on as more people enter the exhibition space. The cloud of computer fans above you begin to spin and to glow more brightly.

In 2008 Satoshi Nakamoto created Bitcoin, a digital decentralized peer-to-peer payment system. Hidden within the original code was a reference to an article from the The Times: 'Chancellor on brink of second bailout for bank'. This reference, together with the opening statement of Satoshi's white paper, [7] outlined how Bitcoin could function as an alternative means of exchange that would not require a centralised financial institution. A bank that is too big to fail. Bitcoin is an experiment that is testing the hypothesis that money can exist without a bank, without a central institution. [8] BitcoinCloud is another experiment that asks how can art exist outside an institution, in this case the art market. The work offers an alternative method to quantifiably measure the value of art.

Bitcoins are limited to 21 million units ever produced, so this first 'cryptocurrency' also represents a deflationary currency. New coins are minted through a sort of 'lottery', depending on the processing power dedicated to the whole Bitcoin network. Computers are required to solve increasingly difficult cryptographic puzzles (called mining) – which is in turn rewarded with newly generated coins.

BitcoinCloud replicates the principles of the "economics of attention", by changing the amount of processing power dedicated to its mining rig depending on the number of visitors and the intensity of their interaction with the installation. By tracking the amount of visitors in the exhibition space, BitcoinCloud creates new Bitcoins and increases in value, only if it receives enough attention. These dynamics of attention allow an ambiguous existence: BitcoinCloud is part of the art market at the same time as it is setting itself apart from this market by capitalising on its own economic attention-value. The Bitcoins earned by the attention to BitcoinCloud were then used by Artistic Bokeh in further experiments in art and value, including Blockchain Performance (2012).

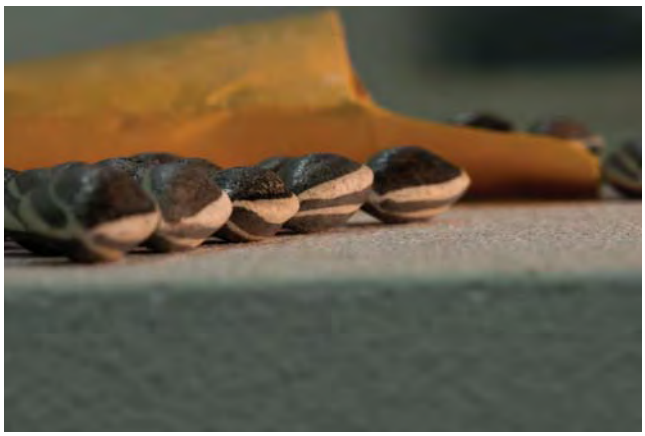

Figure 2. Artistic Bokeh, Blockchain Performance, 2012, 20 Ai Weiwei Sunflower Seeds purchased with Bitcoin from Spacebank ©Artistic Bokeh.

Blockchain Performance

In 2010 the Tate Modern commissioned Ai Weiwei to produce Sunflower Seeds. The work consisted of 100 million double-burned and hand painted porcelain seeds. In the Chinese city of Jingdezhen, 1,600 people had been working on the project for over two years. Visitors at the Tate stole a great number of these small porcelain objects and started to sell them on both Facebook and eBay. The Tate soon decided to not let visitors near the artwork, although they cited health concerns due to the porcelain dust, rather than art theft. In a Sotheby's auction in 2011, one hundred kilograms of the Sunflower Seeds sold for $559,394 and in 2012 the Tate purchased eight million seeds (10,000kg and 10% of the total artwork); these purchases created a market and value for the stolen seeds. [9] In 2013, the exhibition Couriers of Taste at Danson House in the UK exhibited piles of the stolen seeds collected from the nimble fingered from all across the globe. The exhibition included the stories and intentions of the thieves that came into possession of the seeds. The personal narratives demonstrated another means of adding value to the seeds, although not necessarily monetary. The Tate's purchase of the seeds had originally valued them at £3.50 apiece. Currently the prices for Ai Weiwei's Sunflower Seeds on eBay range from $0.22 (USD) to $20.00 (USD) apiece, however the authenticity of many of these seeds is questionable due to the emergence of many fakes. In 2012 Artistic Bokeh purchased 20 seeds as part of the work Blockchain Performance.

Blockchain Performance was a cooperation with the virtual community investment bank Spacebank run by Mexican writer and media artist Fran Ilich Morales. Spacebank's virtual currency is backed by hijacked Ai Weiwei Sunflower Seeds. The Blockchain Performance included transferring 6.8305 Bitcoins mined with the BitcoinCloud to purchase 20 Ai Weiwei Sunflower Seeds to be exhibited alongside other 'process artefacts' from Artistic Bokeh's experiments in the exhibition Documenting Artistic Technology at MuseumsQuartier Vienna, 2013. [10] The transaction between Artistic Bokeh and SpaceBank stays active in the Bitcoin Blockchain and is publicly viewable. The 6.8305 Bitcoins that were used to purchase the 20 Sunflower Seeds from Spacebank were valued at approximately $6,120.00 (USD) at the time of the transaction (26 November 2013); they are currently valued at $3,450.00 (1 September 2014). These 6.8305 Bitcoins were generated from the attention paid to BitcoinCloud during its first exhibition. If the BitcoinCloud had dedicated all of its processing power to mining Bitcoins during this first exhibition, and not only responded to the attention from visitors, it could have generated approximately $450,000 (USD) worth of Bitcoins. The value of the work remains ambiguous, it could be measured by its attention, its exchange value to established artworks within the art market, or it could also be measured by its potential loss of earnings within the Bitcoin market.

Too much money …

Artistic Bokeh continued to experiment with art and value in the recent work "Too much money…" exhibited at MuseumsQuartier Vienna. In cooperation with French collective Societe Realiste and Greek economist Georgios Papadopoulos, we exhibited 4,107 single (US) dollar bills, which were originally converted from Bitcoins mined through the BitcoinCloud. Alongside the money, a print-installation of Societe Realiste's typographic work "A Proposal for a New Alphabetical Order Based on the Experanto Writing System and Pegged on the Euro Rates" was presented. The work of Artistic Bokeh represents a line of research undertaken to not only question the value of art, but to also work with the materiality of value, here exemplified by the dollar bill. One dollar bills provide the most paper cash you can acquire for your monetary value in Austria (in our case from €3,000) which relates to the fact that storage space is costly too, and Austrian banks will only store bills in foreign currencies that are related to the "key currency", which is still the US dollar. Too much money… sought to address the ambivalent relationship between art and the market, pointing to the problematics of commodification, alienation and co-optation of creativity. Similarly to Ai Weiwei's Sunflower Seeds, pieces of the artwork were stolen during its exhibition period: a currently unknown amount of one dollar bills were stolen. In late September 2014, the $4,107 (minus the stolen bills) will be sold as an artwork on eBay. The profit or loss that is made on the material value of the work will demonstrate what artistic labour is worth within the network society.

"Money is of critical importance both for the arts and for society at large, the only problem being that there is simultaneously not enough and too much of it." Georgios Papadopoulos [11]

Figure 3. Too much money… ©Artistic Bokeh.

While pulling down Too much money… packing thousands of dollar bills into a supermarket tote bag, feeling the weight of it under my arm while riding home on the subway, it was evident that money is a material, just like any other, that could be manipulated and moulded by an artist. Value is something different though. At any moment we could cash out from this artwork – instead of having a shopping bag of thousands of dollars sitting in the corner of our studio, we could use it to fund a study tour, travel around Europe, visit galleries and museums, look at artworks. But what would be the value of that?

Acknowledgements

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Andrew Newman is an artist and researcher based between Sydney and Vienna. His performative art practice poetically utilises methodologies from the communication sciences to examine value construction in contemporary culture. Newman is editor of the journal for research cultures (JRC) and is currently investigating immaterial economics as a PhD candidate at the National Institute for Experimental Arts in Sydney. He has been a director of Runway Journal for Australian Experimental Art since the first online issue Prototype launched in 2013. Newman is head of the 'Austria Australia Arts Alliance' which creates an exchange of experimental art positions between Austrian and Australian researchers and artists.

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Responsive Environments and Protagonism: The Sustenance Principle

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Abstract

This positioning paper is in two parts. The first part examines the notion of 'the gift' as applied to artistic works in *The 'Do-It-Yourself' Artwork,* edited by Anna Dezeuze (2010) and to *disrupt* this notion with the countervailing concept of *sustenance*. This analysis critiques sociologist Marcel Mauss' research into the First Peoples of Canada, specifically in terms of the development of his theory of 'potlatch' based predominantly on the Kwakwakw'wakw People and their destruction of property as a show of strength. The paper seeks to *disrupt* this concept, summarised as 'the 'gift' as obligation', with the Coast Salish Peoples' practices of offering *sustenance* to their fellow tribes through the sharing of food wealth. This can, it is asserted, provide resources for the author's present research on responsive environments. The second part explores the principle of sustenance. The paper argues that, from this perspective the artist's role is to create resources that can be *productively* extended, challenged or repurposed by a process of 'protagonism'. This is because those resources, supported by digital technologies, sustain opportunities both in and out beyond responsive environments. This position, it is asserted, supports an intensification and diversification of Claire Bishop's participation motivations of 'activation', 'authorship' and 'community'.

Keywords

Responsive Environments, Protagonism, The Gift, Sustenance, Productive Principle.

Introduction

This position paper examines the use of the term 'gift' in an art and digital art context with specific reference to *The 'Do-It-Yourself' Artwork*, edited by Anna Dezeuze (2010). Marcel Mauss' concept of 'the gift' was based, in part, on the Kwakwakw'wakw People's use of 'potlatch', *as an obligation to return.* [1] This is referenced uncritically in Dezeuze's book as artists forcing obligations onto the viewer/visitor in the artists' own terms. Mauss' notion of the gift has received considerable attention from both advocates and critics. Most notable in the latter category is Derrida who took Mauss to task for his open-ended use of the term 'gift', questioning the project at the level of literary and linguistic probity. [2] By comparison, within the anthropological community Mauss is seen as a founding father. His detailed ethnographic research into the lived experiences of native Peoples is seen as pioneering. Mauss' work is cited continually both in terms of its exemplary methodological approaches and also in terms of its continued influence on notions of community cohesion and practices. [3]

There is, however, another way to critique Mauss' work without overtly questioning the other two perspectives supplied and that is through detailed historical analysis of the process that Mauss did and did not work through. This is about the choices Mauss made before his study began. The significance of this approach is that it seeks to critique the use of the term "The Gift" in an artistic context but by revisiting the origin of the term.

The author argues that more credence should be given to the Coast Salish peoples around the Vancouver area who used the potlatch to offer *sustenance*: surplus food shared with other tribes. This process is repeated so that all the tribes are sustained through communal support. Rather than being about obligatory gestures a potlatch could alternatively be a means of sustenance.

The paper goes onto apply this alternative concept of sustenance to the phenomena of 'responsive environments' arguing that this approach supports 'protagonism': opportunities for productive engagement building on Claire Bishop's participation motivations of 'activation', 'authorship' and 'community.' [4]

A Historical Critique of Marcel Mauss' Gift

Mauss found many parallels in his contemporary France that matched what he had discovered in First Peoples of

Canada. However, for Mauss this commonality is based upon a form of *realpolitik* in the type of comparison across cultures. The notion of gift is translated in the term 'potlatch':

> It is a struggle between nobles to establish a hierarchy amongst themselves from which their clan will benefit at a later date. We propose to reserve the term potlatch for this kind of institution that, with less risk and more accuracy…we might call: total services of an agonistic type. [5]

This refers to the Kwakwakw'wakw People's use of potlatch ceremonies as a means of expressing their wealth. In some cases this wealth would be deliberately thrown into rivers as an act of bravado. However, the presumption from Mauss to "*reserve* the term" potlatch must be challenged. The inference is that Mauss' decision is the result of wide ranging studies that confirm this definition. However, within his study he states:

> We warn that it is incomplete even as to the number and names of the tribes, and to their institutions. We leave out a large number of tribes… [including] the Salish tribes of the south coast. [6]

This caveat is a serious one because it is not possible to agree with Mauss with regard to the *inclusiveness* of his definition. A conclusion from this is that Mauss is seeking to claim the term for anthropological purposes *irrespective* of its use within the communities in the locale. This conclusion is further backed up when the practices of the Coast Salish Peoples are studied with regards to their potlatch ceremonies. For example, William Suttles' study of Coast Salish Peoples includes the following:

> [The Potlatch's] most important function is to be found neither in the expression of the individual's drive for high status nor in the fulfillment of the society's need for solidarity, neither in competition nor in cooperation, but simply in the redistribution of wealth. [7]

This offers a different interpretation of potlatch for the Coast Salish. But could the redistribution of wealth still reinforce the power over others i.e. be an agonistic activity? No, for the Coast Salish Peoples the concept was not agonism but *sustenance*:

> Since wealth is indirectly or directly obtainable through food, then inequalities in food production will be translated into inequalities in wealth. If one community over a period of several years were to produce more food than its neighbors, it might come to have a greater part of the society's wealth. Under such circumstances the less productive communities might become unable to give wealth back in exchange for further gifts of food from the more productive one. If amassing wealth were an end in itself the process of sharing surplus food might thus break down. But wealth, in the native view, is only a means to high status achieved through the giving of it. [8]

This is a direct rebuff to Mauss because it is clear that potlatch is not only used to describe "total services of an *agonistic* type". From the author's perspective there should at the very least be a tempering of Mauss' concept to allow the principle of sustenance as well as agonism.

Artworks and the Principle of Sustenance

The importance of this call for a reassessment is made clear when we read the following quote from Kwon's paper "Exchange and Reciprocity in the 1960s and After" from *The 'Do-It-Yourself' Artwork*:

> *As we know* from the work of Marcel Mauss, the French sociologist and author of the hugely influential 'Essai sur le don' ('The Gift', 1924), as well as subsequent theories of the gift, *there is no such thing as a free gift* or entirely disinterested, uncalculated giving. [9]

The use of the phrase 'As we know' in this context is telling. We are drawn into the certitude of Mauss' concept here. Kwon's treatise on the relationships between artist and public is founded upon the hegemony of Mauss' research focus and definitions. This interpretation is presented as a *fait accompli*.

But the author's line of argument *disrupts* this assumed complicity. Rather than being presented with a *fait accompli* of perceiving the sharing of any art form as an obligation to return something within the remit of the artist we are able to argue that it is equally possible to share art works that offer sustenance to the other. Here the author offers an alternative means of developing art out of an interpretation of the Coast Salish's social practices of sustenance. This accords with Claire Bishop's participation motivations of 'activation', 'authorship' and 'community' i.e. that participation can result in openings for agency, in creative opportunities and in sense of social connection. [10] However, the construction of a responsive environment, through digital technologies, offers the possibility for the intensification and diversification of those opportunities and cohesions.

There has been a long history of research into responsive environments and it is time for that research to inform the debates on 'the gift' and 'participation'. For brevity, this position paper will introduce these possibilities through the pioneering work of Dr. Omar Moore then of the Department of Social Psychology, University of Pittsburg. A sample of other investigations into responsive environments is supplied in the Bibliography below. In 1962 Moore founded the *Responsive Environments Corporation*, which was concerned with the development of computerized educational devices including *The Talking Typewriter* and *Talking Page,* two interactive learning support tools. In this case, the responsive environment was educationally focused and about the innovative use of technology in constructed environments (learning labs). [11]

In 1968, Moore together with Alan Anderson, also of the University of Pittsburg, wrote "Some principles for the design of clarifying environments." [12] This paper sought to both define responsive environments and offer principles on learning that could be applied in practice. Working within a constructivist theoretical framework, Moore and Anderson proposed four principles: perspectives, autotelicity, productivity and personalisation. [13] These principles, as applied to their "Talking Typewriter" project, seek to delineate the roles/positions that a learner can take with regard to the environment. Two of the principles are examined here.

The *perspectives principle* explores the different parts that a person may take in relation to the environments i.e. Patient, Agent, Reciprocator and Referee. These roles express increasing awareness of the processes contained in the environment from a 'patient' role of being in receipt of an activity through an 'agent' role taking control of action through to a 'reciprocator' role of being aware of the moments in the environment where a patient or agent role is being conducted to an overarching role of 'referee' where the person is aware both of the processes at work and also the rules by which those processes are played out. [14] Of significance here is the qualitatively different activities made available in environments but, in each case, the focus is on different level of awareness of the systems at work. These different perspectives open out opportunities for new forms of content to be *sustained* within the system precisely because the means/media, or tools/content, are within reach of, what the author contends are, 'protagonists.'

The *productive principle* privileges the quality of the activity in terms of the degree to which the experience can be taken forward, *sustained* and utilized in new situations. This could be about the promulgation and/or activation of the same idea in a new context or the *principle* or the toolset that is reapplied/repurposed in the new context as an act of 'protagonism'.

It is important to note that the first exploration of the concept of responsive environments offered a *principled* approach. It is asserted that these criteria, drawn from the experience of developing educationally supportive technologies, can be re-applied within electronic art contexts. Furthermore, these principles are complementary to Bishop's stated motivations, although more work needs to be done to integrate these components. However, there are some elements of theoretical framework here, informed by the principle of sustenance and also a variety of ways that protagonism can be supported through artworks. For example, the 'productive principle' connects with the Coast Salish notion of sustenance with resources being moved out into new areas to sustain existing and new developments. Furthermore, the sustenance of an idea relies upon the development, and extension of perspectives. However, while it is important to state that this position paper has sought to challenge certain presumptions regarding artistic practice within *The 'Do-It-Yourself' Artwork,* this analysis has not focused on the specific forms of content/political motivation of the artist. In this regard, the same book contains an article, by Claire Bishop, entitled "Antagonism and Relation Aesthetics." [15] In response to Bourriaud's *Relational Aesthetics*, Bishop offers 'relational antagonism' i.e. it is not always the case that viewers/visitors are invited in to engage in sympathy with the artist. It may be more the case of a *provocation,* an antagonism whereby what is taken away are resources for change both in others and the viewer/visitors that are challenging to all and unexpected, rather than empathetic and supportive: "This relational antagonism would be predicated not on social harmony, but on exposing that which is repressed in sustaining the semblance of this harmony." [16] This might, at first sight, seem to contradict the central premise of this position paper. However, this merely differentiates the possible motives of artists from the specifics of the Coast Salish method of sustenance. Of primary importance here is that digital technologies can *sustain* such challenges both in responsive environments and out beyond them in ways not open to gallery-locked content. What can be sustained? This is the question that provides the context for further research into the notion of responsive environments. Furthermore, there are opportunities for responsive environments unbounded by limitations of learning labs or galleries because they are enabled by digital *mobile* technologies. This is also part of the author's present research. Responses/critiques are welcome with regard to both cases.

To conclude we return to Mauss' book *Essai Sur La Don*. This book is known as *The Gift* in English but "don" can be translated as "talent", "offering", "bestowal", "charity", "hand out", "donation" and "bounty." [17] These additional definitions at least complexify the concept and, it is argued here, point to other social formations that can equally support or provoke protagonist behaviour.

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The Economic Valuation of Digital Media Art

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Abstract

While there are a variety of approaches to examining the valuation of digital media art, I limit my discussion to its economic valuation within the context of Western capitalist economies. In this essay, I argue that the dematerialized and reproducible nature of DMA requires it to have alternative models of economic valuation because the classical model of economic valuation does not effectively value DMA. I examine existing economic models of digital media artwork valuation and I explore unique opportunities for alternative and hybrid economic models of digital media artwork valuation.

Keywords

digital media art, economic valuation, new media theory, art valuation, cultural studies, art, value, digital art, collectors, artwork

Introduction

While there are a variety of approaches to examining the valuation of art including social, atomistic, and phenomenological philosophies, due to the restrictions on the length of this essay, I limit my discussion to the economic valuation of digital media artwork (DMA) within the context of Western capitalist economies. Before delving into valuation and DMA, it may be instructive to define value, analogue art, and DMA in the context of this essay. I will define value as the financial worth of a desired entity. While analogue art may be categorized as art that is created using analogue media and include works such as drawings, paintings, prints, and sculpture, DMA may be categorized as art that is created using digital media and processes, using electronic hardware and software, including videos, 2D images, 3D models, animation, sonic arts, Net Art, generative art, installations, and digitally augmented performances. In this essay, I argue that the dematerialized and reproducible nature of DMA requires it to have alternative models of economic valuation because the classical model of economic valuation does not effectively value DMA. I examine existing economic models of DMA valuation and I explore unique opportunities for alternative and hybrid DMA economic valuation models.

Classical Model of Economic Valuation

The classical model of economic valuation (CMEV) in Western capitalist economies outlines how objects can be exchanged for currency using the laws of supply and demand; when the demand for an object outweighs the supply of the object, the price for the object increases (Ng, 2014; Smith, 2000). Applying the CMEV to both an original analogue artwork and a DMA with high demand in the marketplace, the current impossibility of reproducing an exact copy of an original analogue artwork (e.g. a one-of-a-kind painting) limits the ownership and accessibility of the original analogue artwork and grants it a higher economic value than a DMA file that is losslessly replicable (e.g. a digital image). When an original analogue artwork is in short supply, a situation that rarely occurs with DMA because of digital media's infinite lossless duplication, and there is a high market demand for an original analogue artwork, the economic value of the original analogue artwork normally increases in the marketplace.

For example, the original Mona Lisa only exists in the Louvre and because there is only one original painting, a high economic value is assigned to the Louvre's exclusive ownership of the Mona Lisa. People interested in experiencing the Mona Lisa in person place an economic value on gaining limited access to the one-of-a-kind original by paying admissions fees to visit the Louvre. Based on the CMEV, original, physical, analogue works of art that are limited in supply, like the Mona Lisa, are assigned a high economic value because they are original artworks and exact copies cannot be reproduced from these original artworks (Sturken & Cartwright, 2001). In the CMEV, the artworks' economic valuation is based on their one-of-a-kind nature and the limited availability and exclusive ownership of the original artworks.

The CMEV, based upon limited availability and exclusive ownership, is more difficult to apply to newer forms of reproducible, lossless DMA and the arrival of DMA has created a paradigm shift in the traditional way artwork is economically valued. In 1936, Walter Benjamin (1968) helped set the stage for challenging the CMEV by arguing that the practice of placing higher economic valuations on one-of-a-kind images was losing currency because of the introduction of new forms of reproducible art using media like photography and film. Indeed, DMA are often reproducible, dematerialized, easily accessible, and lossless. As Sturken and Cartwright (2001) explain, an "image being unique makes no sense with digital images" and in "digital images, the idea of the difference between a copy and an original is non-existent." This lossless reproducibility of DMA challenges the CMEV because DMA cannot be effectively economically valued based on their scarcity and physical materiality; copies of DMA can each potentially hold the same value since each copy of an original DMA is lossless and identical to the original work. This ease of access and ability to reproduce DMA that is lossless dis-

rupts the CMEV and necessitates the exploration of alternative economic valuation models for DMA. Before examining opportunities for alternative and hybrid models of economic DMA valuation, I will explore emerging economic models of DMA valuation within the context of Western capitalist economies.

Emerging Economic Models

Despite the growing interest in DMA in Western capitalist economies, it is unfortunate that in the West, especially in the U.S., many overlook art's contribution to culture and the public good and primarily value art for its exclusivity and economic return (Groys, 2011). However, the impact that economic valuation has on DMA cannot be overlooked; DMA disrupts the CMEV. The above-mentioned Mona Lisa example is poorly applied with DMA. Indeed, the laws of supply and demand where the value of physical objects is based upon their scarcity and availability is upended by the immateriality, availability, and lossless reproducibility of DMA. This disruption in the CMEV provides unique economic valuation opportunities for DMA.

A large part of DMA's unique economic value lies in its reproducibility; DMA's dematerialized nature allows it to be accessed across platforms, time, and space. Instead of traveling to a physical gallery to purchase analogue art for future delivery, DMA can be immediately bought and downloaded online. Moreover, the bits and bytes that make up DMA enable its infinite reproducibility; in fact, DMA's lossless reproducibility provides opportunities for a wider distribution network than that of analogue art. One could envision the economic valuation of a particular DMA "going viral" with thousands of people connecting to it. Even if only a fraction of the people who access the viral DMA purchase it for a lower price than the price of a one-off analogue painting, the economic valuation of the DMA could be significant. In this example of a DMA "going viral," the CMEV is upended. Despite the infinite lossless copies of the DMA, the economic value of the DMA does not necessarily diminish; a large aggregate number of purchasers of the infinite, lossless copies of the DMA could result in a high valuation of the DMA.

The economic valuation of DMA stands in stark contrast to the CMEV where exclusive ownership and limited availability determines valuation. Digital media artists are disrupting traditional economic models of valuation, but the age-old question of how artists are compensated remains unanswered for many digital artists; with DMA's wide availability, many digital media artists' work does not fit in the closed, classical art market valuation models. Like Van Gogh, who found funding sources outside the CMEV early in his career, digital media artists are seeking alternatives to the closed, classical art market sales models to economically support their practice (Huyghe, 1977).

While the Internet increases the global exposure of DMA by opening up more venues for the immediate purchase and distribution of DMA, challenges and resistance to the economic valuation of DMA are manifold. For example, many people expect DMA to be free like other forms of digital culture such as free eBooks, music, photos, and videos. People, particularly digital natives, have become socialized to expect free or very low cost cultural content and resist paying for DMA (Ng, 2014). The expectation of free creative work presents unique challenges for digital media artists struggling to find support for their practice. There needs to be an extensive examination of the opportunities for the economic valuation of DMA, but due to length restrictions, I am not going to address obvious solutions like institutional admissions fees and traditional gallery sales models of analogue art. Instead, I will look to those existing models as a springboard for emerging and alternative economic valuation models.

Ownership and Leasing

Although the music industry ownership model is flawed, it is instructive to examine it to inform future models of DMA economic valuation. In a now near historical model of digital music economic valuation, people purchased physical media like compact discs (CDs) to listen to music. As digital technology evolved, people "ripped" and shared CDs by creating digital files that were available to download from the Internet. Just as musicians received reduced royalties for their work from sales of CDs and digital files, this admittedly flawed model has been used to economically value DMA (Witt, 2015). Museums and artists have sought to overcome the challenges of economically valuing reproducible DMA by selling "limited-edition" CDs and DVDs from exhibitions. For example, the Whitney Museum of American Art (2001) sold DMA CDs from the Bitstreams exhibition, but this economic model is becoming outdated as physical media are becoming less popular and dematerialized DMA files on servers in the cloud are becoming more popular (Delson, 2001).

Sales and exclusive ownership of art are not new, but the immateriality of DMA presents unique challenges and opportunities for collecting that differ from those associated with analogue art. For some collectors, ownership of DMA, with its dematerialized and reproducible nature, may be less attractive because it does not fit their understanding of an artwork's economic value as inherently being linked to materiality and exclusive ownership. Leasing DMA is an opportunity to economically value DMA by providing DMA to collectors who are risk-averse to owning DMA or unable to afford to own DMA outright.

The paradigm shift in the music industry of people moving away from economically valuing the ownership of physical media like CDs to people listening to music on dematerialized media like streaming digital files opens up other DMA economic valuation models including ad-supported, subscription, and free satellite and online platforms like SiriusXM, Spotify, Apple Music, and iTunes Radio. This shift in the economic valuation of artistic work away from the physical ownership of creative work to temporarily accessing dematerialized creative work creates new economic valuation challenges because of the wealth of services providing low-cost or free content (Witt, 2015).

Digital media artists can examine the online music distribution models to inform their creation of improved DMA economic valuation models. One avenue they can choose is selling permanent or temporary licenses to exhibit DMA. Digital media artists can build upon the licensing and sales models used by such entities as Netflix, Apple, Amazon, and saatchiart.com or create their own online platforms to sell or lease DMA. They can harness new technology by selling licenses of their DMA across a wide variety of existing and emerging Internet-enabled delivery platforms including PCs, mobile and wearable devices (e.g. watches and clothing), and cloud-connected smart homes and vehicles. These new DMA platforms could provide artists more income than existing and legacy distribution models that charge exorbitant commissions and fees (Puente & Mansfield, 2015).

Digital media artists can provide DMA valuation models by offering licenses to own or lease DMA in physical and virtual spaces. These models would be different from the CMEV used in galleries selling analogue art or museum gift shops selling prints of paintings. For example, streaming DMA could be distributed and exhibited on digital displays for a limited amount of time or permanently (depending on the length of license purchased) and removed without the use of a physical dustbin. Limited time ownership of DMA grants economic value to DMA by providing the opportunity for experiencing DMA on a select number of devices for a specified duration. As collectors become increasingly aware of DMA, they have a greater opportunity to appreciate it and therefore are better able to economically value DMA.

Brick and mortar galleries are experimenting with representing DMA that combine the physical with the virtual and creating hybrid licensing agreements. These limited edition pieces combine computer, display, and software with physical forms. Gering & López Gallery employs hybrid licensing when it sells these types of hybrid DMA by artists like John F. Simon, Jr. Similarly, the DMA project "Earth," was licensed from John Klima for $1,000 a year for display in the National Library of Medicine building (Delson, 2001). Licensing agreements can add economic value to DMA; by harnessing and adapting the CMEV with limited availability and ownership, exhibit admission fees can be employed to increase DMA's economic value in the marketplace. Additionally, collectors willing to pay more for lifetime exclusive licenses provide economic value to DMA and a potential source of income for the artist.

Just as musicians, including Metallica, who famously encountered challenges from some audiences who resisted economically valuing digital music files because they were socialized to collect free music files from Napster, artists selling DMA encounter challenges from people who resist economically valuing dematerialized DMA because they expect DMA should be free (Puente & Mansfield, 2015). Additionally, some collectors who subscribe to the CMEV may not believe DMA holds as much value as analogue art because DMA is dematerialized and can be losslessly reproduced. Just like music, DMA, dematerialized and reproducible, is easily distributed and can be leased for a specified period of time and cost. Although not perfect solutions, owning and leasing DMA provide economic valuation models for DMA.

Applications

Using online free search engines like Google as inspirations, digital media artists could develop applications (apps) to create economic value for their DMA. In developing these apps, digital media artists could use Google and similar search engines' business models; they could gather user search information, collect this valuable information, and sell targeted ads to users to economically support their DMA. Digital media artists could work collaboratively on DMA apps that these artists could then sell and use to exhibit DMA files. In this model, artists would develop their own apps; charge fees for the use of apps; sell exclusive, limited rights to exhibit DMA on apps; or sell apps that function as the DMA itself. Artists would receive compensation and their DMA would have an economic value; less technologically savvy artists who are unable to create their own apps could add their work to a database of searchable DMA on an existing app and receive remuneration if their DMA is purchased. Such independent DMA apps could provide economic value based on the popularity of views and purchases of DMA.

Hybrid and Alternative Economic Models

Morphing Borders

Traditional analogue artwork, like paintings and sculpture, are morphing across borders from the physical world to the dematerialized world of digital paintings and virtual 3D sculpture. This morphing provides opportunities to compensate digital media artists who sell downloadable DMA files for printing at home or for 3D models of sculptures that can be physically 3D printed for exhibition. Emerging forms of DMA technology and techniques are being used to assign economic value in unexpected ways.

For example, the Van Gogh museum in Amsterdam gained financial support from the proceeds of its sale of digitally 3D scanned and 3D printed Van Gogh paintings from its collection. Indeed, museums "are taking a close interest in the commercial potential of 3D" (Alberge, 2013). The money from the valuation and sales of the DMA Van Gogh paintings, dubbed "Relievos," help fund the museum's operations and assign economic value to DMA. Just as the Van Gogh museum was successful selling 3D printed Van Gogh paintings in the above example, there is a potential for individuals to purchase DMA files online and add economic valuation to DMA.

Similarly, the Cooper Hewitt Museum has experimented with hybrid economic valuation models for DMA by exhibiting physical work that combines dematerialized digital code with material 3D prints. Employing a hybrid exhibi-

tion and economic model that bridged both immateriality and materiality, the Cooper Hewitt Museum created an auction dubbed "The Algorithm Auction." This inaugural auction was set up to introduce DMA to a wider audience and to introduce patronage like the philanthropy of Andrew Carnegie (Turner, 2015).

Considering DMA's potential for materiality with 2D and 3D printing, DMA is in a unique position for economic valuation as the trend of customizing cultural artifacts increases. Unlike analogue artwork that is not easily customized, DMA is unique in that it can be customized at any stage of the purchasing process. For example, on-demand 2D and 3D printing provides the customization of DMA in real time granting collectors options for scaling the size or color of DMA to be printed on site. In fact, collectors who want a distinctive artwork to suit their individual tastes may pay a premium to adjust the size or color palette of DMA so that they can create a uniquely designed DMA.

Trending Green

Because of the immateriality of DMA, it is also greener and more ecologically sound than analogue art. As the anti-consumerist and green movements gain momentum, a segment of the population is placing economic value on DMA because of its small ecological footprint, portability, and ability to be shared digitally. There is an emerging market for collectors who do not want to acquire and store physical works of analogue art. As DMA is lossless, reproducible, customizable in real time, and ecologically friendly, DMA requires a valuation model that accommodates the burgeoning anti-consumerist and green movements.

Conclusion

Although the Van Gogh and Cooper Hewitt museums are illustrative examples of institutions that have economically valued DMA, it is important to recognize that DMA is ushering in a paradigm shift from the CMEV applied to analogue art and requires alternative economic valuation models addressing the uniqueness of DMA. The models of leasing; subscribing; streaming; permanent, temporary, and hybrid licensing; apps; and on-demand virtual, physical, and customizable ownership are examples of DMA economic valuation that differ from traditional analogue art economic valuation. This essay provides opportunities for providing value to DMA in valuation models that are not based solely upon scarcity, exclusive ownership, and materiality, and in doing so, upend the CMEV. While traditional examples of economic valuation including charging admission fees and limiting the physical ownership of art are points of reference, the emerging opportunities for DMA's economic valuation are evolving along with experimental valuation opportunities. Indeed, DMA's unique, dematerialized, and reproducible nature and the impact of the rapid pace of technological development on DMA make DMA's economic valuation a constantly moving target necessitating the continued exploration of emerging economic valuation opportunities for DMA.

It is critical to find economic valuation models that maximize and preserve DMA's uniqueness and its differences from analogue art because society is in danger of permanently losing a cross-section of contemporary DMA and culture. Importantly, as Grau (2010) notes, DMA is "rarely collected by museums, not included or supported within the mainframe of art history and nearly inaccessible for the non North-western public and their scholars." Therefore, according to Grau (2010), "we witness the erasure of a significant portion of the cultural memory of our recent history." If this lack of support for and possible deletion of DMA were not enough, DMA is threatened with further marginalization because of the challenges associated with its economic valuation. In Western capitalist economies, strengthened by growing neoliberalism, economic value is still predominantly based on the CMEV and its valuation of exclusive ownership and limited availability. Although there has been some limited success with the economic valuation of DMA, there is still a long way to go toward developing successful economic valuation models that leverages DMA's unique characteristics.

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The Renegade; An Aesthetics of Resolution.
Some Thoughts on a Techno-Imaginative Toolbox and its Potential for Art as — and beyond — Critique

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Abstract

This paper traces the semantic field of the term *resolution* and its potential relevance in current techno-political discourse. Based on an artistic project engaged with the forensics of a market crash, I propose an approach – both artistic and political – for a radical material practice to (en)counter the black box of (automated) evaluation and decision-making. With an ambivalent, contingent and marginal figure at its heart – the *renegade* (a traitor inside and an educator outside systems) – it combines the varied meanings of the term *resolution* – from technology and visualization techniques and definitions; knowledge-production and decision-making; to discretionary competence and joint convention – to propose a multi-layered and transdisciplinary practice for rearranging (acting) against the "box." By creating narrative instabilities, it works towards *renegade solidarity* that coagulates dissent into insurrection for profound socio-political change.

Keywords

Art, algorithms, black box finance, resolution, renegade, dissent, insurrection, solidarity.

Representational Aesthetics in Finance

The following brief analysis[1] focuses on developments in finance and their impact on wider social realms. However, they are not restricted to markets, as similar schemes appear in other fields as well (such as big data or surveillance programs). These operations combine areas like cybernetics, technology, mathematics, probability theory, data mining, and psychology into schemes of evaluation and decision-making that are increasingly programmed to act autonomously. Autonomy, here, exceeds informed decision and accountability. The concept of cybernetics per se is based on self-regulation by feedback and control; implemented on the level of social relations, it becomes a self-governing force whose automated processes are prone to interfere with (non)human relations and activities.

As regards the subject of this paper, my contribution traces a concrete practice engaged in an aesthetics in the field of consequences. This implies an origin – an event, a course of action, a mode of application – which at first provokes queries, dissent and even scandal before it subsequently leads to analysis and investigation. In the case presented, which draws on the analyses of the Flash Crash on May 6, 2010, finance is the provocation. Not only from an artistic standpoint the provocation is as fundamental as it is opaque: finance is the agency of a power that not only resists the classical forms of representation; rather, it tends to operate by stealth, below the radar of common knowledge, perception and thus public interest; the public is not *informed*. Ironically, this also applies to the industry, as finance whistleblower Haim Bodek remarked: "90 per cent of finance doesn't know how the US stock market works."[2]

Instead, finance reformats representation by *forward activating* it: the (derivative) pricing system calculates myriad trajectories for investing in expected powers to be. Here, representation serves as a professional tool invested in navigating shifting states rather than controlling a fixed state: price is situated in the future, not in the present – the latter's incremental convergence due to technological armament of algorithmic trading operations notwithstanding. Thus, price discovery has ushered in a surprising turnaround of the notion of risk: risk is less about insuring against than producing the future. In other words, risk is turned from scandal to precondition to quantitatively calibrate volatility (by stochastic calculus or other means), which in turn is the market's measure of risk. In a sense, prices look back on us, from the future onto the present; derivatives constitute operations nested inside the future as a contingent dictate (a legal contract) to be fulfilled at present. Here, activated representation is virtual (and viral) in the sense that actualization creates a blank, a u-topos, a nowhere; an aniconic present without significance per se.

Hence, the perspective is to reflect on what a political art amounts to – and which tools it demands – by looking behind a veil spun from economics, mathematics, physics, economics and market ideology. In order to work out narratives that counter the 'invisible' fictions of financial biopower and to chart passages that take us from mere dis-

[1] This paper is based on research that resulted in the video *COUNTERING CAPITULATION. From Automated Participation to Renegade Solidarity* (https://vimeo.com/channels/aor) and the text, "Mayhem in Mahwah. The Case of the Flash Crash; or, Forensic Reperformance In Deep Time," in: *FORENSIS: The Architecture of Public Truth*, ed. Forensic Architecture (Berlin: Sternberg Press, 2014), 125-146.

[2] Marije Meerman, *The Wall Steet Code*, 2013, 32:00: https://www.youtube.com/watch?v=GEAGdwHXfLQ, accessed May 24, 2015.

sent – caused by the provocation – to actual forms of insurrection. The multifaceted semantic field of the term r*esolution* and its technological as well as social significance – ranging from visualization, discrimination, and intelligence to intention, purpose, (common) initiative and (joint) decision-making – seems to me to offer a collectivity that presents a conceptual basis for re-thinking socio-political constitutions as well as the conditions that in the name of proprietary and other interests make the ruptures and breaches of social contracts possible. It could thus play a crucial role in the effort to trace aesthetic, ethic as well as political consequences – in other words to move from mere *aesthetics* to a *poietics* (making) of dissent.

At first, the term *resolution* might denote a means to an end in the service of visualization, a detail in the chain of technological operations. At the same time, however, it is a tool that combines technology with supervision, exclusion, and agency. Focusing on resolution is not simply a question of technical specifications or layers of visualization. Rather, resolution techniques embody powerful and ambivalent contraptions of *technowledge*, a term I use to describe the fusion of technology and knowledge in the age of algorithmic automation. For one, resolution serves the construction of enclosures typical for the differentiation machine of information capitalism. It enables the generation of scarcity and allows parceling materials into specific restrictions that belong to a category we have become used to call commodity; and which can be unlocked, i.e. sold and distributed, to consumer classes of varying affluence. By developing artificial senses and at the same time restricting access to their data, resolution techniques are an instrument of power to capitalize on visibility, or, as it were, invisibility – on what we are able, i.e. offered, to see/know; and by implication on what we are not able, i.e. not offered, to see/know. Increasingly, we 'lose sight' of what *there is* we ought to *see*, i.e. what we ought to perceive, comprehend and make informed decisions on. The commodification of significant and relevant meaning – something *resolution* practically provides us with in a technological as well as political sense – produces competitive advantage.

Resolution has thus become a *pharmakon*, to borrow Jacques Derrida's term, a cure and a toxin at the same time. Let's first address the *poison* before we look at a possible *remedy*. The realm we will look at might seem far removed from art but I hope to make up for this with a radical aesthetics of perception. First, however, let us briefly go back to a beginning when space, and not time, seemed paramount.

From Macro-Space to Micro-Time

Algorithms are not new to markets. They first appeared in the late 1960s and early 1970s in derivatives trading. At that time, the common utopian topos was about colonizing our solar system and the vast stretches of cosmic space. Millions of people watched the Apollo 11 mission and the landing on the moon. *Star Trek,* the *Hitchhiker's Guide to the Galaxy* or Stanley Kubrick's *2001: A Space Odyssey* were popular examples representing imaginations of how we might live in and after the year 2000. Rich in fantastic imagery, such narratives heralded a new age and a desire for new life worlds and habitats.

At that time, however, another project emerged: the economic colonization of micro-time. And with it, a very different utopia emerged, which started to attract brilliant engineers, physicists and mathematicians – and thus the specialists who were supposed to furnish the knowledge and accelerated architectures that should make life on earth easy and take us to the stars in a not so far future. When the Black-Scholes-Merton model for derivative pricing and its algorithm appeared on the scene (1973), it revolutionized financial markets. Together with computation and political, economic and institutional changes, such as the end of the Bretton Woods system or the establishment of the Chicago Board Options Exchange, the formula led to an enormous increase in derivatives trading and the founding of new derivative products and markets. For the first time, conceptual economic modeling changed the way financial markets operate and this, among other things, changed the way capitalism has since operated: from industrial to financial (information) capitalism, from labor and production to debt and credit. Even though the 1987 stock market crash was considered the model's 'proof of failure,' financial markets have proliferated by reverse-engineering Black-Scholes to compute option prices. This has lead to a condition in which the pricing regime at the core of global finance does not only define markets but every field in which expectations and anticipations of future outcomes rule.

Such a „technology of the future" (as the financial engineer and philosopher Elie Ayache calls derivatives) produces the future not simply by anticipating it, that is, by pure prediction. Rather, the derivative pricing of contingent expectations serves as a resolution regime to move along (in parallel with) the uncertainty of the future. Hence, mathematical recalibration computed to render prices for any conceivable outcome, i.e. risk potential, 'creates' the future at any present moment of trading. The present as we know it has no bearing here; at the moment when it emerges (every moment), it arrives as price and instantly turns into historic data to enter a new cycle of calculating profit probabilities. The past succumbs to a probabilistic reservoir for the quantification of future events, while the present vaporizes in the actualization of the one price realized from the myriads of virtual prices that "inhabit" these volatile "galaxies" of risk options (to note, these quickly fading "stars" increasingly include a commodity called human capital). Thus, in what I term the *derivative condition* of social relations, not only those contingent futures "collapse" that emerge from subjectivities and their relations; what decays in microseconds is the present as the moment in which subjectivity and agency are born in the first place.

While the derivative markets' mode of production generates risk options that quasi-materialize every conceivable

future at present, algorithmic trading, as it originated in the mid-1990s, commenced with an emphasis on automated trading routines and arbitrage opportunities — more or less risk free profits gained from instant price differences between markets and exchanges. Here, depending on strategy, speed and volume matter. As in derivative markets, profound specialist knowledge and intellectual property are the condition sine qua non for capitalizing on these strategies. This has attracted a large number of so-called "quants" (engineers, mathematicians, physicians) that have subsequently substituted open-outcry markets and human market makers (usually of low-income backgrounds) with electronic trading and bots. Hand in hand with the emergence of a new financial elite we witness an increase in electronic resolution methodologies both technically as well as socially. In its wake, the paradigm of resolution shifted from colonizing macro-space to exploiting micro-time; a move that under the auspices of free-market ideology has had a tremendous impact beyond markets on the way we experience agency, security and decision-making in society. Space travel through the vastness of cosmic space remains popular fiction in which we are *unconscious* – in a state of induced low resolution of sense perception. What has become reality, however, is a presence in which we are *unconscious* in the sense that (without resolution-enhancing devices) we are incapable of experiencing a present that evaporates in moments where future and past collide. This is not to say that technological progress is intrinsically corrupt. Nevertheless, self-governing proprietary interests are prone to blur our shared vision of realities that affect us profoundly. As a consequence of such anesthetics, there is urgency to invigorate the notion of resolution across all the term's semantic registers. In the following, I will briefly address an example, which on the one hand highlights the complexities and intricacies of such an endeavor as well as its achievements and failures. On the other hand, it outlines an instance of artistic practice in the realm of an aesthetics of resolution.

The Forensic Analysis of a Market Crash

The Flash Crash of May 6, 2010 was the biggest one-day decline in the history of financial markets. In less than 5 minutes the Dow Jones Industrial Average plunged by about 1,000 points – 9 per cent of its total value – only to recover the losses almost immediately. When markets hit record lows, shockwaves went through the economic system and CNBC-live – initially debating the Greek austerity crisis – shifted its broadcast to the trading floor of the New York Stock exchange: "what the heck is going on down here? … I don't know… this is fear, this is capitulation."[3]

Technically, capitulation means panic selling due to pessimism and resignation. But the live TV-coverage and subsequent investigations attested to a much deeper impact. The Flash Crash constitutes a watershed event in markets, as it gave evidence to the fact that algorithmic trading had taken center-stage and produced a hostile environment for many human traders who not only lost their bearings in the event, as a live-broadcast for professional traders illustrates: "this will blow people out in a big way like you won't believe."[4] Hence and apart from financial losses, capitulation means liquidation of unmediated human perception and collective resolution.

The quote screen on the right analyzes all futures and equities (stock) trading during the Flash Crash. Numbers turning red in the "Low" column indicate that the symbol made a new daily low. Nanex LLC

Figure 1. Gerald Nestler, *Countering Capitulation*, 2014, screenshot. Image: ©Nanex LLC.

The subsequent investigation resulted in a joint official report by the US regulatory authorities, the SEC and the CFTC. It was published a few months after the incident and put the blame on human trading. In contrast, an analysis of the event conducted by a small financial data provider claimed that the crash was in fact caused by orders executed automatically by algorithms. Nanex LLC, a financial service provider, records trading data and was therefore in the position to examine the event on their own account. They soon realized that conventional market data records did not show any material traces of what might have initiated the rupture that tore the intricate fabric of market prices. Therefore, they decided to go deeper and look at shorter time-intervals. Step-by-step, they enhanced the resolution and developed custom-made bots to analyze the Flash Crash at dizzying depths of time. Finally, they noticed material evidence of market activity at fractions of a second. As the founder and CEO of Nanex, Eric Hunsader, stated:

> The SEC/CFTC analysts clearly didn't have the dataset to do it in the first place. One-minute snapshot data, you can't tell what happened inside of that minute. We didn't really see the relationship between the trades and the quote rates until we went under a second.[5]

At first glance, it looked like a glitch. But what emerged were the material traces of an elaborate scheme. But although Nanex found evidence of activity, the actuator(s) of

[3] See: http://youtu.be/IJae0zw0iyU.

[4] To qualify, human traders ultimately (a matter of minutes) had to enter the site of devastation and rescue the market and the market place. Algorithmic trades had triggered and intensified selling but did not revert to buying.

[5] See: http://www.sify.com/finance/u-s-flash-crash-report-ignores-research-nanex-news-insurance-kkfiEjeciij.html.

this spasmic reaction could not be exposed. In order to support their claim, Nanex had to win access to proprietary and therefore secret trading records to match the data and verify the facts. This unlikely situation arose when Waddell & Reed – the mutual fund that was blamed for the crash – decided (passed the resolution, as it were) to share their trading data for comparison – a remarkable decision, as such an act contravenes the implicit rules of the financial industry. It could shake shareholder confidence – the holy grail of neoliberalism – and jeopardize reputation if done publicly. As a consequence and in contrast to the official report, the forensic analysis exposed that the official culprit could not be held accountable. In their final statement Nanex concluded: "High Frequency Trading caused the Flash Crash. Of this, we are sure."

Figure 2. Gerald Nestler, *Countering Capitulation*, 2014, screenshot. Image: ©Nanex LLC.

Artistic Research. An Aesthetics of Resolution

The findings concerning the Flash Crash result in specific consequences of which some are associated with the analysis while others are part of the artistic research.[6] The former include the fact that even though material traces of before invisible quotes and trades were uncovered and provided evidence they did not open access to knowledge. Only the full disclosure and investigation of secret proprietary data records would allow attribution. Up to this day, the actual catalysts of the Flash Crash are unknown.

The artistic research, in turn, exposed a further disturbing consequence: In the current legal and technological frameworks, which privilege property rights and self-regulation (a premise not only of the law but of cybernetics), an effective analysis of market events depends on insider knowledge. It is contingent on a double figure of the expert witness, when an informant joins the investigation.

Only crisis – a scandal, a counter-provocation – can disrupt affiliations and break the veil of secrecy. What this exposes is an ambivalent, contingent and marginal figure: the *renegade*. A traitor and defector inside systems, she becomes an educator for regulatory authorities and the public at large. Moreover, the renegade in fact constitutes an act that proceeds from mere dissent to concrete insurrection. To give but one example of this figure, the whistleblower is an expert acting from a point of no return, a risk taker at the point of ultimate crisis who rises up against wrong. By speaking out and sharing proprietary data or classified information, she not only discloses what was excluded from public debate but also manifests noncompliance is an act of civil courage for the greater good. Her renegade act – essentially a violation of current custom, rule or law – produces a host of viable resolution materials across the semantic field ranging from shared visualization, discrimination and cognition to decision-making.

Given the power of capitalist markets over public interests, "investors" are not the only ones affected. Capitulation, the term expressed on CNBC, points to a destination where speculation engulfs political power. Taking action in concert with those who put their reputation (and more) at risk requires the cultivation of *renegade solidarity*,[7] an activist politics uncovering, transforming and institutionalizing "intelligence, surveillance and reconnaissance" into knowledge and decision-making in the public interest. Consequently, such an approach opens a field for multifaceted, trans-disciplinary practices engaged in unearthing, narrating and visualizing instabilities that coagulate dissent into insurrection. *Re-calibrating*, *re-assessing*, and *re-evaluating* concrete but opaque material events and operations – to use both technical and financial terms that denote frequency, depth, and consequence of inquiry – reveals evidence (by constructing and establishing truth as a past for-ever present in the future) that in turn may radically reorient critical discourse and common action.

Acknowledgement

Image material courtesy Nanex LLC, www.nanex.net

Author's Biography

Gerald Nestler is an artist and writer with a critical focus on what he terms the "derivative condition" of contemporary social relations and life, in which financial narratives shape the present by preconfiguring the future. At the same time, he works and collaborates on "aesthetics of resolution" as potential counter-strategies. Nestler graduated from the Academy of fine arts Vienna (1992) and subsequently conducted artistic fieldwork as broker and trader. He has exhibited internationally since the late 1990s and received the Austrian state scholarship for visual art (2003). Selected publications: *Yx* (on finance as a field of artistic research, Schlebruegge.Editor, Vienna, 2007), Kunstforum International issues 200/201 on art and economy (with D. Buchhart, 2010), *Making of Finance* (with A. Avanessian, Merve publishers, Berlin, 2015). He is a PhD candidate at the Centre for Research Architecture, Goldsmiths University of London.

[6] Due to the limitation of space, this research is not further described here. Please see footnote 1 for reference and links.

[7] The urgency of *renegade solidarity* is implied in a recent case of financial whistle-blowing. See: Matt Taibbi, "The $9 Billion Witness: Meet JP Morgan Chase's Worst Nightmare," *The Rolling Stone Magazine*, November 6, 2014, accessed May 24, 2015, http://www.rollingstone.com/politics/news/the-9-billion-witness-20141106.

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"The Value of Art" – Transforming User Attention into Monetary Value in a Series of Interactive Artworks

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Abstract

Attention is becoming the new currency in our information and media society. The art market is using art as commodity that can be invested in, and on which one can make profit. That profit can be increased with the help of marketing and attention-accumulation strategies. We will present a series of our recent interactive artworks that deal with the economy of attention and the evaluation of art value on the basis of user attention.

Keywords

value of art, art market, economy of attention, interactive art

Introduction

In this paper a series of interactive artworks will be described. In an ironical fashion they deal with creating value by transforming user attention into monetary value. In the context of participatory art, general issues of the attention economy and its link to the art market will be discussed.

1. Value in Art and the Art Market

For a long time there has been a connection between art and monetary value. In the feudalistic and clerical system of the Renaissance, royals, aristocrats and clerics commissioned works of art and artists had to adapt them to their tastes and requests [1]. Often there was no clear distinction between craftsmanship and art, and entire artist workshops were put under contract to portray and document religious and political motifs. In the Age of Enlightenment artists started to become more independent and the notion of the artist as a free creator and genius was born. It was generally believed that anyone could become an artist if he or she had enough talent. On the other hand, that also meant that artists had to struggle on their own to survive economically and come to terms with an evolving art market system [2].

Michael Findlay [3] writes about the connection between the value of art and its social and economic function. To him the monetary value of an artwork is an expression of various art historical circumstances, the artist's biography, the art dealer, collectors and the influence of the museums.

Jean-Joseph Goux [4] analyses the price of an artwork in relation to its aesthetic value. He focuses on the discrepancy between the labor embodied in an artwork and its market price. In his view, its market value is determined by individual demand to a much greater extent than by its aesthetic value.

Money has always been important for artists. Even though the cliché of the poor, unsuccessful painter or sculpturer is still widespread, there is considerable evidence that artists proactively deal with money and value when they create artworks . Andy Warhol's statement that "Good business is the best art" [5] illustrates that economic success was not taboo for American artists in the mid 20th century. This was quite in contrast to the European ideal of the poor artist genius, a cliché that has been a common assumption since the Romantic epoch.

Several artists have employed money as a motif in their works of art [6]. Edward Kienholz, for example, wrote the presumed value of his painting directly on its surface ("For $13200," 1969 [7]), thereby suggesting what the value of his work should be. John Baldessari also ironically dealt with the process and the material of art making in a work entitled "Quality Material" that he produced in 1966-68 [8]. There he states that good art is composed of quality material, craftsmanship, careful inspection and the artist's motivation to create good art. He clearly refers to the common belief that an artwork is more valuable if it takes

a lot of time to make it, contains expensive materials or has been made by a highly skilled craftsman.

In recent years art has also become a commodity for investment. Goux [4] points out the strong connection between the art market and the stock market. Similar to the bourse where securities are sold, the group behavior of art dealers and collectors determines trends through copycat effects, contagion or inverse investment strategies. Art is now widely accepted as an investment that can be stored until prices rise. In a capitalistic system the artist is becoming a kind of stock that can rise and fall according to market trends and demand. Since the quality of an artwork is often hard to judge and not really obvious, the opinion of experts and gate keepers such as art dealers, gallerists and curators is becoming an important criterion in which investors trust. This can even lead to self-fulfilling prophecies, cascading information systems and snowball effects. Certain star artists will emerge when a large number of people invest in them, and a "winner takes all" phenomenon leads to skyrocketing values for a lucky few, while the value of the works of many other artists remains quite low.

Jacqueline Nowikovsky [9] points out the intricate interaction between the primary and secondary markets, the influence of experts such as critics and curators and their effects on the establishment of an artwork as a masterpiece within the art historical cannon.

2. The Economy of Attention

While there are many components that contribute to the determination of the monetary value of an artwork, attention is certainly a key factor.

According to the Austrian professor Georg Franck, attention is the new currency in our media-based society [10]. Our epoch is characterized by an overwhelming amount of information. But information itself is becoming outdated faster and faster and needs to be permanently replaced. In online platforms and social media we are constantly asked to react to new information, remain attentive and stay informed.

At the same time our epoch is also facing a serious information overload. Unfortunately, we as humans are organically limited in respect to the amount of information we can deal with. Our attention span is short and we have to economize it if we want to avoid sickness or burnout. Attracting the attention of others is thus becoming more and more of a value. A flourishing advertisement industry has professionalized this attention factor, fighting for every second of our brain space with the help of billboards, TV spots, online banners, Twitter messages and other subliminal strategies. According to Franck, gaining attention is now becoming even more important than earning money. As there is more and more information surrounding us, getting attention is becoming increasingly difficult.

In Franck's view, our economic system is moving towards a mix of an attention and information economy. Attention is increasingly assuming the role of a currency, and can even surpass money in its universality.

In this immaterial economy of attention, wealth of attention can amount to prestige, reputation, stardom and fame. These are the new forms of capital in our attention economy.

We can witness this in our media based society: attention is the new currency in social platforms such as Facebook and Twitter. We are constantly being asked to evaluate our surroundings, products, services as well as other people. Followers and "likes" are becoming the new drugs for self-created stars, who acquire increasing fame only because they are famous. Socialites such as Paris Hilton are known for being known, children of stars turn their inherited accumulated attention capital into real capital. The new elites today are those who invest their attention capital cleverly and reap the benefits by increasing their accumulated attention stocks.

According to Georg Frank, the basis of the financial market is its trade with credits [10]. Even the art system resembles a bank in a certain way: its invested capital can, for example, be the artist, the exhibition, the performance or the concert. By accumulating attention, this invested capital can become more valuable, just like a stock that increases in value. Ultimately well invested cultural capital will increase in value through increased attention.

In the opinion of Franck the cultural industry is a capital market of attention. We can also witness this in the so called art rankings, which show the monetary value of an artist and his or her artworks. According to Dossi, these systems do not inform us about the quality of an artist or his/her artwork; they just tell us about the amount of attention he or she has been able to accumulate over time [11], and they often have the additional effect of creating more attention. Once the reputation of an artist is established, it will develop its own dynamics and create guaranteed investment returns.

But the connection between attention and the monetary success of an artist is not a new phenomenon of the media society. Even in the Renaissance artists had to be entertainers and fight for the attention of royals and clerics. According to Vasari, the Italian painter Sodoma became famous and eventually was accepted as a protegée by Pope Leo the 10th, because he engaged in all sorts of crazy entertainment activities, and was a good painter as well [11].

In our times we have similar personalities. When Brat Pitt, who is both a movie star and a star collector, collects the

star artist Damien Hirst, the fame of the collector is transferred to the artist and, vice versa, the fame of the artist benefits the movie star. Rich people collect art not only for the sheer love of art or for philanthropic reasons; often their motivation comes from a wish to gain more prominence and improve their reputation. When they buy expensive (and thus already confirmed „Blue Chip“) art, their own attention capital is enhanced; their social status is confirmed, and the interest rate of their own attention capital skyrockets.

This can also explain spectacular auctions where star collectors bid enormous sums of money for artworks . Art has become a trophy that has to be hunted down, as it can ultimately enhance the status of the buyer among the attention-and-monetary-elite. Art becomes a commodity, and the artist becomes a brand. Dossi states that “The economical construct of the brand has replaced the romantic notion of the artist as a genius, and the ‘divino artista’ of the Renaissance has been transformed into a pop star within the global capitalistic system“ [12].

Famous collectors even now have the power to influence the decisions of well known museums as to which artworks they will display by lending their collections to them or becoming their patrons. Only in rare cases is this done completely selflessly and without monetary interest. When an artwork, which is in ones own collection, is exhibited in a famous museum, its value will significantly increase, as it can now become part of the art historical cannon. The work can later be sold at a much higher price. An expert in this process is the British art collector and gallerist Charles Saatchi, who is a member of various commissions of famous British art museums. There he influences their exhibition decisions, places his own artists in them and thus increases their value [13]. While insider trading is forbidden in the stock market, trading with and with the use of insider information is widely practiced in the art market.

In summary, gaining attention is one of the key factors that enables an artwork to become recognized and valuable in the art market system. Strategically accumulating and increasing this attention through trading and auctioning will make the value of the artist increase. This will attract even more attention and eventually lead to the artist becoming a brand. His or her accumulated attention stocks (fame, reputation value) will rise and fall in the purely capitalistic art market system.

3. From Participatory to Interactive Art

Let us now turn to the context of our own art practice. In media art, interactivity has become a main feature that has done away with the strict borders between the artwork, the artist and his/her audience. Since the 1950’s, participatory art has led to the creation of artworks that can be open and process-based [14]. Instruction-based art by Fluxus artists such as Yoko Ono [15] put audience participation in the foreground, leaving ample room for free interpretation and individual creativity.

In strict contrast to the traditional notion of the artist as a genius who presents the artwork as a finished product, participatory art involves its audience in the completion of the work to a considerable extent. Roland Barthes’ text on the “Death of the Author” [16], Umberto Eco’s writing on “The Open Art Work” [17], Söke Dinkla’s “Pioneers of Interactive Art” [18], Ryszard Kluszcyński’s [19] analysis of interactive art, and Erkki Huhtamo’s list of common misunderstandings about interactive art [20] are important sources of reference to this development.

Interactive art became popular in the 1990ies . It combined concepts of participatory art, feedback mechanisms, cybernetic principles, sensor technologies and computing processes. Interactive art interprets and transforms various sensory inputs from the participating audience. That can, for example, be their gestures, touch, voice input, or various other multi-modal interactions. Although the artists here do provide interactive scenarios and various interfaces and sensor technologies, they leave a big part of the completion of the artwork to the audience. Through dynamic adaptive systems, feedback mechanism, evolutionary algorithms and learning systems they transport the idea of user participation to a higher level.

Although feedback systems and early forms of audience interaction were already practiced in early cybernetic art and some forms of kinetic art from the 1950’s onwards, it was in the 1990’s that ideas of interactive art really caught on.

Many of the artists working in this field deliberately handed over some of the creative work to their audience. This is similar to what Fluxus artists did in the 1950’s and what some relational aesthetics artworks [21], as described by Bourriaud, are now doing. Christiane Paul writes about these connections and points out that there is still a “continuing disconnect between new media art and the mainstream art world.” Besides historical baggage, she sees the reason for this in the “challenges that the medium poses when it comes to 1) the understanding of its aesthetics, 2) its immateriality (a key element of the medium’s aesthetics), 3) its preservation, and 4) its reception by audiences. All of these factors require in-depth consideration to explain the ongoing tensions between new media art and the art world.” [22]

A common feature of interactive art is the changing role of the artist and his/her relationship with the audience. This is also linked to Joseph Beuys’ claim that “Everyone is an artist” [23] (a concept he borrowed from Novalis). In this democratic involvement of the audience, one can also see connections to early forms of communication art as pioneered by Roy Ascott [24] .

The focus of art as an interactive process involving the audience also poses a question as to the value of art itself. When the artists voluntarily retreat from their powerful position of determining the preferred interpretation of their work, they also need to consider how the value of these artworks will be determined.

In Information Aesthetics, Max Bense and Abraham Moles have already tried - in different ways - to offer a method to determine the value of art on mathematical, scientific and empirical bases [25]. Referring to the theories of David Birkhoff about mathematical aesthetics and Claude Shannon's Information Theory, art was considered to derive its purely aesthetical value from the relation between order and complexity, or respectively between information and redundancy. Combining these with Norbert Wiener's Cybernetic Theory, we come to the conclusion that the process of art criticism should no longer rely on subjective opinions, but follow rational scientific criteria. This theoretical framework (which Max Bense proposed in his Information Aesthetics beginning in 1954) challenged the «Stuttgart School of Computer Art » to not only consider information aesthetics as an art critical tool, but as a method for generating art with the help of a computer. Bense distinguished between four phases of an aesthetic object: the numerical aesthetics, semiotic aesthetics, semantic aesthetics and the generative aesthetics [26]. Abraham Moles, however, claimed that subjective evaluations of the observers should be added to the equation [27].

Interactive art with its connection to information aesthetics and open artwork concepts of participatory art is of course in stark contrast to the artist star cult practiced in the current art market system. Here we are not talking about the hyped pop star artist, whose lifestyle and branding is more important than the work of art itself (as pointed out by Dossi [28]). Instead, shared authorship and audience involvement, as well as generative software and sensor technologies lead to the consideration of contemporary cultural issues where interaction and participation are the new metaphors and trends in our media and information society.

4. "The Value of Art" Series

Based on these complex considerations concerning the economy of attention, the context of value creation in art, as well as the questions surrounding authorship and value in interactive art, we created a series of interactive art works called "The Value of Art" in 2010 [29]. The aim of these systems was to deal with value creation in the art world in a symbolic, critical, pragmatic and ironical manner. Building on our background in interactive art, we aimed to raise awareness of the complex topic of value creation and its link to the attention economy by physically involving the visitors in art experiments.

To do this, we transformed existing paintings that we bought at auction houses. We equipped them with sensor technology that can measure the exact time viewers spend in front of them. A small thermal printer is also attached to the frame of each painting. One of them is shown in Figure 1 along with attached sensor technology and a printer.

Figure 1. This shows a close up of "The Value of Art/Unruhige See" painting with the attached printer and sensor. ©2010, Christa Sommerer & Laurent Mignonneau

We know the exact the price we paid for each painting and also the amount of money we spent on interface materials. Besides, we add the value of our working time, which we have fixed at 60 Euros an hour. On this basis, we can calculate the exact initial value of each system and print it out on the thermal printer. For example, the initial value of our first "The Value of Art/Unruhige See" painting was 2,078.70 Euros. This figure included all of our expenses; it was printed out on the paper from the thermal printer at the beginning of the first exhibition. This is shown in Figure 2. As we can see, the paper slip is still quite short.

Once the "The Value of Art/Unruhige See" interactive painting was exhibited, the work started counting the number of visitors and the amount of time they spent looking at it. We have set the value of user attention at 1 Euro for each 10 seconds. This is based on observations that the

average attention span of visitors towards art works in museums lays somewhere between 4-10 seconds. The conversion of 10 seconds into 1 Euro shows visitors their immediate impact onto the work, as the painting keeps printing the new value as soon as he or she stand in front of it.

Figure 2. A visitor interacting with "The Value of Art/Unruhige See" painting. ©2010, Christa Sommerer & Laurent Mignonneau

Our sensor system constantly updates the value of the painting, making the whole process of value creation for this artwork totally transparent.

Visitors can see how the value of this artwork increases. The more they look at it, the more valuable it becomes. At the end of each exhibition "The Value of Art" will have reached a certain monetary value. The artwork could then be sold for exactly that value, or sent on to the next exhibition, where its value would undergo a further increase. The newly printed value is shown on the paper slip, whereby the value increase is proportional to the size of the pile of paper emerging from the painting. The more people look at the painting, the bigger it will become. In Figure 3 we can see a visitor contemplating it ; the pile of paper has already grown significantly, compared to Fig. 1.

In the example of the "The Value of Art/Unruhige See" painting, its initial value was 2078,70 Euros. After several exhibitions in which a large number of visitors looked at it, its value has increased to currently 24.000 Euros.

Figure 3. "The Value of Art/Unruhige See" painting at the ZKM Media Museum in 2011. ©2010, Christa Sommerer & Laurent Mignonneau

We have several paintings in our "The Value of Art" series. There is a portrait of a lady, a portrait of a sheep, an abstract lithograph as well as a portrait of a cat. The choice of which paintings we adapted to our "The Value of Art" series was based on our attempt to find different motifs and determine which of them are more popular in an exhibition setting. So far the "The Value of Art/Unruhige See" painting, which depicts a seascape, has been the most popular one; it has been shown in most of the exhibitions. Because it was the first artwork of this series and has been seen by more people, it also appears to have become more popular than the other motifs. Whether this is related to the self-fulfilling prophecy that Dossi and Franck describe still needs to be discussed.

In each exhibition of the "The Value of Art" works, the visitors told us that they enjoyed the fact that their time and attention has become an issue and part of the concept of the artwork. While many museum- goers intuitively choose which works to look at longer, this system made visitors more aware of their behavior and their attention span towards art in general. On purpose we have kept the sensor technology of "The Value of Art" system simple, as we did not want to create a technical demonstration of high-end camera tracking or sophisticated face detection technology. In "The Value of Art" the attention of all visitors is also treated equally. No difference is made between the art collector, the curator or a layman's time and view. This is also done on purpose to in fact raise this issue of differentiation

as well. From having exhibited the system many times in various countries, we come to the conclusion that most people understood the irony of the system and accepted the fact that the link between attention span and monetary value creation is made up by us to create provocation and criticism about the current art market system and the economy of attention.

5. "The Value of Art/Albertina" Intervention

"The Value of Art/Albertina" is an artistic intervention at the permanent exhibition of the Batliner Collection [30] of the Albertina Museum in Vienna, which has been proposed for 2015/2016.

As one of Europe's greatest private collections of classical modern art, it contains works by such established artists as Claude Monet, Pierre-Auguste Renoir, Paul Cézanne, Amedeo Modigliani, Henri Matisse, Pablo Picasso, Ernst Ludwig Kirchner, Alberto Giacometti and Francis Bacon.

Each of the historic masterpieces has its individual provenance. Their high monetary value is an expression of various art historical circumstances, the artist's biographies, the influence of art dealers, collectors and the museum system. They are all classics in art history.

According to Georg Franck, there are four criteria that a work of art must meet in order to come to be regarded as a classic:

1. The work has to gain a significant amount of attention.
2. The work has to become fashionable and also to attract attention outside of the circle of experts.
3. After a certain amount of overexposure and the thereby resulting inflation, the work has to loose its newness, and seem to be dated. (Franck calls this the "acidic bath").
4. The work has to remerge from the „acidic bath" and again become fashionable. Ultimately it is qualified as a „classic."

Franck observes that once an artwork has reached this level, it will remain a classic forever. The catalog of the classic works of art and the values of those acknowledged masterpieces are some of the most stable values that can be found anywhere. [10]

For the "The Value of Art/Albertina" intervention we will equip certain paintings in the Batliner exhibition with small sensors and printers. These interfaces are not intrusive; they do not touch or harm the valuable paintings and can be removed at any time. A set-up scenario is shown in Figure 4.

Each sensor/printer interface detects the viewer when he/she looks at the painting. The amount of time he/she devotes to it is measured and transformed into a virtual value increase. The new value is then directly printed onto the paper of the thermal printer interface. The initial value of the painting can be set to the actual insurance value of the work. 10 seconds of viewer attention can add a value of 1 Euro to the painting.

This time has been set by us based on studies which show that the average attention span of museum visitors fluctuates between 4-10 seconds, depending on the exhibition and space design. Studies undertaken by the Kunstmuseum St. Gallen [31] demonstrate several patterns of viewer behavior in museums (the expert type, the admirer type, the social type). These studies also reveal a strong connection between the attention of the viewer, the way in which the paintings are hung, the distances between the paintings as well as the motives in the given exhibition.

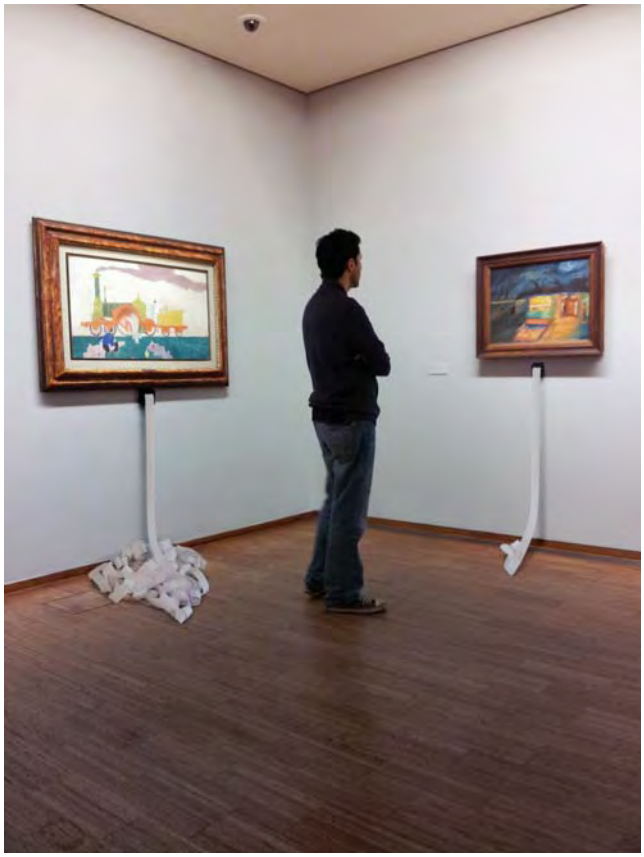

Figure 4. "The Value of Art/ Albertina" intervention ©2014, Christa Sommerer & Laurent Mignonneau

"The Value of Art/Albertina" is not intended to be a scientific study but rather a conceptual artwork that introduces viewers to the concept that their gaze has an influence on the value of the painting they are looking at. Nonetheless,

it will provide some information about the frequencies with which paintings are gazed at and create awareness of one's own attention span in respect to artworks. Some meta-information might emerge, such as which motifs or painting sizes are most popular, what type of visitor prefers which painting etc.

Conceptually „The Value of Art/Albertina" intervention re-discusses canonized artworks by famous painters and artistically points out the connection between the artwork, and accumulated attention. It also deals with the role of the museum as a place where accumulated attention is becoming canonized and integrated into the art historical discourse. The role of the museum, which serves as a gatekeeper and an educational and public institution that requires significant amounts of visitors, is also addressed. Museums are increasingly being asked to present blockbuster exhibitions in order to gain attention and ultimately obtain more monetary support. „The Value of Art/Albertina" touches upon these complex issues and aims to bring these topics to our attention.

Figure 5. A possible scenario in "The Value of Art/ Albertina" intervention ©2014, Christa Sommerer & Laurent Mignonneau

Summary:

"The Value of Art" series and "The Value of Art/Albertina" intervention are critical reflections on the economy of attention, the relationship between the artist, the artwork and the viewers, and the question of how monetary and ideological value are related to the time and attention the viewers devote to an artwork.

In our information economy we are now witnessing a shift; attention is increasingly becoming the new currency. We can also observe a paradigm shift in the art world: the star cult is losing its allure, as audiences and viewers come to demand more participation in contemporary culture and media art. This will also have an impact on the established canonized art system and the art market. The value of art can thus again be subject to discussion, based on new concepts about what really constitutes that value, methods for measuring attention, remarks made by visitors, sensing technologies and critical conceptual frameworks that broach these issues in an artistic fashion.

Acknowledgements

Thank you for YOUR attention !

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[Session 36]

Subversion Conceptions

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Artist's experiment and scientific experiment: the "provability" and creative distinctiveness of an artwork

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Abstract

I would highlight one more parameter encountered in art: creative distinctiveness and creation of a "trademark", "personal style". This is the use of a common visual element or theme that makes the artist and the art recognizable, distinguishable. A "trademark" can also be created for substantive or commercial reasons. The question is: to what extent do we see this "trademark" in technological art and hybrid art approaches? Works by Eduardo Kac, Heather Dewey-Hagborg, Thomas Feuerstein, Paul Vanouse, Dmitry Gelfand and Evelina Domnitch, Julius Popp, Timo Toots are discussed.

Keywords

Hybrid art, Artscience, Bioart, Installation, Generative Art, Computational Creativity, Interactive Arts.

Introduction

If we examine the category of hybrid art, questions about "provability" and verifiability arise. How true are they, aside from being compelling artworks?

The problem is that artists create works that are so complex and technically opaque that it is not possible to evaluate the work's technical structure without specialized skills or technical instruments. An artist's work as an artistic statement cannot be refuted without an expert analysis.

An artist's experiment is distinct from a scientific experiment in the sense that provability is not the main consideration in art. The finding of the artist's work is presented as a visualized, digitized or objectified position. Its truth-value is confirmed or disproved by art-critical text. It may happen that subjective, non-true, "bluffed" art work that is based on scientific knowledge takes on a value in social discourse, having something to say to the public or in the art context in an original way.

An art-critical text accepts or disputes a work. But a critic may be just as misled as the viewer. A critic may deem as truth whatever the artwork presents through the artist's "mouth." The chain reaction of acceptance that comes about as a result makes it pretty much automatic that ordinary viewers will accept the value of the work.

If the work is declared "false," fraudulent, this could have the same significance than were it to be deemed true. In the case of art the most important thing is **whether it "works"** – does it generate a response and interest, and not leave viewers ambivalent. If projects in science can be distinguished as either true or false, in art truth can mean that it functions in terms of art communication. On the other hand, a work that does not generate feedback, and as a result is invisible – even if the assertion it makes is scientifically true and correct – may be false.

I would highlight one more parameter encountered in art: creative distinctiveness and creation of a "trademark." This is the use of a common visual element or theme that makes the artist and the art recognizable, distinguishable. A "trademark" can also be created for substantive or commercial reasons. Considering that achieving distinctiveness became a consistent artist strategy in the visual art of the 20th century, the question is: to what extent do we see this in technological art and hybrid art approaches?

Works that require specialized competence

Works that require specialized competence are ones that must be evaluated by a specialist in a technology or profession in order for its trueness to be validated.

Eduardo Kac's "Natural History of the Enigma" (2003/08) involved a protein produced by Kac's genes in petunia leaves. In a private conversation with the biologist, I learned that it was not possible to interlace plant and human tissues. I could ask whether I would be able to distinguish the "edunia" created by Kac from natural petunias." A biologist might be able to do so. As an art observer, I am completely within my rights to agree or disagree with Kac when I see bio-art-manipulated plants that do not differ to any notable degree from the originals.

Thus the viewer cannot prove without additional technology that Kac's work is what the artist claims it to be. The question mark on whether the work is true or not is, in fact, what constitutes his or her "artistic truth." This is so even if it remains just a conceptual project, a proposed idea for a possible future work.

Looking for counterarguments, I happened upon the blog of Danny Chamovitz (professor of molecular biology and plant ecology at Tel Aviv University since 1996), who believes that Kac's "Enigma" is not a "hybrid" but 0.003% Kac and 99.997% petunia (he sees the term hybrid as more biology-based; it has a somewhat different shade of meaning in art). [1]

In his writing, Chamovitz refers to the fact that plants have genes (BrcA and Cftr), that are shared by humans,

and thus all plants are "plantimals" – the word that Kac used in his project. We could also say that people have genes (Det1 and Cop9, which are necessary for photomorphogenesis) and these are also shared by plants – could we be viewed as "aniplants," then? [2]

To what extent can laymen viewers be fooled? The question is about the possibilities of innovation and novelty in art as a whole. In a situation where art (and even innovative technological art) has exhausted many of its possibilities, artists are gravitating to adjoining specialities, harvesting ideas and bringing them back and thus refreshing their work. The critical discussion is centred on the result and the question of whether new meanings and discussions arise. If they do, the crossing of various fields and hijacking of ideas has been productive. If not, then it is just a simulation of innovativeness and the emperor is wearing no clothes, as it were.

Heather Dewey-Hagborg's "Stranger Visions" (2013) deals with genetic tracking, which makes no bones about the fact that the portrait generated is vague, conjectural and imprecise (Figure 1). The work raises the question about whether genetic tracking is possible, something we could fall victim to unwittingly. [3]

In the case of Dewey-Hagborg's project, vagueness and conjecture is an overt part of the work. For instance, people could not be ID-d in reality based on their portraits. Her artwork contains social, technological and scientific commentary - essentially that the technology in the future will be better and allow the owner of genetic material to be determined with portrait-like accuracy.

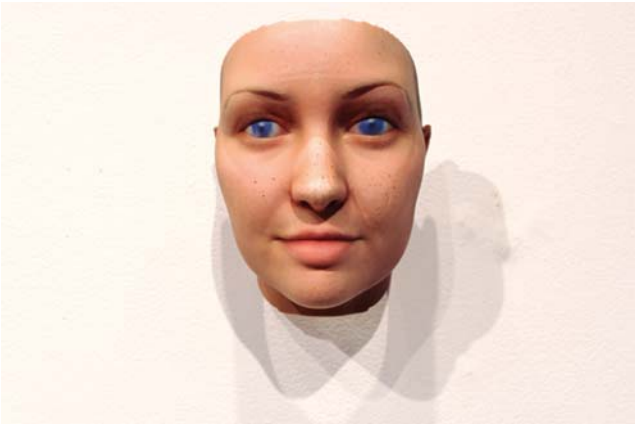

Figure 1. Heather Dewey-Hagborg, *Stranger Visions*, Self-portrait Based on mtDNA, Ancestry Information Markers and 50 trait specific SNPs describing gender, eye color and detail, hair color/baldness, hair curliness, complexion, skin lightness/darkness, tendency to be overweight. © http://www.deweyhagborg.com

She writes:

"Stranger Visions" is meant as a provocation, a confrontation with the viewer containing the possibility that someone can analyze DNA and identity on the basis of a footprint he has unintentionally left." [4]

This example does not hide the fact that the project is limited, insofar as the result – 3D portraits – is vague in spite of the fact that the state of the art technology is used. All of this is completely acceptable when placed in the art context. We could ask whether a "vague" result would be acceptable in science. Likely not, and this would expose the different tolerance in the art and scientific fields have with regard to accuracy and verifiability.

A work by an Austrian artist, Thomas Feuerstein's "Pancreas" (2012, glass, brain cells, steel and technical equipment, measuring 230 x 800 x 200 cm) was executed at the Innsbruck Medical School radiotherapy and oncology radiation department (Figure 2). The author writes that the process-based sculpture "Pancreas" transforms books into sugar (glucose), which feeds people's brain cells. [5] Pancreas is a pataphysical machine that uses biotechnology for translating books into material and flesh. [6]

Figure 2. Thomas Feuerstein, *PANCREAS*, 2012 glass, brain cells, stainless steel, technical equipment, 230 x 800 x 200 cm biotechnological realisation: Thomas Seppi, Department of Radiotherapy and Radiooncology, Medical University of Innsbruck**.** © http://thomasfeuerstein.net/50_WORKS/75_LABORATORY/72_PANCREAS

Feuerstein's project does involve scientific equipment and convincing manipulations, but the goal of the process – feeding a "brain" – is handled as an artwork, sculpture, and installation. This makes the solution playful as a whole, something witty and ironic, but in any event, only a half-realized scientific experiment and moderately interesting artwork, or so it seems to me. The possibility of producing glucose from cellulose might seem novel to a layman, but not to a specialist.

The projects by these three artists – Kac, Dewey-Hagborg and Feuerstein – have in common a use of scientific technology, but the result is vague or half-realized. It is impressive that the projects were executed, but it is not enough for critical observers and those interested in innovation.

Creative distinctiveness and the signature of technological artists

To what extent does an artist's "creative character" and "individual signature" manifest itself in artscience and hybrid art?

We know how the artist's signature was fetishized in 20th century art, which has been critiqued and which artists have attempted to "overcome."

Let us look at examples that can be categorized as artscience and hybrid art.

In his works "Latent Figure Protocol" (2007-09), "Ocular Revision" (2010), and "Suspect Inversion Center" (2011-), Paul Vanouse has consistently pursued an interest in DNA analysis themes and has varied them using different ideas and visualizations. [7] In his work "Latent Figure Protocol," he calls the objectivity of DNA tests into question and shows how to create analogous forms using a synthetic plasmid. Critical commentary is related to the risks related to assigning credibility to DNA tests. Other aforementioned works are similar to an experiment installation in the sense of the hardware and software used. Vanouse operates within the bounds of a recognizable "trademark", as an artist DNA tester. With "Latent Figure Protocol," the result is perhaps the most like a traditional artwork, and most accessible to the general public. It deserves to be mentioned that the installations are performative, with a certain time and public participation necessary for execution, the questions and answers thus provide an additional dimension and educating the audience is not just of passing importance.

Dmitry Gelfand and Evelina Domnitch create environments that can be perceived and grasped with the senses, uniting physics, chemistry and computer science with an unusual philosophical practice. [8] The installations are characterized by the dimension of mutability, they are performative.

"Camera Lucida" (2003) is the quintessence of this quality, it bombards a gaseous environment with ultrasound waves to create sonoluminscence. [9] The heat of the bubbles that burst in this environment are almost as hot as the Sun. Before the viewers are taken to the installation, they stand in total darkness for five minutes so that their eyes can adjust, as the art is otherwise almost imperceptible. The authors themselves argue that too little attention has been paid to this phenomenon in physics and chemistry, hence their interest in an ephemeral and auditively generated visual environment.

Their works "10000 Peacock Feathers in Foaming Acid," (2006), "Sonolevitation" (2007), "Hydrogeny" (2010) and "Memory Vapor" (2011) all involve delicate physical, chemical and acoustic processes that are reminiscent of a scientific experiment balancing on the border of credibility. To the viewer it sometimes appears like a trick but that makes the effect all the more captivating, and even specialists are convinced.

The authors' fragile experiments is the "signature": science experiment-based and imperceptible, fleeting events; participation in them is a performative ritual that becomes an esoteric performance.

The German artist Julius Popp makes original and creative use of technology to create projects that transcend artscience. He has three project series: bit.series, macro.series and micro.series.

If we take a closer look at the three works "bit.code" (2009), "bit.fall" (2001-2006) and "bit.flow" (2008), the first thing we see is the name as a trademark. The works are about the frequency of use of words on the Internet and deal with displaying them through various visualization media. The installations are part of the same family in the visual sense.

In "bit.code" the viewer sees black and white moving plastic strips on the walls, which from time to time form words. [10]

In "bit.flow" we see fluids of different colours being pumped through plastic hose; they occasionally form graphic images – words. [11]

"bit.fall" for its part is a curtain of falling water on a dark background, [12] where a computer-controlled water diffusion system allows drops to fall with perfect timing so that over a fraction of a second, we see the words that appear most often in news sites. [13]

The author calls the work a net-based installation.

"The water droplets are like building blocks, like bits that are used to form information. These minute information components are just as ephemeral as time, which our media-centred society needs to grasp, exchange and update information." [14]

No matter how the artist accounts for the work and the critics' reviews, the "bit.fall" installation is a direct hit: it is vivid, captivating and popular. No explanatory texts or analysis must be read to understand it – it works with an immediacy that needs no intellectual filter.

What Popp's installations have in common is that they use words, are controlled by a computer algorithm and feature online text search.

Conclusion

There are other examples from Estonian artists as well – such as Timo Toots's ID card or the document-reader-based installations "Autahvel/Hall of Fame" (2009) and "Memopol" (2011). [15] Taavi Suisalu's "Epicenter" (2010) harvests real-time text from 30 news sites and displays it in the form of a minimalist screen installation in conjunction with an audio environment. [16]

These projects also demonstrate what I described earlier: web-based text generation and discernible interaction mechanism.

Returning to the assertions I made earlier, such the problem of specialized competence, which we need to perceive technical artworks and creative distinctiveness and the artist's "signature," we see what we could also see earlier, in the 20th century.

The problem of specialized competence does not only exist in technological art but in other art forms where the

viewer is expected to be educated and have a more in-depth understanding of the work. The viewer must be aware of games revolving around the materiality of the art, the nature of the work as an object and the ideas that led to the specific artwork – after all, it does not exist in a vacuum, but in a cultural and temporal context.

The examples of artscience detailed in this essay are a critical example of a situation where only specialists – not to say scientists in a very arcane field – are capable of gauging the trueness of the works. The artist generally does not create his or her works for such specialists; they are intended for the layman, who is sometimes hoodwinked. But this situation imposes quite a high competence requirement on the audience and the critic, the need to be an expert not only in the art process but in the field of the specialized science which informed the creation of the work.

The projects by Eduardo Kac, Heather Dewey-Hagborg and Thomas Feuerstein required scientific expertise and readiness on the part of viewers to deal with technologies that are not exactly commonplace. But all of the projects were, in a sense, unfinished, playful, disputable and questionable in the sense of the visual elements.

Nevertheless, they received recognition from the conceptual viewpoint.

Creative distinctiveness and artist's signature in technological art are presented here as a provocative question that I have tried to answer briefly through examples of art.

Here as well, the artist is bound by the deliberate and intuitive games that work not only in art but in human culture more broadly: to make oneself visible, one has to identify and define oneself with media and topics. We see this in the case of Paul Vanouse, Dmitry Gelfand and Evelina Domnitch and Julius Popp, who use definite themes, technologies and recognizable rituals in the performative sense. The authors have aspired to a certain style, visual distinctiveness, comprehensiveness or methodological uniformity. As a result, we can describe their projects using words previously used for museum and gallery art. We also see that although the art changes in some respect, recurring universal principles come up, which the artists observe and which also works from the standpoint of the audience.

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Hybrid Ontologies: An Attempt to Define Networked Mixed Reality Art

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Abstract

This paper provides an introduction to recent research that explores the psycho-topographical relationship between bodies of matter, embodied data and data bodies, presenting a contribution to the field of mixed reality art, with a particular focus on post-biological identity. The research presents an exploration of several theoretical discourses, along with introducing a number of new hybrid terms, in order to reposition current discourses relating to this field. Through this, a new speculative and flexible framework is proposed that disrupts existing mixed reality discourses, in order to focus specifically on networked mixed reality art in relation to post-biological identity. While there was a considerable practical contribution to the development of this research being presented, this paper focuses particularly on the development of a theoretical framework for speculatively understanding the field, articulating the background to this process and the resulting hybrid terms that have been established in order to better discuss the field.

Keywords

Networked Mixed Reality Art, Post-biological Identity, Embodiment, Speculative/Flexible Frameworks, Hybrid Terminology, Transinduvidual Ontology, Hypersurface Interfacing, Data Bodies

Introduction

This research offers a contribution to an emerging, culturally orientated discourse regarding embodied mixed reality interaction. Through a convergence of existing theoretical discourses and practical experimentation, it seeks to disrupt, challenge and merge existing analyses of hybridised agency and identity, particularly in mixed reality data transfer networks in art. The majority of specific research in mixed reality systems has come from Computer Science and this paper offers a new perspective, from an arts and philosophically based discourse, that aims to disrupt current linear models of understanding the field, through the application of various theories relating to embodiment, data and identity, within a flexible framework of media arts practice. While a clearly documented prehistory of contemporary mixed reality art exists, currently there is a lack of specific research in the particular field of networked mixed reality art environments. The field exists currently in an awkward position, within other broader fields, such a virtual art, or immersive/interactive art and this does not allow for an appropriate focus on the intrinsic qualities that specifically relate to the field.

The concept of mixed reality can be argued to be inherent in all representational spaces (such as art), however recent developments in bridging viewers with digital representation, through mixed reality interfacing, have brought about the need for further analysis of these new post-biological, hybridized states of being and identity that traverse contemporary paradigms of Being. With the advent of networked society, previous linear models of identity, consciousness and reality, such as Milgram and Kishino's Mixed Reality Continuum [1] are rendered obsolete and therefore new representations of these more complex states of Being are required. The practical component of this research experimented with such notions in order to demonstrate that mixed reality artworks often situate themselves across a number of different reality states and in the case of certain examples, also simultaneously networks with other realities and environments (for example merging a virtual environment with an augmented reality space).

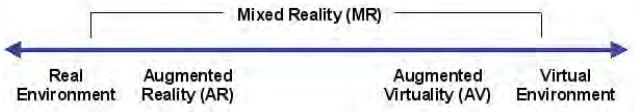

Figure 1. Paul Milgram, Haruo Takemura, Akira Utsumi, Fumio Kishino (1994) Augmented Reality: A Class of Displays on the Virtual Reality Continuum, SPIE Vol. 2351.

"Obviously, mixed realities form an integral part of the prehistory of media evolution described here. Their combining of elements of physical and virtual spaces is leading to the emergence of a new cultural technique." [2]

This statement by Grau suggests that contemporary constructions of identity, rather than situating themselves somewhere on a linear model, follow a more rhizomatic evolution and existence, that is constantly integrated within a layered topology of other networks. This claim shares common ground (within rather different articulations) with the work of Deleuze & Guatarri, Latour and Ascott, along with several other discourses in one way or the other. This leads one to speculate that there is a need to disrupt and deconstruct these disparate, heterogeneous rhetorics, in order to reposition and integrate them within a flexible hybrid framework. Such an endeavour requires also, a redefinition of related terminologies, in combination with developing new hybrid terms for describing networked mixed reality in a homogenous way. Through experimental creative production, these theories relating to networked being can be merged, made tangible and played out, in order to pragmatically reposition them collectively. The pro-

cess of actuating hybrid theoretical propositions through creative practice also allows for new methods of art production, in particular, embodied mixed reality data transfer to be proposed.

It is important to note that this paper does not claim that there is *no* model or framework for understanding such research, but rather, that mixed reality is not currently recognised as a specific art medium in a networked post-biological context. While it is beginning to be a term used more in art, *mixed reality* has a particular established position in computer science already and this research attempts to define it as a unique field, situated in relation to the wider fields of media art, virtual art, embodied art, networked art and so on, rather than simply adapting a definition of the term from another field and then recontextualising it within media art. There is a rather unfortunate history of the humanities borrowing terms from other disciplines and being creative with them (and perhaps this paper joins the club also). All media arts fields can be considered to be rather problematic to classify, due to their tendency to be convergent discourses. In response to this problem, this research aims to define mixed reality art in a speculative, flexible way, in order to present a hybrid methodology for mixed reality art that focuses on augmentation of data bodies, in order to embody post-biological identity.

This endeavour offers a new contribution to a range of existing discourses and therefore it needs previous models of understanding to be articulated, addressed and rethought. From this process, a research position is established within a clear contribution from practice based research, [3] however a convergent practice that actually *relies* on transdisciplinary methods such as mixed and augmented reality arts discourse requires a succinct positioning within existing theoretical and practical frameworks, in order to appropriately progress discourse in the field. Currently there is no definitive text or terminology that focuses explicitly on the topic of post-biological identity in mixed reality art and this research aims to contribute towards the establishment of such a text.

Mixed realties " […] are making an important contribution to expanding the boundaries of visualization and the possibilities of visual intelligence, to differentiation of the degree of possible complexity and, thus, to amelioration of the bittersweet side of immersion. This may help virtual spaces cast off their reputation as surrogates sooner than expected and to aid their development toward a new role as augmenters of experience in the physical world." [4]

A Brief Overview of Practical Research Methods

While the practical component to this research is not the focus of this paper, it is important to understand its processes and contribution to the establishment of what is being presented. Through creating real-time data transfer systems that bridge representations of embodied data and data bodies in mixed reality environments, the practical outcomes of this research traverse related theoretical discourses in order to attempt to propose new notions of post-biological digital identity, through artistic practice. This process involved significant analysis of mixed reality data transfer processes (within computer vision science and philosophy) in relation to understanding of networks and interfaces (from a technical, art and design basis), based on a number of existing theoretical discourses, in order to analyse the field within a framework that acknowledges *all* previous research on the topic. In this process a wide range (and vast amount) of theoretical, technical and practical research was analysed and then furthered through experimental creative practice. The actuating of disparate theoretical discourses through arts practice focuses on five main objectives:

1. To define mixed reality art, as a legitimate transdisciplinary field in relation to the wider field of media art based research
2. To present theory relating to mixed reality interfaces, interactive networks, identity and the body in writing and to merge these discourses through creative practice.
3. To propose a new theoretical and practical framework specifically for mixed reality art, that focuses on representations of the body and post-biological identity.
4. To articulate post-biological identity as a relationship between embodied production and consumption of art and embodiment in regards to the representation of data and ideas in practice, through mixed reality art.
5. To provide better understanding of this relationship through the introduction of new hybrid terms to describe the field.

This process involved the creation of what one might term bridged non-autonomous digital agents. These agents are embodied through being, in some way, representations of real time data that are borne from physical interactions between bodies and mixed reality environments. These agents, or rather *data bodies*, take many different forms, based on the nature of the data in each iteration and are constructed according to a range of interface and content-based solutions that rely on viewer/user participation to function. In such works there are often a number of different options for viewers to access and participate in them, through the provision of a range of simultaneously integrated mixed reality interfaces, including physical, augmented, virtual and networked solutions. This holistic approach to representation across reality states aims to propose that an individual can no longer claim to exist in any one unique state, but rather, that we are in a constant fluxus state of reality, across a broad array of networks and different systems of engagement in which all existence is somehow integrated.

Initially a method was established that used networked augmented reality for real time visual data transfer of embodied representations into virtual environments. These representational forms of agency, while born of data, take on the appearance of bio-referential forms and thus *become* embodied. This method developed a new technique of presenting the real time relationship between embodied interaction and embodied data that focuses also on identity, data storage and ownership. From a series of practical experiments, a reassessment of the reviewed literature was made. This process followed an Action Research model of planning, implementation and review in order to evolve a set of hybridized terms that can be used to best describe the practice of mixed reality arts research. These terms seek to function as an

evolving framework that is flexible and speculative and will be introduced and defined later in this paper.

A Convergent Theoretical Background

Due to recent developments in mixed reality interfacing, interaction and networking technologies, new modes of representation have definitely emerged. The advent of this requires further development of previous research, in order to define how these new mixed reality systems of embodied agency impact on arts discourse and in a wider context, what the implications of such developments are in regards to identity and being.

Networked embodiment of physical interaction destabilises traditional orthodoxies of thought regarding mixed and augmented reality art, through challenging understanding of their representation, confronting materialism, accelerating and smoothing social engagement within them and most importantly, demanding participation in them. This furthermore challenges our understandings of consciousness and presence in way that requires rethinking current available frameworks for representing identity and the body [5]. To achieve this, the following sections attempt to present, merge and apply existing theory on the general topic of identity, the body and embodiment to specifically focus on mixed reality arts discourse. It also aims to validate mixed reality in regards to post-biological identity, interactive art and embodiment, while further establishing the field as a legitimate practice within the media arts.

Bruno Latour's articulation of Actor Network Theory (ANT) is an appropriate model through which to position the various elements within this research. Although it is called a theory, ANT does not so much explain why or how a network takes the form that it does, rather it functions as a method for exploring the relational ties within a network (which consists of many different material and non material elements). As Latour suggests: "explanation does not follow from description; it is description taken that much further." [6] In other words, it is not really a theory of anything, but rather a methodology for understanding such systems. Latour's approach is related to other versions of material-semiotics, specifically the work of Deleuze & Guattari, Foucault, Ascott and Haraway. The application of ANT to such research can also be seen as a way of referencing how common activities, habits and procedures sustain themselves within uncommon networked situations, such as embodied mixed reality interaction.

Through ANT, Latour attempts to explain the convergence of both semiotic and material networks into a shared system of engagement. In this process the various nodes of actors that are involved in creating meaning, consist of both material and semiotic entities that are embedded in the exploration of explicit strategies for relating different elements together into a network so that they form a perceivably coherent whole. These networks are often transient, existing in a constant state of flux, between creating and recreating. This means that connected activities need to be repeatedly performed or the network will eventually disintegrate. [7] Networks of relations are not intrinsically coherent, and may indeed contain conflicts. Social relations, for example, are only ever in process, and must be performed continuously, as is the case for both physical and mixed reality social environments.

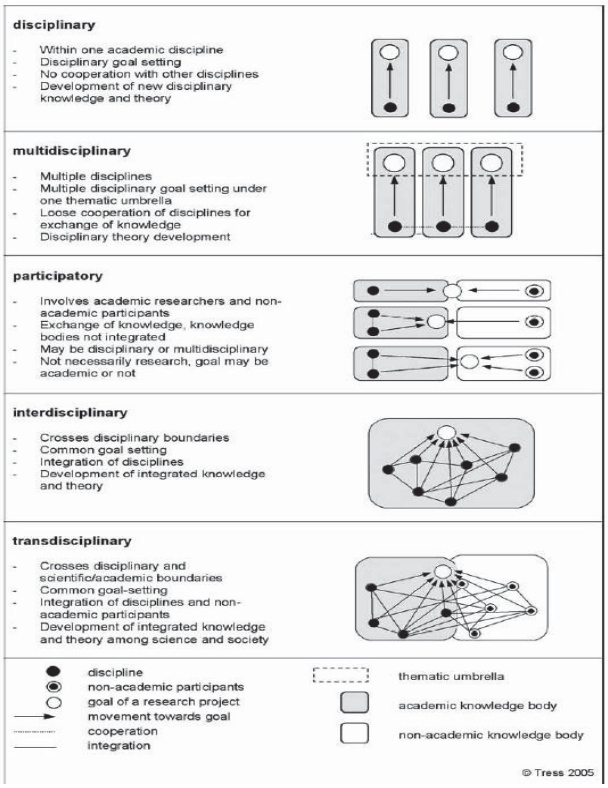

Figure 2. Bärbel Tress, Gunther Tress and Gary Fry (2005) Defining Concepts And The Process Of Knowledge Production In Integrative Research

The field of mixed reality art is extremely transdisciplinary and inclusive by nature and therefore rather broad as a result. Due to the constantly evolving range of interface, content, networking and interaction options available (along with the current lack of a defined structure of understanding this particular field) there are also no specific methodologies for mixed reality art practice. In order to bring the various manifestations of mixed reality art environments together, a network of salient relationships that are intra-active need to be created within this discourse. An ANT-based approach to both the processes and presentation of this research acts as a diagram for articulating the field. More importantly, it provides an established method for dealing with systems that might appear incohesive or unrelated, or the opposite of this.

ANT also provides a sound flexible method for understanding the disruptive relationships between human and non-human agency. ANT proposes the equal treatment of concrete human and non-human actors within networks and this also applies to their assimilated representation (for example real time embodied data in mixed reality art networks). ANT assumes that all entities in a network can and should be described in the same terms. This is called the principle of *generalized symmetry* [8]. The rationale for this is that differences between the various actors/agents are generated in the network of relations and therefore should not be presupposed. This approach allows for the ongoing evolution of a network (for example in the construction of a model for post-biological identity in mixed reality art).

Following the application of ANT to this research process, the development of an Action Research model (as previously mentioned) was established. This was designed in a way that addressed the need for new methods for developing further discourse in networked mixed reality art and embodiment, in order to focus on post-biological identity. Due to the novel and open nature of such a framework for the research, a range of other theories were explored and incorporated as considerations into the research process, such as Roy Ascott's reconceptualisation of Syncretism.

Syncretism has traditionally been regarded as an attempt to harmonise and analogise disparate or opposing viewpoints [9]. Throughout history syncretism has been used to merge different beliefs and views, however Ascott's (rather ambitious) approach to syncretism was developed as a means to further understand multi-layered worldviews, both material and metaphysical that are emerging from our engagement with pervasive computational technologies and post-biological systems. In the case of this research an attempt was made for Syncretism and Actor Network Theory to be integrated, in consideration of the collaborative work of Deleuze and Guattari, in particular reference to the 'deterritorialisation' of the human body through its dispersion into multiple reality manifestations, in relation to how mixed reality data transfer might constitute a 'reterritorialising' effect on our syncretic understanding of post-biological digital identity. [10] The texts of Deleuze and Guatarri, that in fact influenced both Latour and Ascott's work, were also considered in reference to their concept of Body Without Organs (BwO).

"When you will have made him a body without organs,
then you will have delivered him from all his automatic reactions
and restored him to his true freedom." [11]

One could say that participation in mixed reality networks (which are part of a contemporary post-biological condition) are by nature schizophrenic, shifting and often nonsense (through the novel nature of the technology and content) however, it is also functional within (social) systems. It is also literally surface orientated by nature, or as I propose: trans-topological through mixed reality hypersurfacing. Deleuze first mentions the phrase in a chapter of *The Logic of Sense* called "The Schizophrenic and the Little Girl". This text presents ways of encountering the world both distinctly and peripherally, at the same time. [12]

According to Deleuze, in schizophrenia words collapse into the bodies that produce and perceive them, rather than into superficiality. Deleuze defines the Body Without Organs as: "...a new dimension of the schizophrenic body, an organism without parts which operates entirely by insufflation, respiration, evaporation and fluid transmission (the superior body or body without organs of Antonnin Artaud)." [13] This body is also described as speaking an inarticulate language that is embedded more in the primal act of making noise, rather than in articulating specific data. The *Capitalism and Schizophrenia* series, written with Félix Guattari further explored Deleuze's concept of BwO, expanding the term to refer to actual (literal) bodies, in relation to a range of variant realities.

For Deleuze and Guattari, every physical body has a limited set of characteristics, habits, movements and affects, however every body also has a virtual dimension to it: a vast reservoir of potential traits, connections, affects, movements, etc. One might call this a data body, or data body bank. This collection of potentials "make oneself a body without organs" [14] or, in other words, a living, active, personified experiment that can activate virtual potentials. Often the potentials are activated through becomings: when they combine with other bodies (or BwOs), which is directly referred to by Latour in his *Reassembling the Social* text [15]. This particular articulation of the concept proves a very succinct metaphor to use when discussing the process of online (post-biological) identity contruction along with being a constant and direct point of reference within the practical exploration of post-biological identity in mixed reality environments. It is a rather easy concept to materialise/represent and also for the viewer to receive, as demonstrated in *organtrader2010* project, where the viewer literally fills an augmented body with organs that are representation of data from MRI scans of my (the 'artists') body and then these organs are transferred into a virtual organ trade network with a real monetary economy in Second Life. [16] I first discovered the term when researching the work of Australian artist Stelarc, who has also regularly referred to this concept within his cyber art practice. [17]

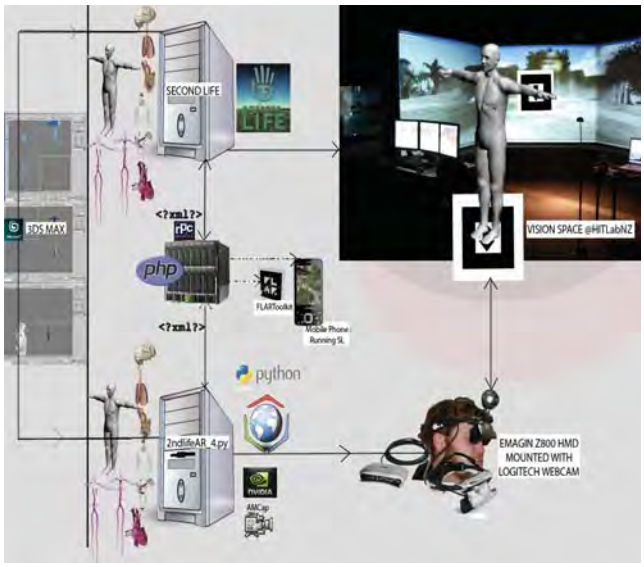

Figure 3. Stadon (2011) organtrader2010 technical diagram

This research trajectory focused on systems that allow for the bridging of the body with its virtual incarnations (BwO in a literal sense), in practice, through unique transfers of embodied data (data that refers to the body, such as 3D body mapping, microscopy biofeedback weather data, motion tracking). These processes involve interfacing artworks that allow for embodied interactions with data bodies (BwO). These are bodies of data in (Syncretic) networked systems that relate specifically to an individual's participation in the system (ANT). The outcomes from these processes, through a series of experimental representations of embodiment in juxtaposition with data bodies, proposes a new framework for understanding participation in such emerging systems, that repositions existing discourses in this field for a more focused post-biological perspective on identity.

The ways that agents are represented in the research outcomes are a differential embodiment of the 'bodies', which first generated that data in their everyday activities. This interrogates the meaning and consequences of data bodies and, in doing so, enables us to question the notion that information, once extracted from the embodied self and placed within a computer system, becomes an intrinsically linked post-biological augmentation of a visceral state. In posing this question we discover that, contrary to what we might at first assume, data is also embodied. The existence of 'embodied information', linked to and yet not the same as embodied selves, creates an interface through which humans negotiate their identities across the boundaries of different reality states, more or less virtual, and yet always involving the mapping or writing of that identity onto 'a body'. By having bodies both material and virtual, humans have become post-biological even as their biology remains the primary point of reference for the data gathering, which enables this transition to occur.

Figure 4. Stadon (2012) organtrader2010 Install Documentation

Humans, like all organisms, are part of a wider system of shared environments beyond the notion of self, including biological, social, political and digital ecosystems. These environments are becoming increasingly networked with individuals, through online identity archiving (data body banking) in social media, real time communication and data exchange, the continued development of big data integration to existing human systems such as political, social and environmental intervention. These systems act as networks that include a range of actors within them. As Latour suggests, these actors consist of not only a range of both objects (virtual and real), but also other phenomena, such as the weather and social exchanges, along with goods and services. This led the practical research to expand the notion of embodied interaction beyond the body and data bodies, to also include environmental conditions, in particular the weather. Atmospheric conditions are, like bodies, convergent within mixed reality environments, so a development of a research discourse in mixed reality art using weather data was also developed.

In mixed reality, a: "panoramic view is joined by the exploration of an image space that gives the impression of a ''living'' environment. Interactive media have changed our idea of the image into one of a multi- sensory interactive space of experience with a time frame. In a virtual space, the parameters of time and space can be modified at will, allowing the space to be used for modeling and experiment. The possibility of access to such spaces and communication worldwide via data networks, together with the technique of telepresence, opens up a range of new options. Images of the natural world are merged with artificial images in ''mixed realities,'' where it is often impossible to distinguish between original and simulacrum." [18]

Figure 5. Stadon (2015) organtrader2010 mixed reality data transfer of virtual organs to a mixed reality 'trader' avatar that traverses augmented space (as seen) and virtual space (in the Second Life environment) depending on user interaction.

This strategy aims at producing a feeling of immersion and presence that are enhanced further through interaction with what appear to be living digital ecosystems. These environments represent the link connecting research on presence (technology, perception, psychology) and research on artificial life and bioinformatics, an art that has not only reflected on in recent years but also specifically contributed to the further development of image technology.

The practical outcomes from a range of experiments that create a range of artificial mixed reality real time data transfer environments constitute, in their own right, a flexible framework for research in the field of embodied post-biological identity in mixed & augmented reality & real-time data transfer art. Recent developments in bridging non-autonomous relationships with machines through mixed reality interfacing has brought about the need for further analysis of these new post-biological, hybridized states of being that traverse traditional paradigms of time and space. As previously mentioned however, in the context of art history, mixed reality is not a new field, however the particular mediums and methods of representation discussed in this paper are, and this is why there is a need for a redefinition (and more importantly a new analysis) of it's impact on society and art. This is particularly the case in regards to how we define such an emerging, volatile, if not transient field.

The main objective of the theoretical writing involved in this project was to situate the research within current theory regarding networked mixed reality transferal of embodied data (data relational to bodies) within a paradigm of post-biological identity. Relevant theories such as Hayle's Posthumanism, Bergson's Intuition as Method, and the previously articulated Body Without Organs, Deterritorialisation and Reterritorialisation, Syncretism and Actor Network Theory. Here an attempt has been made to juxtapose and merge these variant discourse, in order to create a hybridised framework of understanding for this field of mixed reality art, within the context of real time data transfer, in order to understand how this contributes to the genealogy of post-biological identity.

A (re) Definition and Explanation of Terms

While most of the terms that are explained in this section are already established, there is a need to contextualise their specific meanings in the context of this research Layout. Part of the new knowledge in this research is situated in producing a framework specifically for discourse in mixed and augmented reality and in accordance with this new terms have been established to better suit certain phenomena within the emergent field.

Post Biological Identity

By having bodies both material and virtual, humans have become post-biological even as their biology remains the primary point of reference for the data gathering, which enables this transition to occur. This research provides a new framework for understanding post-biological identity that focuses on the mixed reality nature of these ubiquitous, multi faceted networks of self. It extends current discourse to argue that Posthumanism exists inside the history of a post-biological reality. From the birth of human representation, for example prehistoric cave painting [19] and personal narrative (story telling) we have split our identities into two entities. Semiotics explains this as the signifier and the signified (though it does not directly address individual identity). Once we split into the actual and perceived, or (to put it rather arbitrarily) the virtual and real self/second and first self-etc. We became, as individuals, emancipated from our bodily confines and thus rendered post-biological in our understanding of identity.

Brian Massumi states, "The body, sensor of change, is a transducer of the virtual." Through existing in these virtual representations, that are directly linked to living bio-systems, we effectively sense, feel and think in a way that hybridizes the virtual with scientific inquiry, and therefore we require a discourse that addresses whether this does in fact make us post-biological. [20] Through the development of bridging techniques that use real time embodied data transfer to create mixed reality art networks, the practical research for this thesis has created a practical framework for not only articulating, but also contributing to the (until now hypothetical and speculative) theoretical discourses in this field.

Dividual Identity

The work of Gilbert Simondon has influence much of the discourse in this field, and as such; his work provides a foundation for the establishment of the discourse in post-biological identity throughout this research. [21]

One theorist heavily influenced by Simondon was Deleuze and in *Postscript on the Societies of Control,* a theory of dividual identity is presented as an articulation of the relational aspect of all identities, in regards to becoming and divisibility. For Deleuze: "in control societies . . . the key thing is no longer a signature or number but a code: codes are *passwords,* whereas disciplinary societies are ruled (when it comes to integration by resistance) by *precepts.* The digital language of control is made of codes indicating where access to some information should be allowed or denied. We're no longer dealing with a duality of mass and individual" from the modern era. Instead, "individuals become '*dividuals,*' and masses become samples, data, markets, or '*banks.*'"[22] He uses money as his example to explain this further, stating that in disciplinary societies (rather than societies of control, which he declares we have progressed into some time ago) money was always referred to as minted money, in relation to other physical resources, such as gold. [23] In today's societies, money is considered in relation to floating rates of exchange that are in a constant state of flux.

This particular late text from Deleuze seems rather unrecognized (unfairly so in my opinion): "Deleuze's sketch-like analysis has been influential for the way postmodern or late capitalist society has been mapped by critical theory." [24]. Unfortunately, it was written right at the end of Deleuze's life, and seems to have remained rather lost, amongst his other more prominent theories: "While this essay is both exciting, and disappointingly underdeveloped (..) " [25] Contemporary theorist Alexander Galloway frequently makes reference to this text, labeling it as "…at the beginning of something new" [26]. Mixed Reality research should incorporate this term within Galloway's framework to further understand the layered (or folded) nature of the post-biological condition.

Embodied Mixed Reality Art

"This is the basic concept of the mixed reality stage: a virtual space full of information, which is activated, revealed, re- organized and recombined, added to and transformed as the user navigates the real space." [27]

To define any art form as mixed reality is rather paradoxical. All art is representational and spatial and therefore all art is mixed reality. In this proposition, the term refers specifically to art that uses convergent digital environments to facilitate embodied and interactive participation with them. Embodied Mixed Reality Art is art that implicitly incorporates real time data, relating to those interacting with it, into the construction of explicitly post-biological content in the work. Embodied art creates a situation where the body of the viewer is implicit in the creation and continuation of the work through performative interaction with it and the subsequent documentation and archiving of these actions.

In *Parables for the Virtual* [28], Brian Massumi suggests that we need to reposition "movement, sensation, and qualities of experience" back into our understandings of embodiment: "Our entire

vocabulary has derived from theories of signification that are still wedded to structure even across irreconcilable differences" [29] This discourse engages with movement and continuity in regards to the body and interactive art environments.

Massumi suggests that, "When a body is in motion, it does not coincide with itself. It coincides with its own transition: its own variation". [30] Here the body moves beyond being a "known" structure, towards a "state of invention", or an "accumulation of relative perspectives and the passages between them . . . retaining and combining past movements" [31] continuously "infolded" *with* "coding and codification". [32] This research articulates embodied mixed reality art as relational, emergent and incipient: topological but not plottable and through acknowledging the problematic nature of describing it, present a framework for arts based research in the field.

Discussions of so-called mixed reality, a catchword that is still new and trendy, currently center on connecting real spaces, including their forms of cultural and social action, with image processes of virtual environments. One advantage of mixed realities is that in general, the observer is not obliged to wear a head mounted display, or enter into the computer- generated body of an avatar. Mixed realities make accessibility and orientation easier, while still allowing interaction with new fields of action. "Thus, the hermetic image strategies, as represented by previous virtual realities, have now been joined by a concept of hybrid spaces, part real and part virtual. They are dialectical connections of physically and media-communicated image spaces, where usually a darkened space is linked to a large format screen to form a mixed reality." [33]

Hypersurface Interfacing

Giannachi states, "The hypersurface is a zone of exchange between consciousness (language and text) and levels of the inorganic… Able to present dichotomous relationships, between representation and matter, inside and outside, organic and inorganic, the hypersurface is the site of virtual performance." [34] For the construction and exploration of mixed reality to occur interfacing is required to bridge the virtual environment with the physical so that both spaces can be mediated in an autonomous manner. The hypersurface is the site on which bridges are built: where the real and virtual, material and textual, author and agent can meet and interact with each other.

Networked Mixed Reality

While there are many previous examples of real time mixed reality data transfer within media art, interactive design and computer science, this thesis will present a range of unique practical solutions for this process. As part of the practical component of this research, several new methods of creating embodied real time mixed reality art were developed. The term was originally developed to describe one particular system that was developed in collaboration with Raphael Grassett at The Human Interface Technology Lab (HITLabNZ) for the organtradAR series. This system uses augmented reality as a bridge for data transfer from physical interactions with augmented environments, into online virtual environments. This system was the first of its kind and was accordingly recognised through multiple IEEE publications (a significant achievement, considering this is a heavily peer reviewed computer science publisher/organisation).

Current research in mixed reality and interactive workspaces that use the concept of a bridge for data transfer have continued the development of new knowledge in this field, however the majority of previous research in this area has been in the field of computer science. The application of cultural and philosophical discourse to recent developments in computer science will propose new modes of representation that concern themselves with the affective capacities of art in order to articulate a sense of dispersed embodiment. The concept of networked mixed reality data transfer became a significant focus of this research, in terms of medium and technics. The original method that incorporated augmented reality and a massively multiplayer online environment (MMO) was developed further for two more projects and then the concept was revisited in a number of other new solutions that explored particular mediums and messages in relation to particular topics and modes of representation.

Data Body Banks

These are bodies of data in networked systems that relate specifically to an individual's participation in the system and, more importantly, to personal data relating to a physical identity. This term was created to describe the relationship between contemporary data networks and individuals and their post-biological implications for understanding identity and the body. Emerging from discourses in post-biological identity, transdividuality, dividuality, ANT, BwO and syncretism, the concept of a data body bank was heavily influenced by Deleuze's concept of the 'super fold' [35] (different to the original 'fold'), a concept he introduces in his book *Foucault*. "In Deleuze's Appendix to Foucault, entitled, *On the Death of Man and Superman,* the concept of the Superfold is introduced in its relation to new configurations of life, labour and language, or biology, political economy and linguistics [35]

Through this concept Deleuze proposed a new image of society that goes beyond the diagram and beyond previous dichotomies of the organism and the digital, as a mechanism for understanding networked digital control societies and the implications of participation in such systems in regards to identity, privacy and ownership.

With the advent of representation (also personal archiving) came the creation of static data body banks: material archive networks of identities and identification systems. Server based online computing offers a dynamic replacement for previous systems that allows for fluidity of the size and shape of data, along with subjectivity for individual participants and the communities interacting with it. The recent convergence of networked computing and art has brought about a resurgence in interaction as a core communicative element within representation. The recent increase in embodied art calls for a review of how we language such systems of representation and meaning in the wider context of society. Traditional methods of physical involvement in communication

are now being integrated into modern technologies and text/image and this is creating possibly the most complex systems of embodied information exchange we have ever seen.

As many including Ascott and Stelarc have argued, the body is no longer wet as it is so intrinsically linked to data bodies. Wet and dry do indeed combine to create a moist media state, as described by Ascott: "Between the dry world of virtuality and the wet world of biology lies a moist domain, a new interspace of potentiality and promise." [36] This state is indeed post-biological and situated within a contemporary networked mixed reality. Today we exist as viscera and as data bodies, materialised through agency and avatars, forced back upon us by our social media interactions; data zombies borne out of our own personal archives that come back to bite us, to infect us further and further. Life and afterlife become the same hybridized being, that of the post-biological human and its network of data body banks

Conclusion

This paper has introduced a range of theoretical discourse with the aim to scope the field of networked mixed reality, in regards to post-biological identity. It has conducted a rigorous comparison of theoretical texts and authors with a focus on practical implementations in the field of mixed reality art, along with introducing a range of new and redefined terms in order to better understand the field of networked mixed reality arts practice. The research has been constructed to engage with real time mixed reality data transfer systems involving virtual environments, human-computer interaction, artistic representations of embodied agency (through data body banking) and simulated social, biological and ecological actor networks. This research is currently being further developed in order to strengthen the legitimacy of the proposed framework and terms for both understanding and educating in this field. Primarily, it strives to offer a specific contribution to a wider discourse in art, identity, embodiment and reality

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Understanding Third Space: Evaluating Art-Science Collaboration

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Abstract

CP Snow's mid-century idea that a "third culture" might come into being to connect arts and science is perhaps most publically realised today through *art-science* - a heterogeneous field of creative research and production, characterised by the collaboration of artists and scientists and by research combining scientific and aesthetic investigation. This paper reports on the development of a new method for investigating the value of third culture collaboration for both the expert collaborators involved (artists and scientists) and the audiences who engage with the work. The visual matrix is a recently developed psychosocial method for evaluating aesthetic experience, which has been used in various socially-engaged and site-specific art contexts. In 2014 it was experimentally applied to two art-science exhibitions staged in the UNSW Galleries, Sydney: *Amnesia Lab* and *Body Image*. This paper discusses the unique potential of this method to capture the shared, complex, emergent and transformative aspects of the experience of these exhibitions. In particular it highlights the ability of the method to capture the emergence of a "third space" at the intersection of art and science in the public domain – a site of trans disciplinary engagement, enquiry and knowledge production that plays a vital role in the contemporary research landscape.

Keywords

Art-Science, evaluation, collaboration, third space, third culture, expertise, aesthetics, curating.

Introduction

More than half a century has passed since CP Snow identified the chasm between the "two cultures" of science and arts as a serious problem. [1] Today, by contrast, there is acknowledgement that "the greatest challenges for society" require the combined insights of science and arts/humanities. [2,3,4] Snow's mid-century idea that a "third culture" might come into being to connect arts and science has been considerably expanded – but is perhaps most publically realised today through 'art-science', a now heterogeneous field, characterised by the collaboration of artists and scientists and by research combining scientific and aesthetic investigation. [4,5,6,7,8]

Grounded in the conviction that art-science plays a pivotal role in today's research landscape, this paper reports on the development of a method to investigate the value of third culture collaboration for both the expert collaborators involved (artists and scientists) and the audiences who engage with the work. As a form of collaborative research art-science is distinguished by its intersection with the public, and its capacity to connect audiences and stakeholders to researchers in ways that are mutually enhancing. We describe this intersection of art and science in the public domain as "third space". More than just the conceptual bridge between art and science that Snow envisaged, the third space is the site of a three-way engagement between science, art and the public (the 'public' in this context overlaps with and potentially extends 'audiences' for art exhibitions but also includes a variety of stakeholders in relation to science and/or the specific area of inquiry).

Understanding and extending this engagement is important in today's 'connected' research environment, where knowledge production is itself understood as linked to a broad set of engagements and networks. [9] Contexts for research are often forged at the edges of disciplines, or through engagements with industry, non-academic professionals, citizens and publics. [6,10] In this setting art-science provides a means to connect science to a public. But to see it merely as communicating existing science is inadequate. Art-science undertakes research under new conditions, through methods unavailable in a 'two culture' setting. It creates contexts that provide critical "connection to forms of human and subjective experience", informing and feeding into research. [6] The nature of these connections – *how they occur and why they are important* – requires new methods of evaluation capable of capturing and articulating shared, transdisciplinary knowledge as it emerges.

In this paper we report on the experimental application of a new pychosocial method for evaluating aesthetic experience – the visual matrix – to two art-science exhibition held simultaneously at UNSW Galleries in Sydney in 2014. *Body Image,* curated by Felicity Fenner and John McGhee, displayed arts-led modes of visualising complex scientific and biomedical data. It included animations, photographs and immersive virtual reality showing phenomena such as blood and heart vessels, cellular processes, microscopic and molecular views of the internal body and imagery generated from CT and MRI scans. The works in the exhibition were juxtaposed with a selection of preserved human organ specimens from UNSW Medicine's Museum

of Human Diseases. *Amnesia Lab* was an experimental forum in an exhibition setting, bringing together memory experts and artists to explore how photographic images, sound and immersive media can advance our understanding of memory and forgetting. The *Lab* was part of an ongoing research collaboration led by artist Shona Illingworth with cognitive neuropsychologist Martin A. Conway, neuropsychologist Catherine Loveday and theorist Jill Bennett. Whilst both exhibitions represented deep collaboration between artists and scientists they presented markedly different types of audience experiences. *Body Image* was a visually spectacular, immersive and dramatic exhibition, whilst *Amnesia Lab* was a subtle, process-oriented experience, which demanded close attention from its audience. The contrast between the two exhibitions offered a productive testing ground for the development of a method that could effectively capture, and evaluate these very different kinds of experience.

The challenge of art-science evaluation

Art-science is now well established, long promoted through the journal *Leonardo*, supported in the UK by the Wellcome Trust since 1996, and in Australia by the Australia Council Synapse program, as well as Labs such as SymbioticA. As a field art-science is diverse [6]; we focus specifically on work that goes beyond 'science-informed art' to produce a new third culture [5] or transdisciplinarity [6, 8]. We do not yet have the means to properly determine the value of such projects – either in terms of research or exhibition and public engagement. Ferran et al found that art-science evaluation currently tends to rely on existing measures, orienting to the established goals of *either* art or science. [11] But a genuine third culture or third space activity is more than the sum of its parts. Art-science has given rise to new forms of research and to findings that couldn't have emerged from disciplines alone [8, 12], and these require terms of reference that take account of but do not reduce to those of disciplines. Similarly, a research-driven art-science exhibition may depart from conventional exhibition models, potentially extending museum/gallery practice and engaging new publics in new ways. No major study to our knowledge has taken on the task of looking at art-science collaboration in respect of both its distinctive aesthetic modalities and its wider public role in the production of knowledge.

Studies of major art-science schemes consistently indicate that their value is perceived by collaborators to be significant (82% of participants in the Wellcome Trust's Sciart scheme reported that involvement provided "new insights"; scientists spoke of "intangible value and speculative benefit". [13 p.71] But there is currently very little detailed analysis of *how and why* transformation occurs when scientists engage with art and public through aesthetic practice. Quantitative methods (visitor numbers, citations, etc.) do not provide the data needed to determine the value and benefit of aesthetic engagement; conventional quality evaluations are insufficient because they do not assess value beyond their disciplinary value structures.

There are two interrelated challenges for evaluation: Firstly, the lack of a developed discourse for expressing value within this hybrid field. Ethnographic study of the UK "Arts and Science Research Fellowships" describes how participants often fall back on "familiar narratives" and on "the conventional, oppositional distinctions between art and science in describing their integration". [14] Moreover, it is often difficult for collaborators and participants from non-arts backgrounds to fully articulate the benefits of aesthetic engagement. This highlights a methodological issue with the use of participant narratives in areas where there is no established, shared discourse. Secondly, the evaluation of any kind of art faces the problem of how to account for aesthetic experience. By focussing on social and economic indicators and measures, evaluation often "fails to account for the very aesthetic dimensions that count". [15] Conversely, art evaluation may fail to account for utility [14] or value beyond the discipline. An effective evaluative approach needs to counter this polarisation of aesthetics and utility, accepting instead that the distinctive aesthetic (visual, sensory and affective) dynamics of art are central to art's 'practical' value [16] and to its capacity to play a distinctive role in a transdisciplinary field. [12,17]

To address this challenge we formed a research team that combines and applies specialisations in interdisciplinary curating and audience experience (Lizzie Muller and Vanessa Bartlett) practical aesthetics (Jill Bennett) and in psycho-social evaluation (Lynn Froggett) to develop a framework for evaluation of aesthetic experience in a field connecting diverse experts and stakeholders. The project draws on a unique method – the visual matrix – to pioneer a means of capturing the experience of an emergent field.

The visual matrix

The visual matrix is a methodological innovation developed by the Psychosocial Research Unit (PRU) at Uclan to address the need for arts sensitive research in the cultural sector. [18,19] It was initially developed in the Public Art and Civic Engagement project (PACE), which was funded by the AHRC Cultural Value Programme. The method was developed to address two key challenges in evaluating experience. Firstly the problem that the sensory encounter with an artwork usually precedes verbal expression, whilst our understanding of this encounter is usually heavily dependent on people's ability to give an account of it in words. This makes it intelligible and communicable within the research process, but at the risk of denaturing the primary aesthetic and emotional impact of the artwork on participants and audiences. Secondly the problem that interviewing – perhaps the most widely used of qualitative methods - tends to individualise experience, whereas art is also appreciated and understood in the context of a set of social relationships and often in the shared space of the public realm which in part it helps to sustain. Even focus

groups set in train discussions in which people speak from personal knowledge and opinion, often becoming more entrenched in their positions as debate proceeds.

Between traditional evaluative metrics and the intrinsic nature of an artwork lies an area that poses particular challenges for research – that of aesthetic experience in its sensory, emotional, aesthetic and cognitive aspects. This is the ground where individuals and communities can be moved or transformed by a process, object or concept. Positioned between arts based and social scientific methods, incorporating rigorous protocols of hermeneutic interpretation, the matrix fills a gap in the current methodological repertoire by creating a group based setting for shared associative thinking in response to an aesthetic stimulus. The particular conditions in which the matrix is conducted, and the procedures by which it is analysed, are designed to ensure that understanding of the embodied experience of an artwork is not over-whelmed by words thinking. [see 19] The matrix has been applied successfully in public art and clinical contexts, but not in transdisciplinary art-science projects. In the work reported here we aimed to assess the potential value of the method for such projects.

The process begins with exposure to a visual stimulus. In this case we ran two matrices with two different groups – each focused on one of the two exhibitions. Participants spent 30 minutes in the target exhibition before gathering in a separate space nearby. Participants are then seated in chairs positioned in a 'snowflake' pattern, rather than in rows or a circle. The facilitators sit among the participants and also participated in the matrix. This arrangement minimises eye contact and discourages group dynamics. It also discourages direct addresses to the facilitator and any assumption that the facilitator is there to actively direct the process of the matrix. The facilitator introduces the matrix by asking what the images bring to mind. Participants are invited to contribute their impressions, feelings and further thoughts and images. Doing this with others who are present and engaged with the same process allows shared thinking, or at any rate thinking that becomes intelligible within a shared communicative process. This process accumulates into a shared 'collage' of imagery, affect and ideas. For example, the following demonstrates the flow of imagery from the *Amnesia Lab* matrix, with each statement coming from different participant within the matrix:

The thing inside the EEG, for me, was reminiscent of being inside some kind of buzzing hive, or swarm of insects. And quite a lot of the experience of that whole showed me - brought to mind insects, insect activity, scurrying, whining, kind of [9:04] like activity.

I thought it sounded like screaming. It had a kind of sense of pain to it, I thought.

I really liked the shadows on the walls that were cast by the lights. But at the same time the lights really disrupted the way I listened to the sound.

I thought there was something quite spider-like, actually, about just the speakers hanging on the wires.

Spider web.

Yeah. Or spiders legs, or something.

Mmm.

An octopus for your head.

Mmmm.

I heard the sound of - of crickets quite a lot of the time, actually.

Tinnitus.

Mmm.

Evaluating expert experience

The aim of this experimental application of the visual matrix was to evaluate its potential usefulness for art-science contexts. A particular challenge of evaluation in such contexts is the need to investigate the expert experiences of the artists and scientists involved in the collaborations themselves. There are particular difficulties in accessing and evaluating the affective and transformative experiences of experts who are trained to offer well informed and considered analytical opinions. Whilst such informed, critical opinions offer vital information on the impact of art-science projects, they necessarily remain entrenched in individual perspectives and within the narrative arc of an individual's career. The visual matrix offers a complementary method to techniques (such as interviews) that can capture these expert, individual perspectives. In this experimental application of the method we aimed to test its ability to elicit a different quality of data from expert participants – where the shared, affective aspects of experience might offer insights into the transformative impact and transdisciplinary knowledge produced by such collaborations.

We were also interested in experts' experiences of the method itself and their opinions about it – did they find it enjoyable, challenging, interesting, irritating, pointless? How did it impact on their experience of the work itself? What was their assessment of the method and its potential usefulness? In order to promote a rich and rigorous discussion on this topic we recruited colleagues working in the arts and sciences – as both researchers and practitioners. Several had a particular interest in evaluation and aesthetics experience. There were approximately 15 participants in each matrix. The normal analytical process of the visual matrix was slightly modified to include discussion about the method itself with participants (see below). The effectiveness of the method for working with expert experience and the impact of the group composition on the results is discussed later in this paper.

Analysis of the visual matrix

The highly structured process of analysis begins with a group discussion led by the participants themselves. The post-matrix discussion, contrasts with the mental 'wandering' of the matrix, as a process of extrapolating meaning, ordering and linking begins. The session is facilitated by one of the researchers, who notes the ideas that have emerged from the matrix on the board or flipchart. The post-matrix process resembles a form of 'image-mapping', where clusters of images and intensities of feeling and ideas configure as 'maps' and where the interaction between the images, affect and ideas relate to each other as 'scenes' that echo the scenes evoked in the matrix itself. In this project we also used this session to discuss the participants' experience of the method itself, and their views on its effectiveness. This example from the *Body Image* post-matrix discussion demonstrates how the style of thinking and communicating differs from the associative mode of the matrix. Here participants are negotiating with one another to articulate the different emotional qualities evoked in the matrix:

I think that the journey is also linked to anxiety because there is that moment of anxiety before you launch yourself in, whether it's into an MRI machine or into the exhibition space.

Yes.

I mean even during it, not just before it. "Have I done the right thing? Am I going in the right direction?"

Anxiety seems a little lightweight compared to some of the really emotionally heavy words we used, and…

Like what?

Like death.

Yes.

People spoke with some swear words, all sorts of things about what they felt about that. And anxiety doesn't really cover that.

I think fear.

You could go fear, yes.

Fear more than anxiety.

Following the post-matrix discussion there are ideally three further interpretation cycles. The first interpretation panel is a researcher debriefing held the following day. This is composed only of researchers who participated in the matrix. Each one speaks uninterrupted, and in turn, on the impressions that remain with him/her most strongly from the previous day, without looking at the transcript, and in the knowledge that the experience of the scene remains quite close. The panel works back and forth between currently emerging meanings and the original matrix itself. They begin to ask *how* images and associations were offered, with what language and emotional tone. They consider the fluctuation of feeling in the matrix as a whole. [19] In this case this panel was also used to discuss and evaluate the quality of the data and the potential value of the method to art-science projects.

In most applications of the method there are 2 further interpretation cycles where the panel return to the data once further distance has been established by virtue of a break of some days or weeks. These panels establish further links between the material (matrix, post-matrix discussion and interpretation of the first panel) and the social situation and context. They move towards a level of synthesis and abstraction from the material, incorporating more remote ramifications and theoretical and contextual considerations to arrive at a full analysis of the research themes. The final panel can include members who were not present at the original matrix, presenting an outsider view. This is the point at which findings emerging from the matrix can be compared and triangulated with other data sources such as interviews. [19]

It is not our intention here to present the full results of this extensive process of analysis – but rather to present an assessment of the potential value of the method for art-science collaboration based on our experience of the matrices, the quality of data elicited there, the discussion with expert participants and the subsequent researcher debriefing. In the following section we identify the value of particular qualities of the method in this context, drawbacks and challenges and implications for its future deployment.

Aesthetic experience at work

One striking observation from the experiment was the difference between the two matrices for *Body Image* and *Amnesia Lab*. Associations flowed thick and fast in the *Body Image* matrix, with participants rapidly and enthusiastically offering images, memories and sense impressions that seemed to have been generated in abundance by the rich, even overwhelming visuality of the exhibition. Much of this imagery was intensely visceral– evoking physical sensations connected to strong emotions. For example:

It reminded me, the quality of some of those illuminations in there reminded of the experience you get when you close your eyes and you look at the sun, which I guess is the only time when you actually see the inside of your body, actually, because it's a moment when your body is illuminated and you can see it with your eyes. And I did get that sense of that strange luminosity that feels like blood, or tissue, but you can see tissue.

Did you ever shine a torch through your fingers?

Mm.

Yes.

My kid does that all the time with my iPhone, actually, and she's constantly looking at her finger with the iPhone. So I guess that's exactly the same quality of luminosity that I'm thinking of-----

Yeah, yeah, (28:07).

-----the moment when something about the flesh, the nature of flesh, which is opaque is kind of seen from within.

I used to do that so much when I was kid, pushing on your eyes, and then staring at the sun. Whenever you were waiting for your mum in the car. The patterns that show up on your, yeah, I loved it so much.

The pace of the *Amnesia Lab* matrix, by contrast, was slower. Participants seemed to be searching and struggling to find imagery, and flows of association were frequently broken by long pauses. As in the *Body Image* matrix, imagery when it came often evoked intensely visceral and physical sensations, in this case these were often unpleasant – described by words such as "tortuous", "disturbing" and "alienating".

The capturing of "lyric" (moment-by-moment, affective, embodied) experience is clearly important in exhibitions that are so concerned with the materialisation of biological and neurological data. The intensely visceral, but markedly different qualities of these two matrices are isomorphic with the primary experience of the exhibitions. The matrix creates a space in which participants can, to some extent, 're-live' the exhibition. In this way the matrix makes available for examination the nature of the perceptual, affective, aesthetic *work* that is done by the audience within the primary experience. As one participant in the *Amnesia Lab* matrix expressed it:

There was something - I felt alienated, too, and then I was - I was really struggling, working extra hard… for the connection between the visuals on the screen, and the sound experience as well, I really struggled, struggled, struggled there.

The matrix articulates both the pleasures and the difficulties of the experience, as well as its contradictions. Antimonies that are part of the aesthetics of the exhibitions translate into the dynamics of the matrix – such as a tension between immersion and reflection, resistance and surrender evident within *Body Image*.

In revealing the profound complexity of an experience as it occurred, the matrix goes beyond traditional evaluative measures of success. Shona Illingworth – the artist involved in the Amensia Lab – participated in both the matrix and the researcher debrief the following day. She observed that:

As an artist you have very little access to the experience that people have in your work. Art writers are fantastic – but there's a big space that's missing that gets filled with opinion. That is why evaluation is important. There's a massive space that is empty to do with engagement with the work. [The matrix asks] not just "did it work" – but more about a deeper engagement with the concept. Measures of evaluation usually stay at that level of "did it work.

From the specific perspective of art-science projects the isomorphism of the method offers a way to re-create, observe and capture the emergence of new knowledge formed from the frequently complex, difficult and contradictory aesthetic experiences that occur in third space. In the theorisation the hermeneutic interpretation of the matrix Froggett is influenced by Donald Winnicott's account of the space of play as the origin of cultural experience, together with the understanding he offers of the capacity for illusion and reality-testing, and the importance of the 'potential space' (like the space of the matrix) in which these processes occur. [15,20] Whilst many evaluative techniques focus on the idea of a defined and bounded object of experience, the visual matrix elicits and captures impressions stimulated by imagery. These impressions can be disjointed in time and subject position, but by being expressed in the shared space of the matrix provide a multifaceted perspective on a complex project or research topic. The matrix sets in train a process which is isomorphic with the processes it seeks to investigates, and becomes itself and kind of third space - able to reveal aspects of the art-science encounter that have not been articulated, including the reciprocal influence on both parties. As the next section will show, this "thirdness" may also allow the matrix to capture the *shared* experience that underpins the generation of transdisciplinary knowledge.

In-between experiences

Art-science projects necessarily imply the coming together of vastly different kinds of knowledge, held and imparted by individuals with different professional approaches to phenomena and argumentation. In this meeting of disciplines and individuals, knowledge domains become unsettled. A major strength of the visual matrix is its creation of a setting in which an *emergent* language forming in-between two domains can be observed and documented as it coalesces. Led by imagery, visualization and sensory stimuli, rather than processed and explained experience reported in a verbal account, the matrix is able to capture experience before it is re-absorbed into a more settled explanatory framework. Unlike focus groups, which tend to encourage and support the expression of different subject positions, the visual matrix supports a collaging of interrelated imagery. In this way it holds together contradictions and differences, whilst mapping affective intensities that cumulatively reveal shared aspects of experience.

There is some evidence from this initial experiment that the matrix may do more than just capture the emergence of this shared language, but also go someway to supporting its development. Expertise in this context is a double-edged sword. The expert knowledge of collaborators is vital to the productive encounter between them, but limiting in the degree to which it restricts or defines participants' understanding of that encounter. The visual matrix was originally developed to help those *without* expert knowledge of art to articulate their experience of artworks. This experiment suggests that it also helps experts articulate experiences that might be beyond their professional critical or evaluative stance. In the debrief that followed the matrix for *Body Image* there was general agreement that the process of the matrix, and the post-matrix discussion was itself valuable and productive. In fact for some participants this was a source of methodological anxiety. One participant suggested that we needed to conduct pre-matrix interviews with participants:

> *And in that way you might be able to separate out further, what is actually the power of the group discussion. And what might've been there for us individually as we'd started, because I think my difficulty is… that this has enormous potential, but only because of the powerful experience that we have of analysing it together.*

There are two responses to this methodological dilemma. One is to attempt, as this participant suggests, to separate out through additional methods the impact of the primary art-science experience from the impact of the matrix on the participants. The other is to embrace the integration of the art-science experience and the matrix as an indivisible whole in which new knowledge is produced and articulated. The matrix becomes a tool for formative evaluation – a scaffold for surfacing and supporting the production of new transdisciplinary knowledge.

Scientists and artists frequently claim that art-science collaboration is 'transformative'; it changes their perspective or generates insight [21,22], often by facilitating engagement with the public or with stakeholders and subjects of science. [13,23] These claims are cited to underline the success of art-science programs but there is rarely any deeper examination of the evidence for transformation, or of what exactly occurs at the juncture of art, science and public. The notion of third space suggests that the potential for engagement is profound in these cases because it is participatory, not simply in the manner of any interactive artwork, but because both collaborators and the public engage in the third space as a *locus of research*.

This begs the vital question of the constitution of the group and the recruitment of participants. The visual matrix has been shown in previous applications to be extremely group sensitive – producing markedly different results depending on the community or demographic involved. Questions raised by this experiment include whether to combine expert with non-expert participants in future matrices, and how to ensure a balance between different kinds of expertise (broadly between art and science backgrounds). If third space is brought into being at the interface of art and science with the public, then it is vital to incorporate within the matrix the interaction of expert and non-expert knowledge.

Conclusion: Curatorial implications

Our experiment demonstrated that the visual matrix is a valuable potential method for capturing 'deep' responses in contexts where shared knowledge and discourse is emergent. It offers the possibility for an evidence-based inquiry into the impact of aesthetic engagement in the third space. But further it offers a process that is able not only to assess value but also contribute to the creative/research process with which it is engaged. The visual matrix itself, it seems, can play a part not only in investigating but in supporting the aesthetics of third space.

The significance for cultural institutions, and for others involved in art-science development is potentially far reaching. Rather than taking place purely in a lab or research unit, art-science takes the form of a "public experiment" [6] or "living laboratory", enabling knowledge creation to happen within public space. [24], Increasingly museums seek to establish their relevance as "epistemic organisations" – sites for the production as well as the representation of knowledge. [25] Many are grappling with the challenge of how to curate interdisciplinary activity [26,27,28], how to contextualise shared objects of knowledge produced through transdisciplinary research [4,10], or how to foster spaces of mutual experimentation. The implications include new spheres of operation, new formats of exhibition, models of engagement and outreach. In order to develop innovative programming – and ultimately to rethink organisations in relation to 21st-century knowledge formations – cultural organisations need to understand the shape of art-science research and its multiple points of engagements with diverse community or interest groups. The visual matrix offers one of a potential suite of processes, techniques and tools that can allow them to work proactively, and collaboratively with both experts and audiences to understand the nature and significance of art-science.

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An Investigation Into The Impact Of Collaborations Between The Commercial Digital And Artistic Sectors On The Curatorial Realm

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Abstract

This paper examines the steady rise in collaborations between the contemporary art field, commercial creative media and technology industries and the new media art field and reflects upon how collaborations of this nature are reshaping the 'realm of the curator'. Ways in which theorists, and practitioners have approached collaborations between art and industry are considered and a curatorial project, *Binaudios*, commissioned by the author, is used a case study for analysis. Here, the project reveals some of the similarities and frictions inherent within the developing relationship and evolving terms of engagement between these three sectors. This paper explores the impact of these tensions upon the evolving curatorial role, the curator's broadening theoretical context and methodologies and practices developing within the proliferation of new sites of distribution and engagement of art.

Keywords

Collaborative Commissioning, Expanded Curating, New Media Art, Contemporary Art, Commercial Creative Media, Collaboration

Introduction

Pervasive media and ubiquitous computing, alongside the convergence of networked, media platforms, global social access and commercial activity on the world-wide-web has catalyzed the startling growth of the creative media and technology industries over the past ten years. The impact of this relatively young industry can be seen in the radical recalibration of global business practices, and networked, digital culture has had a fundamental impact within wider society.

New technologies have also heralded a radical reconsideration of the theoretical and practical role, function and value of art and the wider art ecology in civic society.(1) This has led to new collaborations and partnerships between the arts and other fields including science and more recently commercial, creative media and technology. While not a direct beneficiary, the 'collaborative commission' case study *Binaudios,* is also reflective of recent strategic funding initiatives that support collaborative practice between the arts, media based platforms and commercial technologies. Examples include the NESTA Digital Arts R&D Fund; a collaboration between Arts Council England, Arts Humanities and Research Fund and NESTA and The Space; a collaboration between the BBC and Arts Council England.

A clear understanding of the evolving curatorial role within the interface between art, new media art and commercial technology is pivotal to articulating contemporary arts position in our new, media universe, in which art is increasingly becoming yet another form of mass culture. Within this space, existing art world concepts, tools and methodologies are found lacking. As such, we have seen developments and new approaches in relation to; funding, commissioning, producing, exhibiting, interpreting, disseminating, critiquing, collecting and selling art, after new media.

The search for common territory between those involved in the arts and those involved in the sciences via curated projects stretches back to initiatives such as Xerox Parc Artist in Residence Programme in the early 1990's. In his book, *Art and Innovation*, Craig Harris highlights the fears of C.P Snow, writing in the 1940's:

"large segments within society were not communicating with each other and were creating language, educational, and social infrastructures that reinforce the gulf between these domains." (2)

More recently, in 1996, cultural theorist Lev Manovich drew a line between computer art and fine art describing the former as Turing land and the latter Duchamp land. Turing land representing the land where technology was taken seriously and is interested in experimental research processes. While Duchamp land satirized technology and wanted a finished art product. (3) In Rethinking Curating, Beryl Graham and Sarah Cook highlight the range of artistic and curatorial activity that is successfully bridging these two 'lands'. They posit the art world's interest in process-based art and curatorial interest in the behaviours of new media art practice form this bridge. (4)

Curators working in organisations whom are actively engaged in redefining the curatorial and organisational role within this new context include;

Heather Corcoron (Rhizome), Julia Kaginsky (New INC), Freeman (Open Data Institute) and Irini Papadimitriou, amongst others. All of these curators have highlighted new, theoretical and practical methodologies for curatorial practice within contemporary digital culture. However, for the purposes of this paper, I will focus on a project by Heather Corcoron and her team at Rhizome, which was the inspiration behind my own curatorial experiment.

Binaudios 2014, represents the output of a curatorial experiment investigating activity within the hybrid ecology emerging within the boundaries of the arts, media arts and commercial industries. It investigates the impact of the differences inherent within the three fields in relation to; roles and methodologies, money and value, crediting and intellectual property and marketing and public engagement, upon contemporary curatorial practice.

Rhizome Seven on Seven

A leading organization actively engaged in curatorial bridge building between contemporary and new media art and the commercial creative media industries is Rhizome. The inspiration behind my collaborative commission between an artist and a creative technologist initially came from a series of events programmed by Rhizome called *Rhizome Seven on Seven*. Initiated in 2010, *Seven on Seven* pairs

"seven leading artists with seven game- changing technologists in teams of two, and challenges them to develop something new - be it an application, social media, artwork, product, or whatever they imagine - over the course of a single day". (5)

It is a high profile, public example of an organisation both curating and facilitating collaborative dialogue between the commercial creative media and technology industry, new media and internet art and art.

The *Seven on Seven* platform creates a particular site of production and discussion for collaborative arts practice, with each participating individual drawing from two distinct, yet merging fields. The tightly curated pairings and open brief create a site that draws from artistic practices and concerns emerging within the terrain framed by Manovich's Turing and Duchamp art lands and the commercial creative media and technology industry. Each pairing had twenty four hours to 'develop something new' and then presented their work at a conference, generally hosted within an arts or cultural venue, to both a live and networked audience. The event is filmed, and then archived on Rhizome's website.

eeeeemail.com

In 2013, artist Jonus Lund and creative technology entrepreneur Michelle You, presented their project *eeeeemail.com* at the Barbican Centre, in London. Lund creates paintings, sculpture, photography and websites that incorporate data from his studies of trends and behaviours within digital culture and the contemporary art world. You, is the co-founder of *Songkick*, a digital start up company with over eight million visitors a month. Interestingly, it is the artist who is the creative coder in this pairing, rather than the 'game-changing technologist'.

Unlike other pairings discussed later in this paper, Lund and You approached their *Seven on Seven* collaboration as a 'hack day' and produced a live, web-based project for their presentation. (6) Using an existing, email service provider, *eeeeemail.com* randomly pairs logged in participants and exchanges sent emails from their account outbox between them. The work attempts to counter the tight, algorithmic, filtering infrastructure of social media platforms by searching for a way to create a sense of chance and serendipity in online interactions.

eeeeemail.com extends both the artist and the technologists personal interests and seeks to explore how users can present a more authentic 'self' online and thus have a more genuine online experience with others. By selecting random emails that have already been sent in the past, the participant cannot modify the email content or their online behaviour. Thus the sent emails reveal an insight into the participant's true self, rather than the persona they can construct on social networking. Lund explains:

"If you give a part of you that actually matters, maybe the experience and exchange will matter more. Rather than something that is self defined."(7)

Lund's interests in seeking to explore how users can present a more authentic self, online, has produced a project that also satisfied You's interests in developing an opportunity for service providers, such as *Songkick*, to have access to and analyse information that goes beyond that which the user themselves provide.

As mentioned, each individual pairing took established their own approach to how they used their time together. In the same year, Graham Harwood's and Alberto Nardelli explanation of how they approached their pairing and presentation is telling. Their approach recognises the inherent constraints and differences in discourses that frame each distinct sector's perspective and practices. While also articulating this need to find common ground and shared points of interest. Thus the

key output for their pairing was to gain a

"a critical understanding of how we are coming to our subject"

and present their efforts to combine their independent methodologies, rather than the 'trinkets of creativity' developed throughout their day together. [8]

The *Rhizome Seven on Seven* project bridges artistic and commercial; perspectives and sector discourses, interests, working practices, sites of production, distribution and engagement, all of which are also related to the realm of the artist and curator. While *Seven on Seven* is an interesting programme to attend, experience and reflect upon, the format has its limitations. My case study would need to go deeper into exploring how a resourced, (art) output oriented collaborative commission between the two sectors would be delivered. How would the pairing of an artist with a commercial, creative perspective impact upon the process of conception, development, production, installation and dissemination of the resulting collaborative artwork?

***Fig 1. Binaudios*, 2014 by Dominic Wilcox and James Rutherford, installation shot in the Sage Gateshead, May 2014 (Photography by Karolina Maciagowska)**

***Binaudios*, a collaborative commission**

In order to explore Rhizome's curatorial strategy of 'pairing' two creative individuals from the art and technology fields more fully, the decision was made to develop a brief for a collaborative commission that would 'pair' an artist and a creative technologist, and task them to create a new artwork that would be showcased as part of the Thinking Digital Arts (TDA) 2014 programme. There were some modifications to the *Seven on Seven* parameters, including; a site responsive brief, an extended timeframe for development and a public exhibition site within a cultural venue.

The commission was conceived as one element of a publically funded arts festival and delivered as part of Thinking Digital Conference (TDC) a commercially driven, creative technology conference. Thus, these two distinct sector voices framed the commission brief, and informed the development, and delivery and continuing dissemination of the work. The resulting artwork was *Binaudios*, a site- specific commission by Dominic Wilcox and James Rutherford. *Binaudios* playfully responds to the unique architecture of the Sage Gateshead, a major cultural regeneration project by the local authority, Gateshead Council, opened in 2004. It explores the social, cultural, geographical context of this large-scale performance venue via sound.

Both the artist and the technologist were invited individually to take part in the commission. They were chosen as they shared similar attributes including; similar stage in their career, established practice, skills and interests, similar level of experience of collaborations between art and technology, a familiarity with each others sector and both had a connection with the NE. Investigations throughout the commissioning process focused on identifying the key similarities and frictions between each collaborator in relation to; their roles and working methods, money and value and the crediting and intellectual property of the final artwork.

Findings:

Roles and Working Methods

Artist, designer and inventor Dominic Wilcox's creative practice produces projects that are at once artistically self aware, playful and potentially useful in contemporary society. While he often operates within it, his practice extends beyond the theoretical, art historical and institutional framework of contemporary art. His artistic understanding is instead framed by the much broader context of theory and practice reflective of networked culture. As such, he regularly works to both art/design based commissions and commercial briefs as well as realising his own interests. James Rutherford is a technologist, working in a freelance capacity as a software developer and a start up mentor within the creative media and technology sector. He regularly organises hack events to encourage creative help open local city and scientific data.

A conscious decision was made to try to establish a non-hierarchical partnership within this pairing in order to facilitate a collaborative context for co – creation. As such, while the brief gave each collaborator their title; 'artist' and 'creative technologist', it deliberately refrained from detailing the roles of each collaborator in this commission. Akin to Lund and You's *eeeeemail.com* project, the potential of the commission lay in the ability for the two individuals to co- create and

share ideas, practices and experiences, that could satisfy both in different ways and to different ends.

However, within the formal context of an art commission, the act of naming each collaborator as 'artist' and 'creative technologist' served to reinforce the sector divide and thus clarify the division of roles from the onset. Thus the artist came to the commission with the expectation:

"To be creative. To deliver an appropriate artwork for the event. To think up the idea, decide how it should work and look"

and the creative technologist:

"To develop a technical solution to realise the commission's concept."

The brief had immediately framed the project as a traditional art commission, which demanded its key output to be an artwork that would be showcased within a cultural institution and established an expectation and hierarchy of what each individual's role would be within it. As such, throughout the research and development period, the artist took creative lead in driving the conceptual framework of the artwork, and led on all decisions in relation to content, aesthetics and design. While, the creative technologist defaulted to advising on technical feasibility and developing the technical aspects to realise the artwork's concept. The early clarification and almost unconscious acceptance of these fully established roles meant that each collaborator worked independently and autonomously on their own element of the commission. It is no wonder then, that Dominic Wilcox described the experience as being more akin to an 'arranged marriage' rather than a collaboration which fostered an authentic act of co-creation.

As Stephen Wright argues within his paper Toward a Lexicon of Usership, in the naming of the roles, I had inadvertently utilised the established language and terminology that

"remain operative in the shadows cast by modernity's expert culture." [9]

By approaching and framing the commission from the existing ontology of contemporary art, a set of predetermined theories, tools, methods and language had been applied to the initiative. While a successful output, the 'art commission', was delivered, the project failed to realise a collaborative site of co – creation for the process of art making to occur.

Money and Value

Like Rhizome's *Seven on Seven* experimental discussion platform, TDA sought to create a range of productive spaces for the co- creation and sharing of ideas, practices and experiences between the arts and commercial media and technology fields. The TDA programme was framed as part of Thinking Digital Conference and delivered in a range of cultural and arts venues across NewcastleGateshead, in the North East of England. The conference is now a private business, however, it had been initially conceived by Codeworks. [10] as one of a suite of initiatives devised to encourage growth and development within the creative media industry across the region.

The conference programme is modelled on the American conference, TED and as such, provides a broad overview of speakers representing the impact of technology on all aspects of society. Its key audience however, remains within the creative media and technology industry. [11] TDA was in part, seen as an opportunity to diversify the conference delegation, provide an art based experience for current delegates that augmented the existing conference offer and in the longer term, increase ticket sales. TDA also needed to address and satisfy the specific requirements of its key funder, Arts Council England (ACE). As the programme was publically funded by the arts sector, it needed to ensure that the programme supported the development of excellence within the arts and access a public audience.

By framing Thinking Digital Arts within a commercial conference, and financing it with public arts funding, inherent differences between established assumptions and concepts within both sectors in relation to money and value emerged. The arts programme was required to both add value in terms of facilitating a range of productive contexts to support the co-creation and sharing of artistic ideas, practices and artworks, which needed to be accessible and experienced by a public audience. It was also required engage the specific delegate audience of the conference and make both a financial and non-economic return for the conference, beyond that of self -sustainability. Within the commission, these tensions played out in various practical ways including; payment, time and value.

The commission was budgeted using bench-marks provided by the arts sector and both the artist and the technologist was remunerated equally. This benchmark immediately highlighted a discrepancy in expected daily rates between the arts and the commercial media and technology sectors. In that the fee was below the regular day rate expected by the creative technologist. However, the value inherent within the opportunity to

collaborate with an artist on a creative commission was acknowledged as enough to compensate for this disparity.

The time allocated to the project by the artist differed in that the technologist saw the project taking

"A couple of weeks work, spread across three months."

were as the artist stated that he would

"allocate an amount of time that will enable the development of a successful piece of work."

This distinction in process and perspective highlights a fundamental friction between the two sectors. Time, in relation to output is valued by two separate theoretical contexts. The technologist saw this as a 'loss leader' project which he would allocate a defined amount of time to complete, while the artist deemed the project as an opportunity to create an artwork, and would give it as much time as was needed to be realized.

The value of the project was however, seen in a similar way by both and rooted in the experiential opportunity to work creatively with another skill set and learn from a different process. The non-economic values of the project, which were mutually understood, created the bridge that connected this pairing.

Crediting and Intellectual Property

The arts and commercial sectors operate on a differing set of assumptions and concepts when it comes to intellectual property and crediting. While relevant to both, intellectual property is used, perceived and valued in different ways. In recent years, much debate within the new media art field has centred around establishing clear terms of engagement between commercial agencies and brands who are seeking to work with artists or to use existing concepts developed by artists.

As Golan Levin explains to ad agencies, in the arts or within open source creative communities, where financial return is not the key driver or motivation for creating work, it of upmost importance that the intellectual property of an artist is acknowledged and credited appropriately if used or exploited by another (third) party:

"As difficult as this might seem to understand, many artists aren't in it for the money -- If they were, they'd be working for agencies. For many, CREDIT IS AN ESSENTIAL FORM OF CURRENCY. They want to be known as the inventors of a technique, as having inspired others. It's understood that their ideas will be picked up and reinterpreted in the Grand Conversation, even in ways that they don't prefer. But being recognized for their prior art is important: they're looking for a place in the art history books. So acknowledge them. Thank them." [12]

Within a commercial context however, where the key driver for working is the possibility of a financial return, intellectual property is valued in a different way.These different perspectives were reflected in the comments of both the artist and technologist within the commission. When asked what their expectations around Intellectual Property were, the artist answered:

"Not sure, shared credit."

And the technologist stated that he expected the IP to be:

"Co-held by myself and the artist. Further exploitation possible by either by mutual agreement."

The brief demanded that the work have equal and shared credit and in many ways this was realised in many contexts. The artwork made the front page of the local North East newspaper, The Journal, and the main image featured both the artist and the technologist, which is unusual within an art commissioning context. [13]

However, within the profile generated mainly by the artist across online art and design platforms and publications, a distinct focus on the artist emerged in crediting the artwork. While the creative technologist was named as an equal collaborator within the main body of the content, many of the headlines and subsequent social networking activity, featured only the artist's name. [14]

Key reasons for this could relate to the fact that the artist was generating the material himself and capitalising on the profile and reputation he held within the art and design fields, which was driving interest in the work. It also speaks to the skillset for self- promotion that artists in general are required to develop throughout their careers. It highlights that the artist has an understanding of how to frame the artwork in order to attract marketing and PR interest across a range of disciplines, including art, design and technology. And could potentially point to the subconscious hierarchy of self assigned roles that the artist and technologist gave themselves at the beginning of the project, which saw the artist take the lead on many fundamental aspects of the art work, including its conception, aesthesis and design.

Conclusion

Collaboration between distinct fields can be fruitful, if complex. This paper has shown that the traditional curatorial role must evolve to:

Ensure that, while art may be moving into a new sphere of mass culture, the context facilitated for artistic process and production is protected and remain autonomous.

Actively determine the terms of engagement between collaborators within the expanding arts ecology.

Pursue new ways to broker the perceived gulf that separates the arts and (computer) sciences. There is much to learn from the curatorial practices inherent and emerging within the new media art field.

Acknowledge that the impact of this new ecology requires an expansion of the curatorial theoretical context and a potential revision and modification of existing practices.

The assumptions, concepts, practices, protocols and interests that drive the collaborators field must be acknowledged and allowed to inform future curatorial, combined methodologies.

Establish a new, collaborative language that represents and reflects the needs of this new, mixed ecology of art production in order to nurture optimum working contexts, practices and thus the new kinds of art, which are framed by an expanded definition and function of art.

Binaudios, is the latest experiment in a curatorial practice that is anchored between contemporary and new media art fields and the commercial creative media and technology industry. Through the process of practice led research, the author has identified exact areas of similarity and friction between these three fields when they engage in creative collaboration. Interrogating the expanding realm of the curator within these collaborations extends beyond the popular rhetoric that all collaboration between these three fields is positive. It furthers the conversation to reveal the potential for these collaborations to become critical and meaningful for fostering and nurturing new contexts for art.

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Curating: A Disruptive Technique for Disruptive Technologies

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Abstract

This paper focuses on curating interactive art in ways disruptive to the traditionally disparate disciplines of fine arts, creative robotics, business theory and philosophy. It takes the interdisciplinary design of interactive systems outside labs/studios and into institutions and cityscapes in the form of prototype exhibitions. The artworks become schema for hypotheses offered for evaluation through the medium of audience engagement. This PhD research focuses on authenticating the audience's experience of interactive art first defining parameters for authenticity within fine arts and creative robotics, then examining how, through the application of evaluative frameworks to iterative exhibition processes, one might capture and utilize the audience as a material in itself. Through an examination of responsive systems, both artists and curator will be led through critical and creative spaces by speculative design, audience engagement and evaluation, and analysis of data collected. The exhibitions for examination are/will be produced by PhD researcher Deborah Turnbull Tillman through her research initiative New Media Curation (NMC).

Keywords

Disruption disruptive technologies, prototyping authenticity curating action research criteria audience experience interactivity

ACM Classification Keywords

J.5 – Arts and Humanities, Fine Arts General Terms

Design Documentation Experimentation Human Factors Measurement Theory Verification

Introduction

This paper will present a curatorial technique of testing based on "disruptive ideas" within a PhD research framework. It will introduce variables to argue the main research question:

Can contemporary curators apply prototype techniques to exhibitions comprised of digital interactive art at various stages to reveal new criteria for curating digital interactive art?

The framework for this study will utilise variables such as authenticity, prototyping, audience evaluation, elicited response (as in creative robotics) and disruptive technologies (as understood in business theory). Authenticity will be investigated within the context of digital interactive art whilst emphasizing the prototyping process as a disruptive force in the making of such art. It will also query the audience's role in eliciting reciprocity from computational systems and the ability to analyse this phenomenon via evaluation. Situating this curatorial study across traditionally disparate media and creative making practices will help in establishing specific criteria. These criteria will be informed by the contemplation of different definitions for authenticity across an interdisciplinary inquiry. Together these outcomes will assist in establishing a common language for the experience of this hybrid art form. If this task can be accomplished, the disruptive nature of the curatorial process in light of new - and arguably disruptive technologies made by disruptive practitioners – can at this point in visual and art histories, assist in establishing curating as a revolutionary act rather than an evolutionary constraint.

PhD candidate Deborah Turnbull Tillman is looking at the audience's role in authenticating the experience of interactive art through contemporary curatorial practice. To broaden the context of this interdisciplinary hypothesis, we will first examine the emergence of disruptive technologies on the larger global digital market, as in business theory. We will then transfer this understanding and application in a contemporary art context, wherein an analysis of the participation by an artist/technologist in a prototyping project will be put forward as a disruptive variable to the way that a curator would normally work with artists in the capacity of exhibiting finished, rather than in-progress works. This discussion will provide the specific context in which Turnbull Tillman is currently working to examine curatorial practice within an experimental environment. Within this context, she will demonstrate how she plans to test her theories on audiences, and begin to formally develop exhibitions in the way that artists/technologists develop the work, through a series of iterative exhibitions that may cause discomfort or anxiety on the part of both creators and consumers of digital interactive art. This discomfort, based on the experimental nature of the process, may lead to the discovery of new knowledge.

In presenting digital interactive works at the prototype phase, Turnbull Tillman is participating in a disruptive practice for all parties concerned (artist, technologist, exhibitors and audience members). She is positing possible solutions to fallouts based on refining the methods utilised in a case-by-case analysis of three of the exhibitions produced by the experimental research initiative that has formed her curatorial practice: New Media Curation

(NMC).[1] During this process, events, exhibitions and happenings will be staged and evaluated using the frameworks referred to below. These evaluations will establish a set of criteria that extends the current knowledge of what it means for an audience member who engages with digital interactive art to have an *authentic experience in the context of interactive art*.

To date, a key problem in this field of inquiry is the meaning of *authenticity* itself. Universities, such as the Institute of Aesthetics in Denmark,[2] are beginning to utilise the philosophical definition of authenticity being true to one's own experience in relation to external forces, pressures, and influences which are different from, or other than, oneself and applying it to courses on digital art (Wood, et al. 2008). In Lotte Philipson's course, students are encouraged to understand all definitions of authenticity and apply them to the digital medium (Philipsen, 2010). Drawing on the work of Dennis Dutton, two closely examined definitions in this course are *nominal* and *expressive* authenticity. Nominal authenticity is more in line with traditional curatorial techniques. It follows the practical history of a work, correctly identifying materials, authorship, provenance, and origins when its practices are applied. Expressive authenticity is more about critiquing experience through emotions that act as a marker of the artist's society or an individual's belief (Dutton, 2003). Where the nominal definition is useful in terms of taxonomy, the expressive definition would be more difficult to evaluate. In relation to digital interactive art, evaluating *affect* would be more advantageous as it "refers to the *experience* of feeling or emotion" and "is a key part of the process of an organism's interaction with stimuli" (VandenBos, 2006). Most interesting is that this "…word also refers sometimes to *affect display*, which is "a facial, vocal, or gestural behavior that serves as an indicator of affect…'" (Ibid). As evaluative markers, it would be simpler to identify and capture *expression* than it would to capture *emotion*.

In defining the parameters of an *authentic experience*, this research will draw from the relevant fields of creative robotics, fine art, and business theory. Where authenticity in fine art may include nominal curatorial practices as defined by Dutton, authenticity in creative robotics may require the ability to replicate expressive authenticity via computer science and engineering. Authenticity across these fields means establishing a provenance precluding a genuineness and truthfulness about the work however, in drawing on the work of Julienne Greer (Senior Lecturer in Theatre) and Sherry Turkle (PhD in Sociology Personality Psychologist), authenticity also means a successful transmission, a pleasurable experience and an emotional connectedness at the conclusion of an engagement or interaction (Turkle, 2007) (Greer, 2011).(Turnbull, et al., 2015).

Disruptive technologies as understood in a broader context, are rather exciting in terms of the evolution of materials for making thought about them. The term 'disruptive technologies' was coined by businessman and technologist Clayton M. Christensen in 1995 (Bower and Christensen, 1995). Throughout the end of the 90s and 2000s, Christensen wrote with and in response to various researchers on this topic, posing dilemmas and offering solutions through various publications. Where he argued for market stability by keeping disruptions minimal and offering explanations when markets were interrupted by what he later termed 'innovations,' there were several theorists who countered that disruptions were totally negative to any marketplace. Oliver Gassman describes technology as being considered "a form of social relationship," that is "constantly evolving." In fact he defines these ecologies and the variables within them as unfixed (Gassman, 2006).

It is at this point that the authors are reminded of the very nature of speculative design, in which experimental practice, and perhaps even prototyping, may be disruptors that find a common purpose. There may be some merit in articulating that the way the materials of interactive art (digital technologies) and the processes for exhibiting (prototyping) and designing (speculative) exhibitions featuring digital interactive art overlap, interweave and develop. Where speculative design tends to find a provocation to start from rather than a design problem to solve, prototyping is a scenario- or event-based type of testing where each iteration is either a little or a lot better than the previous model. The development of the digital component of these works are further outlined below.

Gassman continues, "Technology starts, develops, persists, mutates, stagnates and declines – just like living organisms." Within this particular ecology are different technologies battling it out with each other for the label of high technology (in comparison to creative practice of different aesthetics battling it out for the label of high Art). Life-cycles emerge as new technologies are created and utilized by target markets. When a high technology is determined as the best and most used it challenges the current Technical Support Nets (TSNs) which facilitate and govern market value in terms of technology. Instead of dying out, the governing system has the option of co-evolving (Ibid). Where Christensen is critical of this interpretation, colleagues of Gassman and Christensen argue for the power of disruptive technologies. For example, Joseph Bower speaks to how disruptive technologies can transform an industry (Bower, 2002), and Milan Zeleny speaks of how disruptive technologies can cause resistance, not to the technologies themselves, but to the change they bring to people already reliant on the current dominant system to thrive in the changing of language and practice (Zeleny, 2009).

When one thinks through disruptive technology theory and then introduces its techniques to traditionally ordered processes, like curating art exhibitions, a space opens up wherein experimental enquiry can take place. Many cross-disciplinary practitioners write in this way about the emergence of technology and its effects on

[1] www.newmediacuration.com. Accessed 29 February 2012, 08:43.

[2] http://www.au.dk/en/facultiesdepartmentsetc/humanities/aest-fag/. Accessed 29 February 2010.

aesthetics. As with any emergent technology, some fear it (for example, Sherry Turkle), others embrace it (Julienne Greer), and eventually a co-existence emerges that challenges the previous dominant norm. The effects of technology on the body and on works created performatively are of particular significance to this study, and are examined in particular by artists like Stelarc[3] or Erin Manning[4]. Many of these disruptive techniques were previously initiated and observed by Turnbull Tillman and her mentors and collaborators through the Beta space project, but also in her current research environment at the Creative Robotics Lab (CRL) at the National Institute of Experimental Art (NIEA) at the University of New South Wales (UNSW).

Beta_space: a disruptive force for curating in The Museum

The problems associated with digital interactive art include its immateriality and repositioning of time and space, thus making the act of authenticating one's interaction with it problematic. As discussed in Graham and Cook (2010), these problems place a particular need on the curator to revise traditional practice. Relevant recent work in this field includes that of Ernest Edmonds' research group the Creativity and Cognition Studios. Through their work in Beta space, a publicly housed laboratory at the Powerhouse Museum, Sydney, they have set up an infrastructure, a methodology for measuring experience and emotion in digital interactive art. The writings about this work form an important basis for the PhD research. Reports on the curatorial practice of Lizzie Muller, Matthew Connell, and Deborah Turnbull Tillman all detail the making and evaluating of interactive art at various iterative phases in a public laboratory. Lizzie Muller's PhD and related writings report the core research that forms the background to this study (Muller, 2010). The significance of the Creativity and Cognition Studios work was innovation in:

1 bringing the work out of a university lab and into the public domain before it was finished (Muller, L., Edmonds, E. and Connell, M. (2006)

2 establishing a set of criteria for measuring audience experience (Bilda, Z., Candy, L., and Edmonds E. A. (2007))(Costello, B. (2007))

3 offering this process to the public as an exhibition on display for public consumption (Turnbull D. and Connell, M. (2011) p. 79-93).

4 taking these processes out of the realm of culture and into the community as creative practice for corporations and institutions as well as artists and curators (Muller, L. et al, (2006)(Turnbull, D. (2011)).

5 producing three models for curating digital interactive art, two of which hold preliminary criteria for exhibiting digital and interactive art (Turnbull, D. and Connell, M. (2014) p. 221-241).

These activities are best captured en masse in Candy and Edmonds' book *Interacting: art, research and the creative practitioner* (Libri, U : 2011). This publication not only details the methodologies followed during the 7 years Beta space was actively programmed in the museum, but provides a history of digital interactive art, with Candy and Edmonds outlining the current categories, aesthetics, influences, paradigms, creative spaces, and cultural shifts in relation to the artist and audience the producers and consumers of art (Turnbull, et al., 2015).

Inside the Creative Robotics Lab (NIEA, UNSW)

Where her work at the Creativity and Cognition Studios strongly informs her independent practice, it is but one of many places interested in investigating the potentially disruptive nature of prototyping. In her current research environment at the Creative Robotics Lab at NIEA, UNSW, Turnbull Tillman has again found that artists and technologists are working closely together to create technically sophisticated, but artistically subtle, prototype artworks that engage and respond to the humans interacting with them. Dr. Mari Velonaki, co-author and director of the CRL, is currently collaborating with the Object Design Centre in Sydney on a prototype curatorial project through CUSP.[5] CUSP, curated by Object's Creative Program Manager Danielle Robson, is a platform whereby artists can present their design ideas regarding the way we inhabit the world as humans within a complex set of digital systems. Sometimes in institutions, sometimes out in the cityscape, CUSP is pushing the boundaries of experimental design practice to see what designing the future might be like for artists, technologists, engineers, and architects.[6]

Where Velonaki has previously participated in CUSP in presenting talks on a train that runs from Central Station to Casula (Talks in Transit series), a more recent work of hers is being presented in a prototype way as "chapters" across several venues, the first currently exhibiting at the State Library of ueensland.[7] The work that Velonaki and her technological collaborators are staging at various stages in CUSP is called *Blue Iris*. This is an interactive work that presents like digital wallpaper, but acts as a both a repository and narrator for those who participate with it. It activates the histories of buildings and their occupants by itself occupying space and recording how spaces and surfaces are experienced by audience via engineered screens comprised of thermo-

[3] http://stelarc.org/ . Accessed 18 December 2014.
[4] http://erinmovement.com/. Accessed 18 December 2014.

[5] Mari Velonaki. CUSP. http://cusp-design.com/designer/mari-velonaki/. Accessed 8 December 2014.
[6] CUSP. http://cusp-design.com/about/. Accessed 8 December 2014.
[7] CUSP @ State Library of ueensland. http://cusp-design.com/event/cusp-state-library-of-queensland/ . Accessed 19 December 2014.

chromic/thermoresistive patterns and a gold nano-particle-based floral motif.[8]

Velonaki finds the prototyping process disruptive in the making of digital interactive art. The physical disruption, however, takes a backseat to the rewards gained from discomforting herself and her team. This discomfort extends to the exhibition phase, where she feels no one is really happy with the prototype being on display because it is not yet representative of the bigger picture everyone has in mind. In living this discomfort, she also finds the process invaluable. In being exposed in this way, in exhibiting a raw model of her aesthetic ideal, in fashioning a "good enough" version of the idea and then standing back and releasing the concept as a simpler version/form of the whole idea to the audience, she, as the designer, becomes removed from it. Velonaki can let it be experienced this way because she knows that the feedback from this process will inform future design decisions across the team. Together everyone, the artist, the engineer and the computer scientists, have all taken a step back and viewed how the audience engages with the work. Velonaki now finds this incremental processing so fundamentally helpful that she wouldn't do it any other way. The discomfort has become more ideologically disruptive, with the rest becoming and remaining her process.

One of Velonaki's collaborators, mechanical engineer David Silvera-Tawil, considers the prototype process to be incredibly disruptive, particularly in terms of construction briefs. In the engineering world, prototypes to test an idea can be 'quick & dirty' with minimal consideration to aesthetics. Alternately, one of the predominant concerns of any collaborating artist would be aesthetics, so ensuring a prototype system looks cohesive enough to both exhibit and engage/hold an audience is a challenge. In participating in this interdisciplinarity, Silvera-Tawil thinks of research outcomes first and what they might learn from the project as a whole. Where he finds creative prototyping "incredibly disruptive" to his engineering practice, he also finds much value in approaching these challenges differently then he would traditionally, with the end goal of producing a different kind of data set or a different kind of new knowledge.[9]

Curating as a disruptive technique: posited methodologies

As a curator, representing institutions and funding bodies whilst also working quite closely with artists and technologists, disruptions come in different forms those of observing, recording and analyzing the intentions, actions, and reactions of artists, technologists and audience members. The PhD study by Turnbull Tillman proposes to reflect on a series of her exhibitions, treating them as curatorial prototypes for analysis in order to form the foundation of a larger iterative cycle involving practice-based research and curatorship. The three exhibitions proposed for analysis are:

1] Memory Flows, Sydney Olympic Park Authority (May 2010) http://www.newmediacuration.com/projects/past

2] Grid Gallery, Ausgrid (June 2010) http://www.newmediacuration.com/projects/past

3] genart_sys, the Australia Council for the Arts (Jan 2011) http://newmediacuration.com/genartsys/ @genart sys

This analysis becomes important in relation to the question of authenticity and accessibility when a curator is faced with issues like a second iterative cycle of the same group of artworks. If one wanted to re-create the conceptual message of original exhibitions in another space, analysis of the first iterative cycles would assist in curating the next cycle, which would lend to an authentic experience of the artworks via a stronger transmission of their message. The results of this formal analysis will inform 2 new case studies featuring:

1 a time-based and distributed performance in Sydney, Australia featuring emergent practitioners from UNSW | Art & Design's student body. Audience experience will be measured, data collected and analysis performed.

2 an exhibition in the UNSW Art Design gallery spaces featuring time based and interactive works by established practitioners where the audience's experience is measured, the data fed back, and analysis performed.

The methodology to be employed for the case studies will be practice-based, drawing upon the action research approach (Stringer, 2003). Stringer's approach of LOOK - THIN - ACT is based in social reform and draws on Lewin's "spiral of steps" that attempt to depict "comparative research on the conditions and effects of various forms of social action, and research leading to social action." (Smith, 1996). Johnson, a social scientist from the 1970s, has revised Lewin's spiral utilising words such as UNFREEZING - CHANGING - REFREEZING.

It is important to note that these research cycles are modifiable and iterative and may be performed more than once during the inquiry into authenticity of audience's experience of the work. When applied to the proposed case studies, it is expected to follow the below flow, attempting to capture affect and expression both at the prototype and final exhibition phases, so that the resulting criteria might be useful despite the stage of production:

1 *time-based and distributed performance in a public space utilising prototype interactive works produced by emergent practitioners; ie/ students. The audience's experience will be measured and the data collected and analysed:*

[8] Blue Iris. https://www.sites.google.com/site/silveratawil/Research. Accessed 18 December 2014.

[9] Views expressed by David Silvera Tawil in an interview with Deborah Turnbull Tillman on 8 December 2014, 11am-12:30pm.

Lecture and work with the students attending the studio courses at a post-graduate level - watch the way they work to produce artefacts ideas - perform evaluation on their prototype pieces - act by providing feedback in terms of conceptual and physical design for the spaces where the works will be exhibited - allow for development and revision of these ideas - plan themes and exhibitions based on the end results of these studios - exhibit the works as planned - document this exhibition via photography and video -> evaluate the audience's experience of these works - collate and analyse this evaluation - establish a set of criteria for performing these tasks in future - repeat these tasks in a second case study with an improved knowledge of the experience

2 *an exhibition in the UNSW Art & Design Galleries UNSW Art & Design with established practitioners featuring time based and interactive works where the audience's experience is measured and the data collected and analysed:*

Establish relationships with select artists with an established practice - visit their studios/workspaces and watch the way they work to produce artefacts ideas - perform evaluation on their prototype pieces - act by providing feedback in terms of conceptual and physical design for the spaces where the works will be exhibited - allow for development and revision of these ideas - plan themes and exhibitions based on the end results of these studios - exhibit the works as planned - document this exhibition via photography and video -> evaluate the audience's experience of these works - collate and analyse this evaluation - establish a set of criteria for performing these tasks in future - publish the findings of both case studies and attend conferences to deliver new knowledge discovered (Turnbull, et al., 2015).

Conclusion

The proposed outcomes of this study will be a set of criteria for curating digital interactive artworks, taken from exhibitions, events and happenings, and distributed via publications like this one. These criteria will be determined by applying an iterative and action-based approach to analyzing techniques disruptive to an already experimental curatorial practice situated within the contexts of experimental fine art, creative robotics research and business theory. The main aim is to understand the benefits of these disruptions of iterating, evaluating and modifying within a curatorial framework. Though discomforting, these techniques are already assisting artists, curators, and institutions to embrace their own discomfort around engaging with prototype and speculative design practices at any stage in its iterative cycle, encouraging the recreation of experience authentic to the moment an audience engages with and influences a work. This will ultimately provide practitioners with innovative methodologies that though disruptive, hold the potential to generate new knowledge, some of which may already be embedded in the action research of New Media Curation.

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Identifying community resources using data mining, crowdsourcing, and networked co-curation

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Abstract

The curatorial process is typically an expert led endeavor that requires extensive content review and judicious selection to assemble an archive of shared cultural value. Recent innovations in digital social curation open up new opportunities for non-expert participation in assembling collections, although challenges remain in terms of maintaining quality, straddling expert and amateur goals and integrating disparate and related efforts. In response, we present a flexible online web application designed to computationally support collective curatorial decision-making across diverse communities of interest. Findings from a 10-week deployment with a technology-arts community point to the utility of the system in accurately identifying and recommending useful content.

Keywords

Crowdsourcing, digital curation, network co-curation, community resources, art/science

Introduction

The act of curation is typically associated with expert identification and interpretation of critical cultural artifacts experienced in museums and galleries. The process of collecting, and explaining cultural archives presents implications for memory making [1], identify formation [2], and individual and institutional power [3]. Recent innovations in social computing, the digital humanities, and online curation have opened up new opportunities for expanding the remit, roles and activities of curators, communities and audiences.

Of particular current interest are social bookmarking platforms such as Delicious and Pinterest, which have given rise to the notion of online crowd curation [4]. These platforms serve to diversify the spectrum of individuals adopting curatorial practices, leading to the emergence of previously unknown arbiters of taste and cultural value. However, these platforms typically empower individuals to self-select and identify content of relevance and interest to them. While these amassed lists of content may have general or broad relevance to a community of interest, they are not typically authored explicitly for them. Additionally, these online environments lack collaborative features to allow a group to collectively identify resources of relevance and only allow informal opportunities for a community to highlight those resources which are of use and relevance to them.

Yet communities of interest regularly identify, disseminate and exchange online resources and such practices are visible and apparent in the regular interchange between community members in online social platforms such as Twitter. While these platforms are not intended as a breeding ground for curatorial practice, there is a wealth of information, as well as social metadata, that can be co-opted for such an endeavor.

In this work we explore the use of a mixed method approach combining crowdsourcing and automatic computational methods to augment and support traditional expert led judgments for digital resource curation. We propose mining Twitter to identify potential resources on an ongoing basis, the adoption of crowdsourcing techniques in combination with machine learning approaches to recommend resources for inclusion, and finally computer mediated review to aid in the organization of accepted content into a structured archive. Through this process we seek to distribute the curatorial effort across a diversity of community opinions, while creating value and reward for participation.

We present the design and implementation of our approach, developed in collaboration with a small and emerging art/science community with a strong interest in creating a shared repository of useful and diverse resources. Beginning with a review of related work, we next introduce our approach integrating community-led activities and algorithmic processes. Our system is implemented as an online web application and we describe findings from a 10-week study with fifty members of our collaborating community. We conclude our paper with a discussion of our results and details of ongoing and future work.

Background

There is a recognized need for curated community archives to enrich a shared understanding of the nature and practice of art/science integration [5, 6]. Several past efforts have explored the development of a reference space to coordinate this emerging interdisciplinary community. Notably, the late Stephen Wilson maintained an extensive online

repository of art/science projects, which was additionally compiled into several books [6, 7] while organizations such as Rhizome offers an online database of new media works and artist profiles. While valuable, these initiatives present some limitations. In particular several of them have been driven by a small number of individuals with a leadership role in their preparation and maintenance. Thus, the potential scale and scope of the archive is limited by the availability of their time. Additionally, as these archives grow, so does their complexity, placing significant burden on those gatekeepers to successfully sustain and maintain them.

Curation typically describes the expert led process of identifying, organizing, and explaining content of cultural or communal value. As a professional practice it is well understood within the context of a museum, gallery, or in the art world. It is however far less established in the digital domain and there are many challenges present in this nascent practice. Specifically, Botticelli notes that digital curation is marred by a lack of specificity as compared with its more traditional counterpart, owing to ”lack of established standards and best practices” and that there are “significant gaps in [the needed] skill set relative to the demands of curating data collections” [8]. This motivates the development of new digital techniques for this context and in response, Sabharwal offers “*networked co-curation*” [9] as a means to decentralize the curatorial process and to collaboratively amass content of shared value on an ongoing basis. The heart of this is a democratized, decentralized and collaborative approach to digital curation. While it raises issues of inconsistency and quality, it provides mechanisms to enrich public discourse, identify emerging knowledge, and increase access to cultural volumes.

While distinction is often drawn between the traditional practice of curation and its social online counterparts, networked co-curation clearly overlaps with many online strategies for information management and connoisseurship found on the social web. While these ‘lightweight shared spaces’ may be more ‘tastemaking’ rather than actual ‘authorial act’ [10], the social web still has much to offer. In particular, it provides technical platforms whereby institutions can leverage ‘amateur’ interest and ‘extend the reach, use, and usefulness of their own collections’ [11].

Networked Co-Curation

Our approach combines human and machine decision making within an emerging form of curatorial practice. First, we propose a flexible technical solution for recommending prospective content blending content mining, content weighting and collective action. This technical approach is implemented as an online web delivered application and is readily adaptable to a variety of use-cases, domains and contexts of use. Secondly, we ground the design of our solution within a clear user-centered experience, with direct support for outreach, feedback, and distributed verification tasks.

Using our web application, we created a Twitter account and selected a variety of high-profile art/technology accounts to follow. On an hourly basis, the public timeline for this account was reviewed and any tweet with a URL was retained. In order to rank the collected content, we used two particular measures to determine the likelihood that each shared link was a good resource – the number of unique sources sharing the link and the total number of shares. Assuming that multiple individuals within the network shared a single link, there was increased value ascribed to it based on the explicit action to disseminate it. Where more sources of community content had distributed a single link, it was assumed that it had increased relevance for the community. Once the content was collected and ranked, the online web application then began the community review component. The system periodically contacted participating community members asking them to perform a targeted review of the discovered content. Community members were notified of the set of new review assignments by email, where they could click on any of the assignment links to bring them to the application login and subsequent review page.

Figure 1. Review Interface

Figure 1 depicts an example review screen for an assignment for a community member helping to curate arts/science resources. Here, the link to be assessed was displayed within an iFrame, allowing the actual link content to be viewed alongside the rating functionality. The member could also chose to load the content in a new window if they wanted to examine the content in depth and in full context. Community members were asked to rate the content according to the review criteria developed by the curatorial community of interest (e.g. in Figure 2, the art/science community curators requested yes/no/unsure rankings on the ‘usefulness’ of the linked content, where additional instructions were provided via the “What is a

useful resource link?"). After completing an assigned review or set of reviews, the option to review additional content was presented. In this way, members were encouraged to contribute above and beyond the set number of reviews assigned to them each week.

The individual decisions by community members contributed to a combined score for the content. Recommendations for inclusion incremented the score by 1; 'unsure' did not alter the score; while an exclusion recommendation decremented the score by 1. The cumulative score was then used to provide a community driven recommendation to guide the community curator's ultimate decision. Community curators were expert members in leadership positions as defined by the participating community. A minimum of three community reviews was required before the rated link content was submitted to a community curator. Community curators arbitrated and guided the decision making process, relying on input from the community along with their own domain expertise and knowledge. To this end, the system separated community reviewed items into two categories for curator review: 'clear cut' decisions, and 'controversial' content. Community curators were notified daily with a list of the controversial community decisions that required their attention. The community curators review constituted a final decision on inclusion or exclusion to the resource database. However, the curator had to include a brief rationale for his or her decision to enhance decision making transparency and support ongoing community training.

System Implementation and Evaluation

Our system is currently implemented as part of the NSF sponsored XSEAD initiative (http://xsead.org), providing an online collaboration and presentation platform for a multidisciplinary community of art/science practitioners, critics, and researchers. Between February 2014 and March 2014, our system was deployed over a ten-week period with forty-eight participating community members and two community curators. These participants were opportunistically recruited through known networks of relevant individuals and through social media. During the ten-week study deployment, the system emailed community members on a Monday and Wednesday asking them to review and make judgments (yes, no, unsure) on three suggested art/science resource links. The two community curators received daily notifications asking them to verify or resolve disagreements based on community recommendations. Included items were made immediately available in online archive that was publically assessable both as a HTML page (see Fig. 2) and as an RSS feed. On Friday evenings, community members received an email thanking them for their participation, as well as giving them feedback on their decisions as verified or resolved by the curators. At the end of the ten-week period, a questionnaire was distributed to all community participants investigating their perception and experience of the task. In total, ten participants completed the distributed questionnaire.

Figure 2. Archive of included resources

During the initial system rollout, 81 Twitter accounts with broad relevance to the designated art/science community (primarily US focused) were identified and followed by the project's account. These represented well regarded art/science institutions, initiatives, creative hubs, and individuals. These accounts shared a total of 13,366 distinct links representing an average of 196.14 per source. A total of 1202 assignments were sent to community members, requesting ratings for a total of 310 distinct art/science links. Of those 752 (62.56%) were completed by the community members.

Although assignments were generally completed within the same day as the email request, some users preferred to complete several sets of reviews at a later stage and en masse. Review assignments were typically completed within 4.52 days of the original request. This is reflected in the community members questionnaire responses, with one member noting *"I completed the reviews for the first email that got sent out and then sort of "binge completed" the rest of them up to a point."* A total of 1,766 ratings were completed during the study period for 811 unique links. While community members had the option to indicate if they were unsure of a rating decision they rarely did so. This constituted only 85 of the reviews made, or 4.8% of total ratings. 955 reviews recommending exclusion were made and 726 advocated for inclusion, with each user contributing an average of 33.4 ratings.

In total, the two community curators made 982 decisions on content links, selecting 234 links for inclusion and rejecting a further 748 links. While this represented a rela-

tively shallow inquiry into the total pool of socially shared links (7.4% of the 13,336 mined archive was reviewed), the process was effective in identifying useful content and supporting continuous growth of a shared archive. With a reasonably small pool of curators and community reviewers (50 total), an average of 23.4 resources were found per week. For judiciously selected content, this represents a solid growth rate.

Responses collected via the community member questionnaires highlighted some useful findings on the community feedback approach. Seven of the ten respondents agreed that the review was interesting to them and presented content relevant to the task. Five respondents indicated that the presented content was relevant to their field (and commented that it offered them an enriching perspective on art/science integration: "*I gained new perspective on science/art connections and found new resources for my own research.*" However, participants indicated mixed views on the task understanding with responses well distributed with one participant remarking: *"I didn't really know who the end user of the platform was intended to be at first"*. Participants were similarly mixed in their perceived self-efficacy. While half of the respondents felt they were confident in their decisions, the other half were unsure or unconfident.

Discussion and Future work

In this work, we have explored techniques for digital curation to support the assembly of scalable archives that are responsive to emerging knowledge. It is important to remember that curation is an end-to-end process that encompasses content identification, synthesis, organization, preservation, explanation and communication. As such, the technical model and user-experience we describe in this work represents a preliminary step in a larger research endeavor.

We acknowledge that curation is a complex problem space that goes beyond content discovery and recommendation. It requires not just careful selection of content and meticulous organization, but also the inclusion of explanation so that the value and significance of the assembled content may be recognized. As such, curators must not only prepare the archive but also need to provide a context to the items they curate and synthesize structures so that value can be found at multiple levels. This offers a particular challenge for the next stage of our research.

Within this work, we have explored the opportunity to leverage social multimedia, social web mining and collective action in tandem to facilitate the co-curation of shared archives. This work also reflects how the solicitation of 'amateur' expertise and computational support can greatly assist expert led curatorial practice. Although, we have presented mechanisms to assist the pro/amateur curator, there are still several open questions on the best mechanisms to engage, motivate and continuously educate community members in co-curating shared archives.

As part of the ongoing work with this project, we are now preparing a significant revision to the online platform based on these findings. While we will continue to explore mechanisms for improved resource identification, as the archive begins to scale new challenges and opportunities emerge for research in this space. In particular, the complexities of managing, maintaining and organizing continually growing community archives will become increasingly important. As part of this ongoing work, we expect that new strategies for continued participation, motivation and engagement of community participants will become particularly important in fostering community stewardship for shared co-curated archives.

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DIY Instruments and Sound

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A Pioneer of Interactive Art: Nam June Paik as Musique Concrète Composing Researcher

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Abstract

Nam June Paik is mostly known as the father of video art. At the same time, he can also be regarded as a creative pioneer of interactive art. Unfortunately, most scholars and art historians still neglect Paik's remarkable achievement in interactive art with his musical background. Especially, Paik's experience with Musique Concrète was a core springboard to develop his interactive pieces. However, among Paik's artistic backgrounds Musique Concrète is hidden by well-known influences from John Cage, Karlheinz Stockhausen and Fluxus. Based on Musique Concrète, Paik created basic elements of interactive art such as database, non-linearity and sensorial translation at Paik's first solo show, *Exposition of Music – Electronic Television*, in 1963. These are still considered fundamental properties to make interactive pieces. In this regard, Paik as an interactive artist can be a significant contribution to finding an origin of interactive art since art theorists have started to explore its genealogy.

Keywords

Interactive Art; Musique Concrète; Nam June Paik; Random Access; record Shashlik; Participation TV

Introduction

Even though Paik is not generally considered an interactive artist, it is not altogether a new idea to see him as a pioneer of interactive art. Some interactive artists and theorists agree with Paik's importance to this field. An artist duo Christa Sommerer and Laurent Mignonneau frame Paik's *Magnet TV* (1964) as one of the oldest interactive artworks, in which viewers are invited to manipulate images on television by using a powerful magnet. [1] Art historian William Kaizen describes how Paik tried to overcome the passive aspects of mass communication by using a microphone as a visual manipulation interface in *Participation TV* (1963). [2] Christiane Paul argues that Paik anticipated the revolution of non-linearity in digital art through *Random Access* (1963). [3] The project displays cassette tapes on the wall, which allows audiences to playback the sound with a hand-held head of a cassette recorder. Errki Huhtamo considers Paik's responsive "cybernetics" sculptures and closed circuit video-installations points of origin for interactive art. [4]

Although these artists and scholars contend that Nam June Paik is one of the significant pioneers of interactive art, they do not profoundly explore how his background encouraged him to make interactive art, and how he developed interactive art without any preconception about typical interactive pieces. Fortunately, Paik wrote his idea about interactions and interactive art in several books and magazines. In his articles, his interactive art simply did not originate from a technophile's passion, but a gradual development based on his art theories and art practices in the academic fields in both Asia and Europe. In other words, this paper does not describe a genius's creative method to make interactive pieces. Instead, it deals with the energetic artist who gradually developed his idea of making interactive art. The progressive musical influences from Arnold Schonberg's serialism, Karlheinz Stockhausen's electronic music and John Cage's indeterminate music to Paik are relatively well known in books and articles about him. Unfortunately, Musique Concrète is usually omitted in those literatures. However, in a material perspective, the music is regarded as an early influence to a video collage. [5] In this regard, video artist Bill Viola stresses the inherent difference between film and video. Whereas film chemically comes from photography, video electronically derives from music. They share the same electromagnetic technology. [6] While Viola explores the material relationship between video and music, Chris Meigh-Andrews historically traces the relationship between Musique Concrète, Fluxus and video art [1].

[1] Chris Meigh-Andrews traces the relationship between Musique Concrète and video art in chapter 5 "Musique Concrete, Fluxus and Tape Loops". A History of Video Art : The Development of Form and Function. (Oxford: Berg, 2006). In the chapter, the founder of Musique Concrète, Pierre Schaeffer, was described as a seed germ for the experimental phenomenon. The author also

Especially, before the Cage shock, the exploration between Musique Concrète and Nam June Paik can articulate how Musique Concrète influenced Paik's interactive art. By tracing the relationship between them, Paik's contributions to interactive art can be reappraised.

Nam June Paik in Both Music and Musicology

Nam June Paik studied diverse courses from philosophy, aesthetics and musicology at the University of Tokyo. He was overwhelmed by the twelve-tone serialism, in which duration, pitch and color were aspects of the same thing, [7] since he had been in high school. In the description of his project, *My Jubilee Ist Unverhemmet* (1977)[2], he confessed that he was disappointed in Schonberg's piece when he listened to it first. The reason why he likes Schonberg is that he is extremely progressive. Schonberg gave Paik very ambivalent feelings. However, Paik still dreamed to be a musician with Schonberg's progressive method. He graduated from the University with the thesis on Arnold Schonberg's serialism. After being rejected from a music competition in Japan, Paik decided to study musicology, which is mainly in a theoretical field, instead of music, which is mostly in a practical field. In 1956, when he went to Munich to study music history[3], he could change his mind because he thought, "I can compose at least as bad as they do." [8] This study abroad experience thoroughly encouraged Paik to study music in a practical way and demystify the absolute Western music. This fluctuation led him to simultaneously study music in both a theoretical field and a practical field. In 1958, he went to the Musikhochschule Freiburg in Cologne to study music in a progressive way. Professor Wolfgang Fortner at the school referred him to the Studio for Electronic Music of the West German Radio where electronic music was born. In his reference paper, professor Fortner mentioned that Paik was interested in Pierre Schaeffer's experimental music in the beginning of 1959. [9]

Musique Concrète

Musique Concrète was a progressive music style in Paris during the late 1940s created by Pierre Schaeffer. He coined the term to "compose with materials taken from given experimental sound in order to emphasized our dependence, no longer on preconceived sound abstractions, but on sound fragments that exist in reality and that are considered as discrete and complete sound objects." [10] Schaeffer created the database music with recordings of daily-life sounds like bells ringing, trains, and humming tops, which were manipulated using various sound editing techniques, including reverse recording, changes of speed and removal of the attack and decay, recording loops of these sounds onto discs. [11] This experimental music incorporated using noises and daily life sounds as well as a manipulated sound database. The blurring boundary between life and art was also a main idea of a global avant-garde art group, or Fluxus. Nam June Paik who was one of the early Fluxus members had the same idea, and independently studied Musique Concrète. [4] By using prerecorded sounds, a composer does not need a skilled musician any more to make a final sound. Instead, he can create music with his wide range of database. This appropriation method breaks an interrelationship between signified and signifier as Marcel Duchamp's conceptual art. This is a very phenomenological experiment due to direct sound experiences without visual and contextual references. Even though Schaeffer could not eradicate the indexical point from the objects, he made a creative way to mix readymades in the sound field. [12] Unlike Duchamp's conceptual art, Schaeffer experimented with a lot of databases, which consisted of more than 500 records in 1950. [13] After the records project, he adopted slicing tapes between two different sound data with the same envelopes[5] to make a smooth transition by using tapes instead of 78 rpm records after 1951. [14] This new medium provides audiences with a soft montage sound. Ultimately, he dreamed a huge cybernetic-like machine that could achieve millions of combinations. [15] This haptic manipulation and cybernetic idea based on a huge database are the main elements for Paik's interactive art such as *Records Shashlik* (1963) and *Random Access* (1963). To articulate these elements, Nam June Paik as a Musique Concrète composing researcher is an important approach.

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emphasizes the material similarity between Musique Concrète and video art. After that, Meigh-Andrews stresses John Cage's critical influence to Fluxus and video art in the chapter.

[2] The project is a hundred of limited editions of the LP records.

[3] Paik continued to study philosophy, aesthetics and musicology as he did in Tokyo. *Nam June Paik Fluxus/Video* includes his study books, which shows courses that he took in the University of Munich. However, Decker simplified his courses as music history. In *Video n' Videology*, Paik wrote his academic career in German from 1956 to 1958. However, he continued to study music in the University of Cologne from 1960 to 1962.

[4] Nam June Paik and George Maciunas were interested in the progressive music before they knew each other. Refer to Friedman. Ken, *The Fluxus Reader*, (Chicester, West Sussex ; New York: Academy Editions, 1998), 183-184.

[5] It is hard to mix two different sounds because each sound has its own envelopes. To reduce a spectral transposition, Schaeffer connected with each other by finding similar envelopes. Refer to Palombini. Carlos, Machine Songs V: Pierre Schaeffer- From Research into Noises to Experimental Music, (Boston: The MIT Press, Computer Music Journal Vol. 17, No. 3, Autumn, 1993), 15.

The Relationship Between Nam June Paik and Musique Concrète

Nam June Paik posted his articles about new music in a Korean newspaper[6] several times when he studied musical composition in Cologne. He was also a foreign correspondent for two music magazines in Japan[7]. In this regard, he introduced progressive European music tendencies to Korean and Japanese readers. His exhibition catalogue, *Nam June Paik: Videa 'n' videology, 1959-1973*[8], included a copy of Paik's article from the Korean newspaper in the appendix part. A simple description in English was added to the article: *1958. "A report on the Paris studio of Pierre Schaeffer and Musique Concrète." Chayushinmun, Seoul, Korea*[9].

Since the article is not translated from Korean into English, most Western scholars cannot understand what the article means. However, the English description significantly provides them with an important clue to the relationship between Paik and Musique Concrète. Furthermore, the content of the short article includes critical elements to trace his influence from Musique Concrète. First, Paik has deep knowledge on the trajectory of the progressive music that is composed with records and tapes. He enumerates diverse composers who use records and electronic music such as Paul Hindemith, Pierre Boulez, Pierre Henry and Karlheinz Stockhausen to explain what Musique Concrète is in the article. Second, he titled himself as a Musique Concrète composing researcher at the end of the article. It explains that he was seriously engaged with the new experimental style, and studied not only about the theoretical method of Musique Concrète, but also about the practical method of composing it. Third, the main title of the article is 'The Foremost Contemporary Musician Who Gives Power to Noise.' The title implies that he is interested in noise, a daily sound, as a key element of music. In this regard, it predates two important influences of his artistic life such as John Cage and Fluxus. Paik's interest in Cage's chance music, which not only incorporates noise in music, but also is theorized with Asian philosophy, the Zen Buddhism. The progressive penchant continues Paik's Fluxus participation, which blurs a clear boundary between art and daily life. Paik's passion of unity toward tones in serialism was expanded to unity between noise and music.

For Paik, the year when he wrote the article is very meaningful. First, he moved from Munich to Cologne to study more progressive music. Second, he finally met John Cage in the yearly International Holiday Courses for New Music in Darmstadt festival in 1958. [16] Third, he also changed his major musicology into music composition in the same year. This was the year that Paik started to create experimental works, especially *Homage à John Cage*, which consists of a diverse sound collage like Musique Concrète[10]. Even though the article is short in a Korean newspaper, it predicts Paik's future toward Musique Concrète and electronic music. After the article, he performed as both an independent artist and a collaborator with his contemporaries in Germany. Especially, in Stockhausen's *Originale* (1961), as a guest performer, Paik practiced the idea of Musique Concrète with a sound montage from two recorders as well as throwing beans into the audience to fight against bourgeois music. [17] Paik expanded his action music with the idea of Musique Concrète.

The Idea of Paik's Interactive Art

Interactive art is mostly under the umbrella terms, digital art, computer art, or new media art. Interactive art is still ambiguously characterized by artists and scholars alike. Unlike painting, sculpture, or ceramics, interactive art is seldom a discipline that is represented by academic departments in institutions of higher education in the United States. When represented, the field is usually included in art and technology, digital media, emerging art, or digital art. Due to the lack of academic foundation, art historians and theorists hardly consider interactive art as a separate field of artistic research and practice. This fact has been instrumental in the lack of attention paid to interactive art in the academic discipline of art history. Compounding this is the myth that interactive art relies exclusively on computer devices. Art historian Soke Dinkla proposes that "interactive art refers to a category-specific designation for computer-supported works in which an interaction takes place between digital computer systems and users." [18] On the other hand, "some authors ask whether computer-supported art should even be called interactive at all, insofar as there are numerous art forms that activate the recipient to an even greater extent without the support of technical media." [19] In this regard, interactive art is not fixed yet, and it can be a comprehensive definition, which understands interactive

[6] The newspaper was Chayushinmun, which means liberal newspaper in English. The company was owned by Paik's big brother.

[7] http://www.ohmynews.com/NWS_Web/View/at_pg.aspx?CNTN_CD=A0001872542. This fact was posted by Hyungsoon Kim from a Korean newspaper, *Oh My News* in June 5, 2013

[8] The Everson Museum of Art, (Syracuse; and Galeria Bonino, Ltd., New York), January, 1974.

[9] Since the article has a number of binary code page in the catalogue, the translation the binary-code number into the decimal-code one is 83.

[10] *Nam June Paik: Videa 'n' videology, 1959-1973,* The Everson Museum of Art, Syracuse; and Galeria Bonino, Ltd., New York, January, 1974. 81

art more generally as that which involves the behavior of participants in the final outcome of a work.

In this regard, Cybernetics, which is one of the most important elements in interactive art, fundamentally supports defining interactive art. Originally, in 1947, Norbert Wiener coined the term Cybernetics from the Greek word *kubernetes*, or "steersman." According to art historian Edward Shanken, "The scientific discipline of cybernetics emerged out of attempts to regulate the flow of information in feedback loops in order to predict, control, and automate the behavior of mechanical and biological systems." [20] In the same context, art historian Katja Kwastek insists that cybernetics opens up new perspectives on processes of interaction. [21] Paik philosophically explained what cybernetics is with the Buddhist ideas like Karma and Samsara, which means relationship and metempsychosis.

> *Cybernated art is very important, but art for cybernated life is more important,*
> *and the latter need not be cybernated. . . .*
> *Cybernetics, the science of pure relations, or relationship itself, has its origin in*
> *karma. . . .*
> *The Buddhists also say*
> *Karma is samsara*
> *Relationship is metempsychosis* [22]

Cybernetics can be interpreted as the Buddhist idea in two different ways. First, cybernetics can explain a relationship between human beings as well as a relationship between a human and a machine or computer. In this regard, Paik's cybernetics has a concrete relationship with relational aesthetics, which Nicolas Bourriaud defined. This art also needs a viewer's interaction. However, the interaction is more related to a social relationship by breaking a link between daily life and artwork and between a participatory project and its participators. Relational aesthetics does not need any electronic devices to interact with as Paik interpreted. Second, metempsychosis can be translated to a relationship between 0 and 1, or on and off in the digital age. Paik's idea on cybernetics incorporates any relationship from human beings to high-tech electronic devices. For these reasons, Paik's interactive art has both qualities from interactive art and relational aesthetics. This perspective can contribute to bridging the gap between these two different fields now.

Musique Concrète as Inspiration for Interactive Art

Paik explored how to give audiences more choices to make them more active. As a result, he planned a specific music environment.

> *In 1961, I have written a sketch to the "Symphony for 20 rooms", where the audience has a choice of at least 20 different sound sources, between which they can freely circulate. The free time leads the music necessarily to the space-music (room-music) because the free time requires more than two vectors (directions), and two vectors constitute necessarily the space (room)*. [23]

The unrealized exhibition consists of sixteen imaginary rooms in which viewers are invited to experience various senses from acoustic, visual, tactile, and olfactory events, which popular multi-sensory approaches now prevail in interactive media labs. For example, Paik placed different media such as a live hen, readings from detective stories, walls covered with national flags and erotic underwear, prepared pianos, tape recorders with diverse sound collages, and television. [24] Audiences could choose any room in a nonlinear way, and experience diverse senses in each room. Furthermore, among the rooms, Paik suggested several rooms where viewers could take part in making sound and experiencing tactile senses from audio recorders, contact microphones on the floor and readymades such as toys, whistles and instruments. [25] Although the project does not fully provide viewers with interactions as recent interactive art does, *Symphony for 20 rooms* explains Paik's own artistic direction toward freedom for audiences. For this reason, art historian Manuela Ammer insists that *Symphony for 20 Rooms* anticipated prime importance for *Exposition of Music – Electronic Television*: the active involvement of visitors in the performances and the exhibition in general. [26]

Strangely, Paik did not mention Musique Concrète anymore in his writings. In the artistic life of Paik, Musique Concrète was hidden by other influences. Returning to the Paik's Musique Concrète article, he regards artistic phenomenon as a debauched bastard the parents of which we do not know. He deliberately thought that the progressive style was intertwined with diverse factors such as, the futurist experiments, the industrial development and so on. Paik defers to find a simple cause of the new music style easily. Instead he definitely insisted that without Schaeffer, we could not write a history of contemporary music. Paik used the same sentence with bastard in a different article to explain *Symphony for 20 rooms*. However, in this article, Paik uses the sentence in an opposite way to credit his first spatial interactive project to Cage and Stockhausen[11]. Unfortunately, he omitted the founder of Musique Concrète, Pierre Schaeffer, afterward.

When Professor Fortner referred him to WDR studio, he mentioned Pierre Schaeffer as well as John Cage in the beginning of 1959. The moment is identified with Paik's

[11] Nam June Paik, "To the Symphony For 20 Rooms", *an anthology*, ed. La Monte Young, 1963, unpaged. "With respect and appreciation I note Cage's and Stockhausen's priority in this respect; although art is often a bastard the parents of which we do not know."

other article about John Cage in the Korean newspaper. In his article, he reported Cage's chance music in the yearly International Holiday Courses for New Music in Darmstadt festival in 1958. The first meeting came to be of exceptional significance to Nam June Paik with "Silence," "Noise," "Chance" and "Indeterminacy" on Music. [27] Pierre Schaeffer vanished in Paik's writing soon after Paik met Cage. Furthermore, Paik moved into Cologne, the origin of electronic music. The long-standing Franco-German antagonism could not be neglected when Paik was in the center of the electronic music. [28] Finally, even though Musique Concrète and electronic music share similar ideas such as manipulation of tape and collage, they have different approaches. While Musique Concrète is based on phenomenology, which tries to eradicate data's indexical information, electronic music focuses on synthetic aspects of the electronic quality as well as sine wave, which is generated from an electronic device without any physical instruments. Paik's transitions from Musique Concrète to electronic music and Cage's indeterminate music naturally made Paik forget the name, Pierre Schaeffer, in his artistic trajectory.

Although Paik forgot Musique Concrète, it was apparent that he actively utilized his Musique Concrète experiences to make his early interactive pieces. To understand the relationship between his Musique Concrète experiences and his early interactive pieces, it is necessary to explain the process of making Musique Concrète.

> *There was usually a rack from which hung pieces of tape that had not yet been spliced together. Holding a strip of tape in your hand was like seeing and touching sound. You could manipulate this normally elusive phenomenon in ways that were previously unavailable to composers. It was a technological, psychological, and social breakthrough without parallel for music* [29]

This visually describes how to prepare to make Musique Concrète. From diverse musical databases, Concrète musicians choose tapes, and splice them with the haptic experience. Since Paik several times created this kind of music for his progressive performances, a collaborative performance with Stockhausen, a part of performance for the Fluxus festival and his unrealized first solo exhibition, he could not avoid the process of creating Musique Concrète with the hapticity. Paik's statement in *Decolage 3,* which his fluxus colleague, Wolf Vostell, published, supports his idea toward interactive art.

> *The audience cannot distinguish the indetermined time or sounds of the interpreter, form the determined time of the interpreter. The audience cannot fully co-feel the waiting, surprising, disappointment, hesitation, shuttering, expecting, jumping, flee, deviation, jetting, betting, choosing, pushing, being pushed back, determining, deciding, plunging into, vacant space, bathered space, common space, filled space, fully vacant space and/or(=) vacantly filled space – consummation, purge, ejection, stop, crashing, etc… of the interpreter, which all usually constitute the main substance, (or a-substance) of the conception, (or a-conception) of so-called freedom*. [30]

Paik emphasized that audiences as passive listeners could not find a difference between indetermined music and classic music since they are all a one-way performance. At the end of his statement, he mentioned that even though he highly respected for Cage and Cage-friends, he had not composed any indetermined music. He ended with the variation of Abraham Lincoln's famous phrase: "Music for the people, by the people, of the people." His aspiration toward a two-way art is reinforced by the idea of the American democracy in Paik's interactive art. [31] Finally, he applied his Musique Concrète experiences to his interactive art at *Exposition of Music – Electronic Television.*

Paik's Interactive Art

Exposition of Music – Electronic Television was held at the Galerie Parnass in Wuppertal in 1963, where an architect, Rolf Jährling resided[12]. Paik exhibited *Record Shashlik*, *Random Access, Participation TV* (1963) and other television projects, which encouraged audiences to interact with. He created interactive pieces to overcome the limitation of audiences' freedom rather than artists' freedom. In his work, passive audiences became active participators. We can read the growth of audiences' role in these projects, especially, *Record Shashlik* and *Random Access,* also meta-Musiuque Concrète pieces. They utilized the process of making Musiuque Concrète with fundamental materials of it. By unfolding the sound database in two different ways in the gallery, he gave audiences a chance to be a Musiuque Concrète composer in a nonlinear way. These converted graphical materials into sounds. In the opposite way, *Participation TV* converted audiences' voices into abstract images. This sensorial translation created a mutual interaction between different media as well as audiences' interaction with a piece.

Record Shashlik

Paik's experiments for interactive art finally led him to the nonlinear access of *Record Shashlik.* Shashlik is a worldwide food from Asia to Europe, which consists of skewers threaded with meats and vegetables. Like shashlik,

[12] Jährling partly used his house as a gallery space. However, Paik used a whole of Jährling's house as his exhibition space. Refer to Manuela Ammer, "In engineering there is always the other – The Other." in *Nam June Paik : Exposition of Music : Electronic Television : Revisited*, (Köln : New York: Verlag Der Buchhandlung Walther König, 2009), 66.

Paik threaded several records in two different axis on a table in *Record Shashlik*. He made a movable head for playing records in the rotating axis. Audiences could choose any starting point of the records. In other words, they could access music databases in a nonlinear way. They could compose an ephemeral music in real time. The method of access is similar to the process of making Musique Concrète. However, *Record Shashlik* provided an unpleasant sound between two different sources, whereas Musique Concrète presented a soft sound with montage skills. For this reason, Paik did not provide viewers with a final work, but made them take part in the process of creating a music collage. This open work gave viewers active interactions. By providing audiences with diverse choices of sound databases, Paik created his own interactive piece. This project can be regarded as an ascendant of interactive art with an electronic device, which mixes and manipulates different sounds in real time.

Random Access

Like *Record Shashlik,* Paik's *Random Access* showed how to access sound databases in an analog way. However, Paik used a different interface in *Random Access*, which was an advanced Musique Concrète storage medium, electromagnetic tape. After dismantling the tape recorder and the cassette tape, he attached the tapes on the wall, and made viewers interact with the graphical tapes using the recorder head. They could listen randomly to disturbing sounds depending on the position of the recorder head like *Record Shashlik.* However, this project allowed audiences to change the speed of reading the tape strings. Furthermore, it visualized abstract graphics on the white wall. Paik suggested a distinct interactive method in this project. He appropriated a passive white wall in the gallery to make an active interactive interface. When audiences interacted with the white wall, they manipulated sound in real time. The white wall as interactive canvas has been a popular interface for interactive art since the late 1990s as the projector has become more affordable. For example, Camille Utterback's *Text Rain* (1999) allowed viewers to interact with small colorful rain-dropping texts on the white wall as a digital mirror, which reminds us of one of Paik's early computer-generated art, *Confused Rain* (1967)[13]. They can change the position of dropping text images on the screen in real time. Ultimately, *Random Access* predicted a wall-size interactive screen as an interactive interface.

Participation TV

Nam June Paik used an inverse signal direction of *Random Access* in *Participation TV*. It allowed viewers to change their voice sounds into abstract images on television in real time whereas *Random Access* encouraged viewers to change graphical lines into a sound piece. Paik explored how to alter passive viewers into active ones by appropriating a television, the popular appliance. To escape the one-way medium, Paik used two microphones as interactive interfaces. Viewers at that time could only watch programs on television. They could not create any content or manipulate the images at all except for normal functions such as controlling brightness, contrast, saturation, and simple color corrections. Their interactions were limited to check the program schedules and to select their favorite programs. In this regards, viewers were passive audiences that had no right to change the content. Paik not only made this passive device the interactive device, but also changed passive viewers to active participants. A viewer's voice generated electronic signals. Paik used them as an input signal to draw abstract images on television. Any viewers could manipulate images in *Participation TV*. This became a very basic interface for interactive art. Most computer programming languages for interactive art such as Max MSP Jitter and Quartz provide the interactive environment as a typical example for the beginner. For example, artist and professor Golan Levin used the same interface in his interactive pieces several times, especially *Messa di Voce* (2003), which made audiences' voices generate abstract images and manipulate their shadow on the screen at the same time.

Conclusion

Paik's interactive art implies how artists can make interactive pieces based on his Musique Concrète experiences. Paik's three interactive pieces experiment with the two-way signal translations between sound and image. In his first solo exhibition in 1963, Paik had already suggested a non-linear approach, a database, a translation from sound to image and vice versa in interactive art. These became typical methods to design contemporary interactive art. Based on the methods, several interactive artists such as Utterback and Levin have developed their interactive projects. Furthermore, Japanese artist Toshio Iwai created *Tenori-On* (2006), which is a visual musical device with LED grids. Since the portable device is collaborated with the Japanese musical instrument company, Yamaha, this can be regarded as a musical instrument. However, users can simultaneously create abstract LED-dot images by directly touching the LEDs.

[13] Paik was a residential researcher at Bell Labs from 1967 through 1968. At the lab, he created *Confused Rain*, which was a printout of the letters of the word confused falling down the page in a random accumulation. William Kaizen, "Computer Participator," in *Mainframe Experimentalism: Early Computing and the Foundations of the Digital Arts.* ed. Hannah Higgins and Douglas Kahn, 231.

Between abstract images and sounds, users cannot tell which signal is first. The endless circulation between sound and image can expand into a synesthesia work. Paik's three different influences to interactive art based on Musique Concrète still encourages artists to make interactive art in a creative way in the 21st century. The project reveals that Paik's interactive art was a fundamental contribution to developing a new kind of interactive art.

In the landmark textbook of 20th-century art, *Art Since 1900*, foremost art historians Hal Foster, Yve-Alain Bois, Rosalind Krauss, and Benjamin Buchloh did not even mention Paik's creative approaches toward interactive art. Instead, they included the works of Paik's contemporaries, Woody and Steina Vasulka, as early interactive pieces even though their works were created later than Paik's pieces. [32] These art historians mainly pointed to his negative aspects such as a technophile and an anti-feminist. Nam June Paik himself as well as his interactive pieces is underrated in art history.

Outside of mainstream of art history, some art theorists have reevaluated his first solo show, *Exposition of Music – Electronic Television*, as one of the earliest significant interactive art exhibitions in a gallery. After a book with the same title was published in bilingual texts, German and English, in 2009, the background of Paik's first interactive art exhibition could be more articulated. This was a breakthrough event tracing the origins of interactive art. Subsequent studies are strongly needed to articulate Paik's interactive art. In Paik's musical background, the endeavors to emancipate audiences from a one-way art piece guided him to make art in a two-way direction, and created his own interactive art. In this condition, among his interests in progressive music, Musique Concrète can be a Paik's significant influence to his interactive art. "Although art is often a bastard the parents of which we do not know" as Paik mentioned, this research found one of those parents in his creative adaptations from Musique Concrète to make interactive pieces.

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DMIs AMONG THE OTHERS – Live at the Concert Hall

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Abstract

In this paper we propose ways to promote the use of specific Digital Musical Instruments (DMIs)[1] in live performance situations. Some of these instruments (DMIs) are usually conceived as personal objects, adapted to precisely instrumental techniques or as expositive artwork such as sound and multimedia installations.
To make this possible, it is necessary that composition paradigms includes, from the very beginning, integration strategies of DMIs together with traditional instruments and groups (ensembles, orchestras, etc.).
The regular presence of DMIs on stage with traditional musical instruments, could lead to new aesthetical dimensions of music and a new compositional and performance paradigms in the framework of contemporary music. The emergence of these instruments and their integration with traditional instruments in musical contexts, will also lead to new dimensions of DMIs design. Our research in the framework of DMIs prototypes is strongly concerned by all these premises and we hope to contribute to the development of new compositional paradigms and some instrumental techniques. This paper presents our vision concerning the DMIs and their role in the musical environment and in musical history.

Keywords

DMIs, Families of Instruments, New Models of Musical Composition, New Sounds, Hybrid Projects, Musical Performance.

Introduction

Nowadays we are still living in a period of historical excellence for the New Music and Sound Art. Like in the past, scientific discoveries and new technologies allow musicians to free themselves from traditional methods of creation, enabling them to participate in interdisciplinary teams of artistic production.
Apart from the desire of creation and the discovery of new sounds and timbres, we found as well other motivations connected with the development of new musical instruments. These are for example, the instrument conversion in a personal interface or group interaction interface and collective musical expression. [2]
Many authors have already explored different themes concerning the DMIs, such as their different needs/liberties linked to music, used technologies, or their design as a musical instrument. However, it is fundamental to focus in a discussion on how to give continuity to the potential of the recent and old DMIs that are presented to the academic community and how we can get an appropriated composition models for them.
In furthering this subject, we consider important for composers, without previously contact with specific DMIs, to be able to understand the specificity of some instrumental techniques related to DMIs, and at same time be skilled to compose for them in the same way that they composes to traditional musical instruments.
In fact, the separation between composing to DMIs and playing DMIs could increment the musical production and, as consequence, can easily generate new opportunities to bring these instruments to the concert situation.
This perspective will open new opportunities to instrumentalists with classic training, to play more and more the DMIs, because someone has already understood the influence of extended techniques applied to their instruments.
Based on these principles (articulation of extended techniques on the traditional instruments) they can reach new sounds and they will be capable to learn how to play new digital instruments.
Both, the experimentation and innovation are the most important challenges in music history. The tradition was perpetuated by artistic heritage, the transmission of knowledge and aesthetic opinions. The music has survived through the centuries, thanks not only to the permanence of their own rules, but as well, because of a shared conscience of its own necessary recreation. Stravinsky summarized in a single sentence this idea: “we have a duty toward music, namely, to invent it”. [3]
The New Musical Interfaces including the DMIs are responsible for shaping the music of the future, and not only be played with improvisation parts. [4]
Performance and Composition are both themes connected to the general universe of the DMIs. It is in situations of installation focused on the idea of public art or stage, that we can take advantage of the novelty and potentialities of these new instruments.

[1] Digital musical instruments (DMIs) are musical interfaces focused on musical instruments that use the computer as the main device to create sound. A gesture controller that leads the musical parameters of sound synthesis in real time mostly sets up these instruments. [1]

Some authors have been referring the need of developing DMIs with a more robust construction and with a learning technique, so that with these adjustments they keep having an historic continuity. [5] [6]
These Digital Instruments arise to counteract the amount of learning time for traditional musical instruments, which are not easy to learn. However it is important to have a balance between an easy-to-use interface and continuous musical evolution, achieved by long hours of training with the instrument to reach their maximum potential in terms of creating unique sounds. [7]
Taking in consideration the new possibilities of musical creations with DMIs, and the importance of the cooperation between the different disciplines on sharing concepts and vocabulary, and all the hybrid practices in the arts and technology, we are able to affirm that the DMIs are hybrid musical instruments.
We reflect on the impact caused by interdisciplinary work and how composers and creators, who worked in key hybrid projects, came to be extremely important. They rewrote not only the history of music, but also the definition of art itself influencing the contemporary art projects, namely the Digital Musical Instruments (DMIs).

Do It Yourself - An Academic Perspective

An important incentive for the fulfilment of our research is the presence of a large number of academic works and a reckoning of active students and participants in an emergent artist and social community Do It Yourself (DIY) and DMI.
The emergence of new technological crafts for musical and artistic proposals brings new approaches to *sound art*, extending the study field of an instrument to become necessary rethinking the definition of instrument, music, concert and musical composition.
Musical devices can take diverse systems, including interactive installations, digital musical instruments, and augmented instruments. [8]
Nowadays, there's a lot happening inside the DMIs community. This is not only related with technological changes, but also with a series of transformations that cause changes in the musical approaches in the way we see music. The main change factor is the easiness in sharing information on the internet, leading a lot of people to recreate *sound toys*, sound generators, tools for musical creation and even DMIs, participating in blogs, taking part of the DIY culture, and using Open Source software.
With all this action happening, these changes became more current and will continue to challenge the meanings of artist, composer, performer and participant in this musical and technological context. [9]
The definition of instrument did not change as the definition of music. Its significance was questioned and re-fitted to new situations only with the introduction of electronic instruments and computers. [10] A new instrument or a DMI only acquires the status of a complete musical instrument when it gains historical and technical contextualization. [11] However, this is a topic that remains constantly changing. No traditional art has been so agitated in its essence, practice models and communication by the new media and recording technologies, retransmission and synthesis as music. [12]
When we approach this question of DIY culture and the existing facility to access tools for musical creation, we must assume that it exists not only for creative artists, but also, and mostly for users of their personal interactive objects.
The construction of DMIs, the interface design, sound synthesis in real time, new practices for musical composition, and existing models of improvisation (based in computers, or not) may actually lead to a new model for musical interfaces. [13]
These concepts are still the source of current studies, and are strong pillars to define new DMIs - whether they are conceived to specialized public, like artists and musicians, or to the general public, without musical training.
When we talk about the relationship between DMIs and musical composition, even more associated to the academic and DIY communities, it is essential to clarify that musical interfaces are not a DMIs or musical instruments.
In this context is capital to establish a kind of transition between these two instances (musical interface and DMI).
The DMIs had a great expression in the 90's and the early 2000s, but they still continue to exist for mainly two reasons: the sake of performance and a freer musical composition, indeterminate and experimental. However, if we want that DMIs find their place on stage alongside other instruments, it is important to understand the compositional and performance paradigms for DMIs.

From Experimentation to Composition

For centuries western music saw music as tonal, composed by notes and forgetting what was inside or behind them. [4] While there were composers in the beginning of the last century that broke these patterns of thought (e.g. Stravinsky) the change was slow. However, we have already seen more than half a century of computer music that made music reborn completely, not only at the technical level as well as aesthetically.[2] [14]
The twentieth century brought free systems for musical composition and new techniques for playing traditional musical instruments, whose principal body was the sound character, the timbre, and not only formal aspect of the musical structures or the composition of rhythmic and melodic elements, as had happened before.
This change will open the ways to write music, even though the traditional methods have already changed. New forms of musical notation were always discussed, and received special attention from contemporary composers of the last century, resulting in the development of new systems and the appearance of new symbols. [15]

[2] Stockhausen and Maconie, *Stockhausen On Music.*

The music has a natural tradition regarding its relationship with collaboration and socialization. The DMIs have sought to evaluate systems for multi-user's thinking of composition/interaction models for sound installations, under the compromise of searching the simplicity of interface given the complexity of the musical results. However, these ideas can be transported to concert situations with interpretation of pieces written for DMIs, always thinking about the role of composer and performer exploring the compositional characteristics linked to new sounds and concepts from digital technologies, believing it is here that provides consequences for the music of the future. Nevertheless, it has not been an easy road for composers – thinkers, who took electronic music as a break required to classical music, because initially these two genres did not mix together. Only later, during the 70s, with Stockhausen, ideas proved the opposite. From then composers could compose both orchestral and electronic music, and even combine the two genres in the same musical piece. [14], [16]

Ensemble Music Featuring DMIs

Contemporary music and musicians are no more than the continuation of an important tradition: the classical music. For Manoury, new technologies and the latest developments at the technical level of traditional musical instruments and of the design of new instruments are not as surprising if we consider these events in a greater reality. They are only the perpetuation of a knitted history jointly made through news, research, experiments and memory. [3]

For example, ensemble music already combines acoustic instruments with digital instruments, with computer music and electroacoustic music in concerts programs for new music. However, adding DMIs to these new ensembles creates some difficulties for composers by obvious limits associated with the techniques of playing and composing for these new digital instruments, as mentioned.

There are not many composers that compose for traditional instruments and program the electronics for their electroacoustic pieces. In fact, many composers usually ask to software designers or software developers. In contemporary music written for ensembles of traditional instruments, it has been a while since traditional instruments won a new expression for the way they have been explored in terms of implementing techniques by the electronic addition or even the visuals. Nevertheless, we will focus only on the sound part.

When the computer has earned a place in music and joined the traditional musical instruments, most of the time and currently, this is a sound presence / acoustic / spatial and not physical. In fact, the computer had difficulty finding their place on stage in performances as a tool, but less as an object. [11]

A major criticism drafted to electronic music was based on its lack of expressiveness. To counteract this, many works have been made to create software and DMIs to convey this missing emotion. That's why the gesture control and *mapping* are so important in the development of DMIs. [5], [17] This way, composers and musicians could benefit from creating and synthesizing their own sounds for their compositions and performances. However, there's a big gap to be filled: there's no musical training regarding DMIs. Some programs must be implemented, providing, composers and musicians, enough skills in instrumental techniques so they can explore satisfactorily these new instruments. It is also important to promote propitious environments - such as improvisation sessions - where musicians shall be able to experience freely DMIs, understanding both sides strengths and weaknesses. [18]

The examples of DMIs that we want to see on stage and in new ensembles, and which we propose with this paper, are those that can help to solve the lack of expression still present in electroacoustic music, bridging the still existing need, mainly from the audience, to add a musical instrument – an object to the sound that most still do not understand but already know it as digital. Therefore, it can be argued that we are in a transitional phase.

Conclusion

Interfaces and technologies present several additional difficulties, and so, both composers and performers must deal with them carefully.

An interface is not only a controller; it is also a barrier and a resistance factor that needs to be overcome. However, there have been new interfaces for music that express the sound and musical aesthetic needs, that so often composers seek for their works and do not find in traditional instruments.

We hope to continue our work producing new prototypes that can, with their new models of composition, help to break with the past and make that contemporary music lives a new paradigm. Only with the hands on experimentation is possible to discover and contribute for new music technology.

In fact, it was not yet possible to find a synthesizer in the normal *lineup* of a symphony orchestra, although pop music uses them to imitate the sound of traditional musical instruments present in orchestras. [14] The grow up process of DMIs performance and the incrementation of DMIs among other traditional musical instruments "on the stage" strongly depends on new musical composition paradigms, were the balance between the aesthetical dimension of noise and sound, must be complemented.

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The Lungta Projet: Physical Visual Music

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Abstract

Following the democratization of technology that we have seen since the mid-1990s, a new phase of democratization is currently underway with open hardware. After decades of advances within the software paradigm, interfacing with the physical world is currently one of the most prominent trends in creative computing.

Computer music is at the heart of these new developments and many sound artists are part of this movement. In parallel to the development of musical input devices and the use of sensors for artistic purposes, many are working to interface with the physical world through actuators.

The *Lungta* project, an audio-robotic performance, continues this idea of linking computing to the physical world hence propagating musical gestures to actual physical movement.

Keywords

Physical Computing, Computer Music, Visual Music, Physical Pixels, Arduino, Kinect, SuperCollider

Introduction

This article discusses the *Lungta* project, an audio-robotic performance and interactive installation featuring an electromechanical device. The device corresponds to a physical matrix of 192 motor-driven fans activating sheets of common stationary paper along a two-dimensional grid. Acting as a sort of pixel-based video image synthesizer or display, the matrix permits the specification of a rich and complex interaction between sound, video capture and performative gestures.

The project follows a visual music research initiated several years ago. After various works focused on audio-reactive live computer graphics, the *Lungta* project seeks to transpose into physical space the emphasis on form, color and movement traditionally encountered in visual music.

The article discusses the work from different angles, beginning with an historical context. Next is a description of the technological aspects of the project, i.e. the electromechanical device and its software components and the Kinki software, developed for this project. Following a brief descriptive analysis of a section of the work, the article concludes by addressing some issues about the sustainability of works based on digital technologies.

Physical visual music: sounds, images and objects as movement formats

In parallel to visual music, kinetic art, whose roots go back more or less to the early 1910s, is the cornerstone on which another expression of movement has set itself up. Works by Italian futurits or Marcel Duchamp (1887-1968), or works like mobile structures of Alexander Calder (1889-1976) will lay the foundation for an artistic practice whose ramifications are still active.

The kinetic works of 1950s Op Art like those of Victor Vasarely (1906-1997) or Bridget Riley (1931) make use of movement from the perspective of vision related phenomena such as persistence of vision or optical illusion. It is rather to Len Lye (1901-1980) that we owe the first explicit references to movement as a medium. Some of Lye's texts, dating as far back as 1935, clearly express that desire for a Movement Art that began mainly in abstract cinema but whose full expression came later in the 1960s with his sculptural work. "Movement is strictly the language of life. Movement is the unpremeditated being; it is the uncritical expression of life." [2] Like the English painter Alexandre Rimington (Color-Art)[1] and later Lumia artist and lute player Thomas Wilfred[2], the art of movement desired by Lye has many similarities and references to music. Lye talks about composition when it comes to dealing with the organization of movement. For *Harmonic* (1960), he composed the movement by changing the strength and radius of a polished metal rod in rotation. For Lye, all animated materials are one and the same, i.e. movement for-

[1] English painter Alexander Rimington (1854-1918) is the inventor of the Color-Organ, an imposing light instrument standing more than three meters high equipped with colored lights above a keyboard comprising five octaves. The colors are associated with the keys based on a subdivision of the light spectrum for different intervals of the chromatic scale. An interesting fact to note is that Rimington's instrument emits no sound and its author recommends not to add music to its use in order to better appreciate the color and movement.[4]

[2] Thomas Wilfred (1889-1968) is the inventor of the Clavilux, a device that looks surprisingly like modern lighting consoles, where a performer manipulates a series of potentiometers. Like Rimington, Wilfred's works, which he calls himself Lumia, are to be observed without music. This said, Wilfred also gave representations accompanied by music. In 1926, he performed with the Philadelphia Orchestra playing Rimsky-Korsakov's Scheherazade.[3]

mats. Thus sound, kinetic images on film or physical objects exist only to render movement; an abstract movement that is preferably not associated with any narratives.

Figure 1: *Harmonic*, Len Lye (1960). (c) with permission of the Len Lye Foundation Collection, Govett-Brewster Art Gallery.

Many artists are now developing a body of work continuing in some way the work begun by Lye. Among them are many composers and sound artists so the proximity between physical movement and sound remains with the same relevancy today as it was about 100 years ago. In this regard, we should mention the works of the Cod.Act[3] collective with projects like *Cycloid-E* (2009) and *Pendulum Choir* (2010). We should also mention the *Frequencies* series by composer Nicolas Bernier [4] or *Cinetose* by the EVA Project[5] collective. It goes without saying that the *Lungta* project presented here is part of this evolving process.

Physical Pixels

The *Lungta* project is designed around an electromechanical device of imposing dimensions (2.5 x 7.3 meters). It is composed of 192 small DC motors equipped with a propeller in order to send an air jet that controls individually the vertical elevation of sheets of paper hanging before them. The matrix responds to sound, to a camera capture system and to a 3D interactive environment system making use of Microsoft's Kinect.[6] Each sheet of paper is actually a kind of physical pixel for displaying images rendered at very low resolution.

Figure 2: *Lungta* (2012). (c) Patrick Saint-Denis.

The interactions with the device are framed by two software components made in c ++ (openFrameworks[7]). The first is a graphics-rendering module while the second comprises a video compression algorithm that allows downstream to convert the rendered images in electricity to activate the motors.

Most of the graphic animations are constructed from elementary geometric shapes (circles, rectangles, etc.). Several parameters of the animations involve randomness in order to have, at each renewal of the animated sequences, minor changes while keeping a constant general behavior. These animations rendered within FBOs[8] are fed to an image analysis module which will calculate the overall brightness according to a grid that corresponds to each sheet of paper or "pixel" of the electromechanical device. The result of this analysis can be seen at the lower right of the control interface (see figure 3) with the resulting image based on 16 brightness levels corresponding to 16 positions of elevation of the paper sheets.

[3] codact.ch

[4] nicolasbernier.com

[5] projet-eva.org

[6] The Kinect is an interface initially designed for the video game console Xbox 360. It allows one to control video games without using a controller.

[7] *openFrameworks* is a collection of functions that facilitates the development of creative applications. `www.openframeworks.cc`

[8] An FBO or *frame buffer objects* correspond to virtual canvases where images can be rendered without being necessarily displayed.

Figure 3: Control interface with visual rendering of the transfer module between images and the DC motor array.

Figure 4: The same image with emphasis on the transfer module.

In fact, the maximum resolution in terms of brightness and voltage levels sent to the motors is 8 bit or 255 different values. This definition not being visually perceptible, a coarser resolution is used. Before being sent, the values corresponding to the individual voltage of the motors are managed by a data compression module that is broadly in line with the principle of the H.264 video codec. This video compression codec is known for greatly reducing the size of video files by deleting the information relative to pixels that remain the same between two successive frames. This principle is adapted here in order to limit the information circulating on the serial ports where three Arduino[9] boards translate the data in electricity.

KINECT KREATIVE INTERFACE (KINKI)

In parallel with the interactions happening on the wall of paper, the musicians are also evolving in an interactive audio environment. This environment makes use of Microsoft's Kinect and a graphical interface developed for the project. This interface is an openFrameworks application based on an implementation of the OpenNI, NITE and SensorKinect librairies. The application facilitates the design of an interactive three-dimensional space. It allows the definition of interactive zones as well as their linkage with different body parts of a user.

[9] Arduino is an API, an IDE and a printed circuit that have been designed for exploration in electronic arts. The set includes a text based programming environment and a printed circuit facilitating the use of microcontrollers.

Microsoft's Kinect

The Kinect is an interface for Microsoft's Xbox 360 game console that was launched commercially in 2010. The principle of the device is to allow users to play video games without a controller via voice and movement recognition systems. Ideally positioned about one meter in front of the user, the device comprises an infrared projector, an infrared camera and a standard camera. The unit is mounted on a motorized base that rotates the optical sensors and infrared projector to adapt the device's field of view depending on the positioning of users. The Kinect was an immediate commercial success with more than eight million units sold in less than two months after its release. The interest that it creates today goes far beyond the gaming industry.

Figure 5: The Kinect, a peripheral for the Xbox 360 game console from Microsoft. (c) CC-BY-SA-3.0, via Wikimedia Commons.

The movement recognition system of the Kinect, developed by Israeli company PrimeSense, is based on a range imaging system. The Kinect's infrared projector emits light patterns that are invisible to the naked eye. These patterns are then captured by the infrared camera and this uptake is analyzed. A series of information can be deduced from this analysis such as the depth of the pixels or the recognition of a human figure.

Figure 6: Infrared light patterns projected by the Kinect. (c) CC-BY-SA-3.0, via Wikimedia Commons.

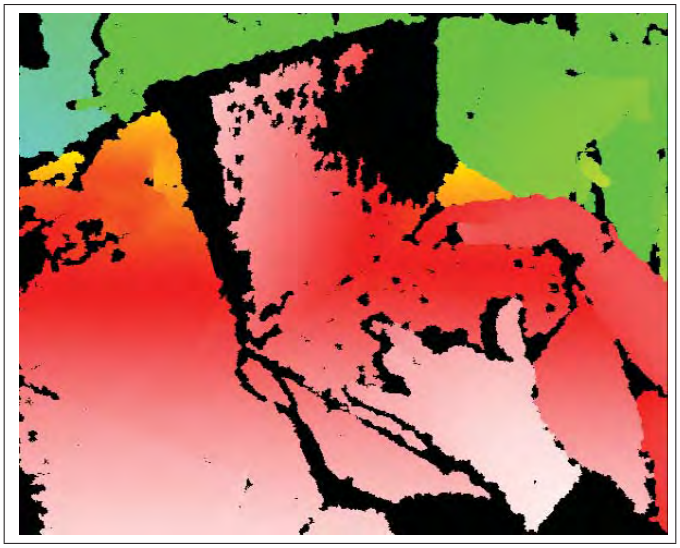

Figure 7: Depth image acquired by structured light. (c) CC-BY-SA-3.0, via Wikimedia Commons.

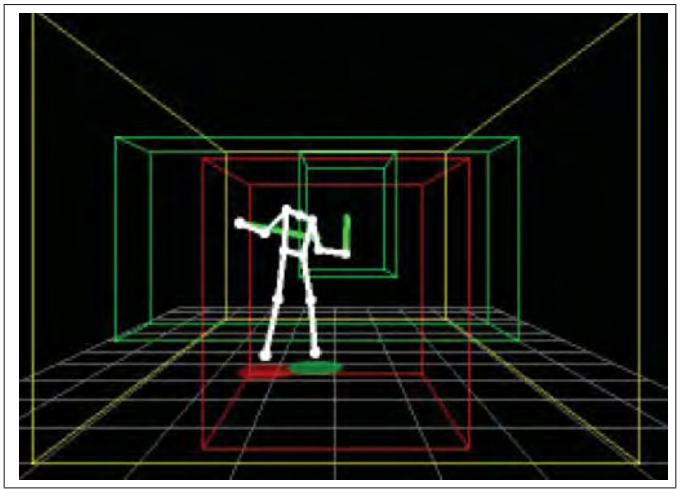

Figure 8: kinki (Kinect Kreative Interface).

kinki (Kinect Kreative Interface)

Kinki is an openFrameworks application that helps defining tridimensional zones of interaction and their relation with different parts of a performer's body. By using the Open Sound Control protocol, the application allows one to connect a performative gesture to any software or programming environment that handles OSC communication.

The application is built on OpenNI's software architecture and includes two operating modes: *edit mode* and *performance mode*. *Edit mode* lets one add or modify objects that consist of interactive zones that can be fixed or attached to a user. Objects are grouped into scenes, enabling rapid object configuration changes. By default, the application is calibrated for a single user but it is possible to increase this number up to 8 simultaneous users.

The interface includes various controls for modulating the objects (position, size, etc.) and the body part of the user that will activate the interaction zone.

All OSC messages of a project are sent over a single port using the following nomenclature:

If an object is not activated[10]:

```
/oscTag 0
```

If an object is activated:

```
/oscTag 1 xPosition yPosition zPosition
 rho phi teta distCenter
```

The arguments corresponding to the position in x, y and z (xPosition, yPosition and zPosition) vary between 0 and 1 while the arguments associated with spherical coordinates (rho, phi and teta) are reported between 0 and 360. The last argument (distCenter) corresponds to the distance from the center of the interaction region and is always between 0 and 1.

Summary chart

The diagram at figure 9 summarizes all the hardware and software components of the work. The different data acquisition interfaces are in yellow boxes. Digital manipulation modules (audio, computer graphics) are in white while output devices (the wall, speakers) are in green boxes.

[10] i.e. if the body part associated with the object is outside of it.

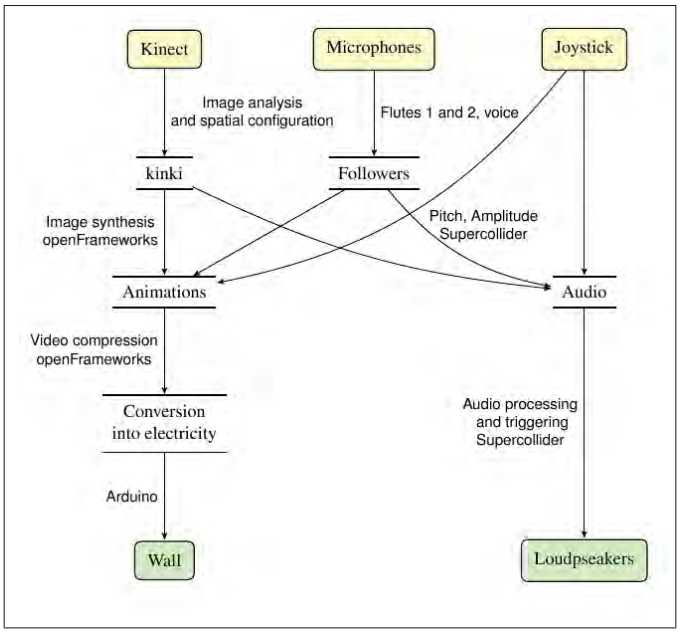

Figure 9: Summary of the work's components

Descriptive analysis of the central section

The central section of *Lungta*[11], designed for female voice and audio-robotic interactions, offers a concentrate of all the project's components over four minutes. Some short audio clips (4-8 seconds) are generated live and triggered by the performer according to amplitude thresholding. The sound of the breath is also manipulated live. First, an FFT treatment separates the noisy signal of the breath from the more periodic sound of the singing voice. The amplitude of the noisy signal is modulated by an LFO whose frequency involves elements of randomness. The result is then mixed back to the continuous signal and send to the loudspeakers. Amplitude thresholding of the voice also triggers a series of movements on the machine. These physical movements correspond to graphic animations initiated from the center where 12-20 rectangles translate to the sides. The traveling speed, the number of rectangles and direction of displacement involve randomness so that the movement is continually renewed while keeping similar mass profiles.

[11] www.vimeo.com/87890177

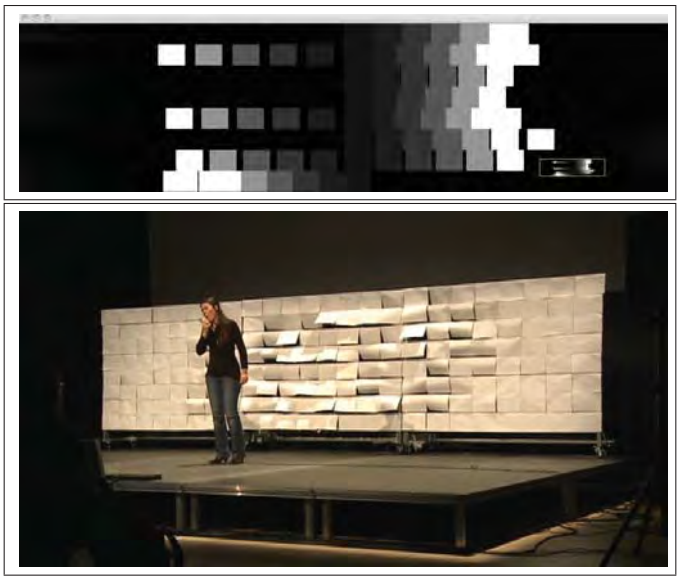

Figure 10: Animations and resulting effect on the wall of paper.

The singer then begins to perform a series of rotations with the right hand. The Kinect, placed on the floor in front of the stage detects the three-dimensional position of the right hand. The data collected is then used to power a synth composed of noise generators. The amplitude of the synth is controlled by the distance of the hand relative to the central point of rotation when it is in the forward half of the circle. Spatialization of the sound is determined by the position of the hand performing the rotations. These data also generate movement on the machine. When the hand is in the back half of the circle, a graphic animation is activated according to the hand's position enabling a wave movement initiated by the singer's hand movement to be seen on the wall.

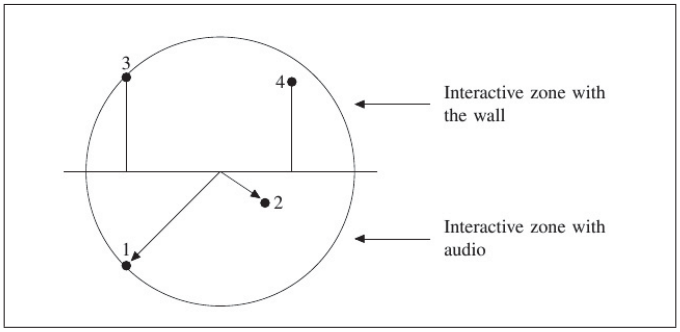

Figure 11: Visualization of spatial interactions. Top view. 1 = audio interaction, maximum volume and panning on the left side. 2 = audio interaction, low volume and panning on the right. 3 and 4 = Audio volume 0. Interaction with the wall, the graphic animation follows the normal relative to the diameter line.

The performer sings continuously so that her voice is only amplified when the microphone comes close to her mouth. This intervention will last for a moment before building up in

rotation speed. Towards the end, the voice becomes less airy and more pitched. A long note in the high register is heard. This is the only pitched material of the work.

Aesthetic of the ephemeral

True generosity toward the future lies in giving all to the present. -Albert Camus

Lungta is necessarily destined to an ephemeral existence. The tools developed for the work are subject to the evolution of computing technology. For example, as we wrtie these lines, the Kinki software is already in need of two major updates. Microsoft has just launched the Kinect 2, which is not compatible with the OpenNI modules on which the application is based and Apple, which recently just bought the PrimeSense firm, is to conduct a complete shutdown of OpenNI. It took only one year for the obsolescence inherent to new technologies to catch up on this work.

Similar observations can be made on the wall. Handling and use of the latter require maintenance before each performance and its dimensions cause many storage challenges. Maintenance activities concerning the software components of the machine will have to be undertaken eventually. The pattern of re-performance of musical works, to which classical traditions associated with written music have accustomed us, simply doesn't apply to this project. The performance requires the presence of the composer as well as that of the musicians who contributed to its creation. A user manual does not exist and, considering the ephemeral nature of its hardware and software components, it can't exist. The *Lungta* project does not respond only to ephemeral art, it is a work in constant transformation because it evolves and is modified every time it is performed.

We are now thousands that create digital works necessarily linked to the tools and computing languages that constitute them. If digital art resolutely generates new practices, it also questions our commitment to the notion of the work-monument as a legacy for future generations.

In an interview with the composer and pianist Michael Levinas, Danielle Cohen-Levinas notes the following:

> "It is hard to imagine that in future times to come one will take out the famous 4x of the museum (IRCAM's early computer) to run it. There is a real transfer here. Technology is such that there is a transfer capability of a number of discoveries that have happened in relation to a specific technology. This does not prevent the obsolescence phenomena that new technologies impose. This is not the case for the instruments you speak about, like the harpsichord, the pianoforte or the piano. They may be in the museum, but they are also in concert halls. "[1]

The musicologist notes here the difference between the way transmission (transfer) in computer science operates and the idea of inheritance to which the musical tradition has accustomed us. The composer answers this assertion by pointing out that technological media fail to standardize, that their deaths are inherent to the economic and industrial agenda.[1]

It is true that the evolution of computing is mainly driven by the requirements of the market and digital art is often found in the wake of changes imposed by the industry. But in the same spirit, we must recognize that market forces can lead to great changes and developments in artistic practices. Perhaps one should interpret this transformation of the notion of inheritance brought about by computing as a new relationship between the realms of industry and culture.

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Art with a Life of its Own: Questioning Mimesis in Media Art Prototypes

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Abstract

This paper is a theoretical discussion about new media art prototypes that use interactive components such as programmed microcontrollers, which respond to the presence of viewers in a host of dynamic ways. The media art prototype is examined in relation to the Western philosophical concept of mimesis, or the convincing imitation of aspects of life, with the aim of understanding the overall aesthetic and cultural implications of media works of art that appear to possess life or agency of their own. Media art is shown to reinvigorate the ancient concept of mimesis in important politico-cultural capacities: by revealing that works of art can be endowed with the illusion of agency, contemporary new media artists also suggest that such powers of agency and possibility for change extend to other aspects of the lived world. The former modernist/postmodernist critique of mimesis as rote naturalism or hegemonic cultural coding thus modulates itself. The suggestion of mimetic animism in new media art prototypes proffers invention and manufacture as a potential space of reconciliation between mechanized materiality, systems of production, and organic life.

Keywords

Mimesis, microcontrollers, prototypes, interactive, agency, autonomy, code, programming, hardware, physical computing

Introduction

The notion of mimesis in art, or the convincing imitation of nature through various systems of artificial representation, is an ancient concept in the tradition of Western aesthetics.

et its venerability as a contested aesthetic concept discussed by Plato, Aristotle, and myriad other writers in the Western canon, has not precluded its continued relevance in a modern and even postmodern context. The debate over mimesis remained central to the avant-garde critique of art history in the first half of the 20th century, in which a concerted break with the ideological goal of naturalism or verisimilitude manifested in one regard through the guise of pure abstraction. In postmodern theory, mimesis has taken on fresh valences in relation to issues of simulation, virtuality, hegemony and appropriation, among other topics.

I argue that this profoundly historical genealogy of mimesis can currently be reconsidered once again in light of the contemporary proliferation of new media art prototypes, particularly those that feature a digital interactivity based on coded microcontrollers equipped with reactive components such as sensors, which respond to the movement of the viewer in a manner that suggests the illusion of life or sentience on the part of the artwork. How can this impression that the interactive new media artwork has autonomy, animism, agency, or a life of its own, be compared with the traditional and pre-digital aesthetic value of mimesis, or the skillful imitation of given aspects of reality? Does the new media art prototyping process correspond in some significant manner to the preliminary drawing, the painterly study, and the masterpiece in its pursuit of the perfection of a persuasive imitation of life? More fundamentally, what does the frequent showcasing of life-like qualities for contemporary new media artworks mean in terms of critical aesthetics, in which art encompasses the ability to comment upon and potentially shape cultural horizons?

Ultimately I conclude that new media art prototypes using interactive components like coded microcontrollers radically alter the ancient and ongoing dialogues about mimesis in Western art, and that this commentary implies an important critical statement about contemporary culture as a space of polito-cultural possibility and not just mechanicity. Media art prototypes employ programmed circuit boards that vastly transform and enhance the representational illusion permitted by traditional fine art mediums such as painting and sculpture. Rather than resembling life in the form of a convincing representation or image, media art prototypes enact a paradoxically automated sentience through programmed hardware. This suggestion of animism on the part of the artwork projects an aesthetic statement of increased agency in general: on the part of the maker, the viewer and the artistic object alike. Such a scenario of suggested shared agency is, I argue, a platform for an optimistic, though not necessarily utopian, position of possibility in human-to-human and human-to-object relations.

Old Mimesis and New Media

Although interactive media artworks actively engage the aesthetic concept of mimesis through their extensive play with registers of illusion and imitation, they also fundamentally recalibrate mimesis. Whereas traditional art mimesis

was based upon the sign operations of the icon, which communicated through visual resemblance, new media mimesis is activated through the language of code. Programmed code, as a set of encrypted instructions that communicate and translate messages between human and machine, has nothing to do with resemblance and association based on likeness, to be sure. Inter-textual reference systems such as citation and allusion are also minimized or excluded altogether in programming. 1 The increasing prevalence of artworks based on programmed code in current new media art production therefore suggests another crucial break or refusal (out of many former historical breaks) with past legacies of imagistic mimesis in art production, but also importantly points to the fact that such interactive art prototypes must be 'read' in new ways by viewers who are conscious of the difference between programmed code and the cultural encoding inherent in the mimetic work of art. Rather than mediating between reality and virtuality in a mimetic and semi-transparent fashion as the resemblant image does, coded digital art interacts with the physical world through concealed formulas and algorithms preconfigured directives engineered by an artist-programmer and scenarios of code communicating directly with code. Even while a contemporary interactive art prototype may engage with the registers of both iconic mimesis and cultural encoding, it will also always contain a third coded-register: that of programmed code, generally inaccessible to the viewer and not legible for 'reading.'

Nevertheless, the issue of artistically-rendered, visual verisimilitude is still central to a discussion of digital art prototypes in an overarching manner, as is the communicative nature of the work of art as a coded signifier. Such a change in the dynamics of communication between artwork, artist and viewer inevitably shifts the viewer's reception of mimeticism and the ramifications of this aesthetic endeavor in important ways that merit analysis. In a broad sense my aim is to take stock of what could be perceived as a significant shift in aesthetics in the 21st century from a focus on mimesis as a form of resemblance or depiction – *or* an avoidance of mimesis altogether through various avant-garde strategies such as abstraction, the readymade, time-based arts, language versus image and others – toward a re-invigorated potential for *imitatio* that has more to do with activating a kind of artificial life and/or an artificial consciousness into art through the application of sensors, digitally-programmed robotics and other physical computing components. Rather than allowing for a convincing *depiction* of life per se, as the veristic image might be said to achieve, interactive digital art permits a *fabrication* of animate simulation that can itself actively manipulate the surface of the physical world to some degree, with suggestions of autonomy, agency and even certain kinds of independent purpose – even while such autonomy/agency may only be illusory and a result of preprogrammed directions.

This activation of artificial life, the crafted appearance of a work of art that possesses some form of 'sentience', exceeds the mimetic capabilities of the iconic image even in light of the more relational art historical interpretations of the icon as having 'presencing' and 'presenting' capabilities that link it physically and semantically to the body of its original 'physical' example: the actual model that is imitated, represented or copied by an artist. 2 Due to the kinetic, responsive and operational character of interactive art prototypes in a new media context, the mimesis of life there – although most often not based on imagistic resemblance – potentially allows for a more literal, immediate and deceptive expression of mimesis or life-like representation than do other forms of representation.

My interest as regards interactive digital art lies primarily in the domain of the concrete and the physical, the three-dimensional and perhaps at times the sculptural, and slides toward the rubric of the thing or the object or the construction and therefore away from the mirage-like capabilities of the ever-ghostly and eidetic *picture*. In particular, these reflections concern the developing trend in a new type of prototyping in contemporary art over the last decade, with an emphasis on materiality as a kind of *hardware* vehicle that supports coding rather than unequivocal objecthood as such (understood to be complete in itself), and the way in which this peculiar version of materiality corresponds to and/or diverges from the legacy of the visually resembling likeness (and previous art historical rejections of such optical mimeticism) in the Western art tradition. At the same time, it seems pertinent to mention at the outset that this is not merely a question of image versus thing and therefore also a query about different tiers of resembling iconicity and materiality – nor is it even a matter of the familiar aesthetic binary of ideal and real. Rather than investigating the physical and conceptual differences between images and things as such, I am more interested in distinguishing between the systems of communication, meaning and information exchange that are embodied by images and also by 'encoded hardware'. For it seems that the fundamental contrast that is novel in current culture is not so much a question of the typological 'order' or ontology of things and representations themselves as it is the mode of rhetoric and signification that defines the status of their iteration in society. The preference in contemporary new media art prototypes for the animate illusion of artificial awareness or life (rather than mimetic representation through iconic images) is a result of augmented technological capabilities and is also part of a larger shift in postmodern art in the substratum of presuppositions about the way art should represent us to ourselves. 3

Prototyping and Physical Computing in Art

The cultural development that concerns this discussion is the recent spread of physical computing and digital prototyping practices in fine art production over the last decade, which

have pioneered a new sophistication in the area of interactive aesthetics. 'Physical computing' refers to the construction of physical digital tools that interact through hardware and software with the analog world in a manner that is more readily understandable by non-technicians, and that can be used in a comfortable and practical manner by the animate form of the human body. 4 The term 'physical computing' was coined in 1992 by Dan O'Sullivan, Associate Professor of Communications and Director of Research at New ork University's Interactive Telecommunications Program, as part of the Tisch School of the Arts – a department that was founded in 1979 as one of the first graduate education programs in alternative digital media. According to Tom Igoe, O'Sullivan's close collaborator and co-author of the 2004 book, *Physical Computing: Sensing and Controlling the Physical World with Computers*, the phrase 'physical computing' may have been recently coined, but such attempts to create user-friendly interfaces between engineered entities and humans is by no means new. In particular, he cites E.A.T, the Experiments in Art and Technology Program out of Bell Labs, Myron ruger, Max Matthews, Heddy Lamarr, and George Antheil as 20th century precursors to the current understanding of 'physical computing', although he also suggests ties to such efforts in previous centuries. 5

The exercise of physical computing and the consideration of body-technology interactions often results in functional prototypes. By 'prototyping' I refer to the process of constructing experimental, preliminary models that are self-consciously understood by their makers to be incomplete and require periods of testing, manipulation and possible revision. Prototypes are 'early' or 'primitive' versions of various kinds of operative entities that gesture toward future iterations based upon information learned from the testing process, although in current art practices most prototypes are rarely meant to reach an endpoint of perfection or finality. They embrace an aesthetic of the rudimentary and the developmental.

I refer in particular to the recognizable increase in art-making of various kinds based on 'smart' open-source digital hardware, available for free or at a low cost on the internet or in certain stores and hacker spaces. A key development of note in this regard is the debut of the Arduino microcontroller by an international team of designers in Ivrea, Italy in 2005, to which Alicia M. Gibb devoted an Art History thesis in 2010 at the Pratt Institute. 6 Responding to a practical need for affordable, easy-to-use microcontrollers to serve as learning and teaching tools in schools, the Arduino design team pioneered a remarkable series of unique prototyping platforms that facilitate a host of new applications made by a diverse body of users. At the same time that practical considerations were at the fore of this design impetus, however, the Arduino collaborators fostered an ideological orientation in their prototyping process from the beginning, remaining committed to values of pedagogical information sharing, the goal of technological progress and an open-source copyright model. Users are encouraged to hack, 'prosume' and modify Arduinos at will in order to make clone microcontrollers that will support the needs of their unique projects, and the product source code and instruction manuals are made available to the public under open-source terms.

One example of this phenomenon is a prototype by the German collective VR/Urban (Christian Z llner, Patrick Tobias Fischer, Thilo Hoffmann and Sebastian Piatza), the *SMSlingshot* (2009), which was included in the "Talk to Me" art and design exhibition at The Museum of Modern Art in New ork from summer to fall of 2011. Employing a hacked Arduino board, a high frequency radio, a display screen, a laser, a wooden keypad, a wood sling-shot support and batteries, *SMSlingshot* aims to arm the passive viewer of urban media with a remediated weapon of intervention and participation. 7 Users enter text messages into the keypad which are then fired off by the responsive mechanism of the slingshot and virtually propelled onto surfaces in a cascade of dripping, luminous color, with the help of a projector and a laptop featuring a custom software interface. As part of their commitment to the "visual activism" of "reclaiming screens" that have been imposed upon urban dwellers in public spaces, VR/Urban's prototype becomes a tool based on the graffiti tradition of empowering individuals through the practice of tagging and 'bombing' (graffiti slang for applying graffiti to an unauthorized surface). 8

The physical computing platform of the slingshot, with its featured Arduino, provides a medium through which the viewer/user can negotiate and manipulate the interface between the real and the virtual, thus rendering the slingshot itself a hybrid entity as well as that of its activation as a physical object with a digital interface. The object then absorbs something of the diaphanous and mirage-like qualities of the image, while the digital interface exhibits an increased sensitivity and emphatic responsiveness to the physical world. It is the Arduino microcontroller that allows this amphibian navigation of two kinds of spaces, for its flat screen of connections is the ground and support for coded communication between programmer, computer, device and user.

As a digital tool, the *SMSlingshot* already subverts any totalizing comparison with the aesthetic register of mimesis, although certainly there is a simulacral quality to its utility as a virtual 'slingshot' of programmed data bits, as mentioned above. As an imitation of a tool/weapon that hurls tangible objects, *SMSlingshot* is in some regards a mimetic representation in that it adopts the resemblant form of a slingshot even though this form is not vital to its digital operations. On one level then, *SMSlingshot* does function as an image, given this mimicry of an actual tool as well as its ability to converse in an intermedial fashion with a rich host of historical and cultural associations (biblical narratives, the history of graffiti, other popular culture references and so on). et, as an interactive art prototype produced in a new media context, *SMSlingshot* also takes this mimesis to an-

other register as an encoded device that enacts its functionality digitally through programmed directives that are not readily apparent.

However, not all contemporary art prototypes submit themselves to 'use' per se, nor is their virtuality the most common prerequisite for connections with the venerable language of mimesis. Take for example the 2011 work, *Tape Recorders, Subsculpture 12-14* by Rafael Lozano-Hemmer, who has pioneered the growth of interactive digital art in a variety of internet and 3-D approaches for nearly two decades. Like the *SMSlingshot*, Lozano-Hemmer's *Tape Recorders, Subsculpture 12-14* uses an embedded microcontroller and several other devices to permit programmed correspondence between the living and the artificial, and yet *Tape Recorders* emphasizes the artwork's illusory appearance of lifelike agency even while it is still reliant on the viewer to activate its sensors (as well as its programmer to write its code and its engineer to build its components). On each wall of an otherwise empty gallery, twenty-some metal-encased measuring tapes are bolted securely into place on an even horizontal plane. When viewers enter the installation and move through the room, the measuring tapes automatically respond by successively emerging from their casing, projecting upwards steadily until they at last extend the full three meters—the tape itself ultimately collapsing onto the gallery floor with the weight of its length.

Eventually the tapes retreat entirely, with only a few yellow inches protruding, poised for the next interaction with the viewer. Witnessing this 'defeat' of the work of art that seemingly seeks to act of its own will and 'size up' the onlooker through its calculating measurement apparatus, the viewer can appreciate their own experience of ambulation as a subtle form of escape from the rampant work of art. Rounding the corner to another anteroom, the viewer then apprehends another kind of 'secretion' by the pseudo-sentient tape measures. A computerized tracking system surveying the movement and amount of time that visitors remain in the installation prints a long receipt of 'time spent' for the sum of viewers each hour.

The step away from iconic mimesis and toward the illusion of consciousness as another kind of mimesis (dependent in the new media context upon programming) that I argue is encapsulated by digital interactive works like the one described above by Lozano-Hemmer, concerns both their status as prototypes as well as their computing identity. The work of art in this capacity is both 'becoming' rather than 'resolved', and 'responding' rather than 'resembling'. As an art prototype that employs physical computing aspects, Lozano-Hemmer's *Tape Recorders, Subsculpture 12-14* achieves definite functionality as an operating system, but at the same time presents itself as an evolving and open-ended platform in two ways. First, it creates variation in its outcomes, even while it repeats a pattern of action, through the randomness of the effect of gravity forces and the comings and goings of mobile spectators. Second, its mechanical system, which was made by a collaborative team of programmers and designers who assisted Lozano-Hemmer, is constructed with diverse elements such as cameras, computers, tracking systems, motorized measuring tapes and customized software and hardware (including microcontrollers), which possess potential for probable future adjustment, improvement and modulation (a few different versions of the prototype have already appeared). But more impactful perhaps than this developmental model for the work of art that responds to variable surroundings and must endure mechanical 'tune-ups' of sorts by a team of collaborators, Lozano-Hemmer's work appears to be 'open-ended' and 'evolving' through its engagement with a powerfully convincing order of mimetic illusion which gives the viewer the false impression that the work of art is to some degree 'alive' and 'aware'.

This robotic and interactive form of mimesis, made possible by programmed code and digital technology, is radically different from the 'aping' of reality inherent in most past iterations of iconic mimesis, which were more limited in their attempt to breathe the semblance of 'life' into the work of art. et, both kinds of mimesis are also inherently linked. As Lozano-Hemmer himself said in a 2005 interview:

> Today digital art, – actually all art – has awareness. This has always been true, but we have now become aware of art's awareness. Pieces listen to us, they see us, they sense our presence and wait for us to inspire them, and not the other way around (…). Pieces of art are in a constant state of becoming. It's not that they 'are' but that they are 'changing into'. I think the artist no longer has a monopoly over their work, or an ex haustive or total position over its interpretation or rep resentation. Today, it is a more common idea – an idea that I defend – that the work itself has a life. 9

Whereas art of the past encompassed the "aura" that Walter Benjamin ascribed to the singularity of the tangible work of art as expressed through the hand and mind of an individual maker in a unique material and temporal context, the data-laden mechanical matrix of contemporary interactive art entails the convincing illusion of art's 'awareness', which supposedly reacts to the transient life and somatic idiosyncrasies of the artist and viewer. *Tape Recorders, Subsculpture 12-14* aggressively disrupts the act of spectatorship through a reflected surveillance of the viewer and an unruly attempt at contact with the living through the action of programmed microcontrollers and sensors. According to Lozano-Hemmer this amounts to a conceptual 'freedom' of the work of art from the intentional burden of its maker and toward a semblance of autonomy that defines its own place in the present moment – and yet the work remains 'dependent' on the artist as maker/programmer and the viewer as mobile 'activator'. This 'inter-activity' creates a complex circulation of different kinds of 'code' between artist, work and viewer: the operational programmed source code and the cultural coding. The ongoing drive toward 'awareness' in works of

art, which Lozano-Hemmer characterizes as a continuum between different platforms of mimesis, therefore becomes more open-ended in this complex system, allowing for the viewer and artist to 'depend' on the work of art in some limited capacities, upsetting hierarchies of agency.

The Aesthetic Implications of Art Prototyping

Can the kind of prototyping executed by Lozano-Hemmer and his team in *Tape Recorders, Subsculpture 12-14* be compared to earlier examples of prototyping in a modern art context? Although I argue that digital prototyping using physical computing in contemporary art is related to industrial prototyping methods that were often adapted into modernist art from the 19th and 20th centuries, it is important that their numerous divergences are also made clear. As anthropologist Susanne üchler has shown, the Western canon of modernist art is permeated with homages to the industrial prototype and meditations on its subtle differences from more venerable modes of experimentation, perfection and reproduction in a studio or workshop context, such as artists' proofs, moulds, multiples and studies. Centering on the shared drive toward what I would distinguish as iconic or representational mimesis, Western art practices before the modernist period relied on various methods and stages of preparatory work in advance of the complete and perfect über-example, the masterpiece.

Pedagogical structures such as apprenticeships, workshops and later academies supported a culture of models to be repetitively imitated and multiple studies to be completed in advance of the finished work, as well as an archive of canonical images that were deemed worthy of the role of recognized iconic signifiers to be incorporated and cited across generations. Entrenched within this society of mimesis was the ever-present tension between the original and the copy, of course, as well as the drawn (*disegno*) and the physically fabricated, the material and the immaterial. 10 The constant struggle in art practice to adeptly translate the fluid mental concept or idea into a less-pliant rendered image or manipulated material, and even more crucially – to morph the real into some form of the ideal – was painstakingly articulated in the permutational and developmental compulsion of the preparatory model schema.

I concur with üchler that the upsurge of the industrial prototype in modern art coincides with the avant-garde critique of mimetic representation in the wake of a dawning information society, and that the broad shift away from preparatory model to prototyping in late 19th and early 20th century art production is indicative of such historical shifts and the attendant impact upon aesthetics and taste. The avant-garde revolution and its upset of academic hierarchies permitted the privileging of strategies that were favorable to the trial-and-error operations of the prototype: process, incompletion, experimentation, an ethos of design and utility in art, the ascent of the conceptual over the mimetic, the aestheticization of the machinic and industrial, the acquisition of non-art skills, and collaborative authorship, among other impulses. However, it is arguable that for the most part modernism primarily embraced the *aesthetic* of industrial prototyping through methods such as serialization, multiplication, objectification through the readymade and the embrace of duration and diagrammatics, rather than adopting actual *prototyping methods* that were widely in use for practical, utilitarian and investigative ends in the industrial realm. The examples that üchler discusses by Degas, andinsky, Le Corbusier and Duchamp therefore approach the prototype more metaphorically than literally: they embrace their ambiguous status as stages in a process of becoming they are moments in a larger series or more specifically (as in the case of Duchamp) they are pseudo-utilitarian commodities that need to be 'tested' by the viewer-consumer.

It seems rather that the experiments in avant-garde art that merged more fully with design and engineering practices fall closer to the spectrum of procedural prototyping as such, with early kinetic works by Bauhaus practitioners such as Moholy-Nagy playing a crucial initial role, as well as constructivist sculptures by Naum Gabo and Antoine Pevsner. Later efforts in kinetic and machinic art by Len Lye, Jean Tinguely and Alexander Calder, among others, also contribute to this lineage of art prototyping as a method of instilling an interactivity into three-dimensional art that went beyond the engagement of the senses and conceptual activation in the mind – and toward the kinetic, operational, the reactive and the animate. That all art itself is inherently technological seems more apparent from the standpoint of today's intensely mediated world, but the question of the artist as a designer is still tenuous in dialogues about aesthetics. This legacy of art that engages directly with engineering is not limited to modernism and postmodernism, of course, as the persona of Leonardo da Vinci must constantly remind us, but nevertheless is a branch of aesthetics that has been overshadowed in historicization and institutionalization for most of art history's existence as a liberal arts discipline. The contemporary obsession with technology and the recent digital revolution, however, have rendered any ideological separation of aesthetics (be it in production or in critical consideration) from the language of engineering nearly impossible, and so art production can again now sway toward this well-established and well-founded tendency of art as *techne*.

et, there are inescapable differences between the digital age and the mechanical or industrial ages that must be illuminated to some cursory degree at least, if the gap that exists between industrial prototyping practices and digital prototyping is to be understood in relationship to contemporary art. Without reverting to the contested argument regarding the possibility of a 'third' industrial revolution – that of the digital, it is clear that computing proposes elaborate variations from older models of building and making in opposition to that of the mechanical and the industrial. Unlike earlier forms of prototyping, which sought to "*tame variation*", "transcend chance" and deliver a "world *made* to

measure," digital prototyping presumes an entirely alternate outlook toward production, consumption, the nature of medium and source, and authorship. 11 An analysis of some of these differences in outlook permits further comprehension of this shift in aesthetics I have tentatively described as a move toward a distinctly encoded kind of mimesis, and from the image to hardware as a platform for artificial sentience.

Like earlier forms of prototyping, digital prototyping stems from an experimental, procedural operation that assumes a process-based approach to creation and construction. Prototypes are preliminary versions and test cases based on a repetitive activity of trial-and-error, implemented hypothesis and elimination through application and validation. But where in mechanical-industrial prototyping the tools, components and materials used to build various prototypes may vary widely and not share identical commonalities, digital prototyping is always identified at bottom by the physical computing aspect of its makeup, even if these sensors and microcontrollers are stored in markedly divergent 'housing'. These miniature 'brains' of the work are not necessarily identical. Different users purchase, make (or design and pay to have fabricated), and even print myriad kinds of digital hardware components, and each unit has the potential to achieve specific ends tailored to the task at hand.

Nevertheless, at the heart of these prototypes is the determining anchor that is the circuit board, the breadboard or the microprocessor, which presents a vast array of potential applications thanks to its dynamic capabilities of interface with different hardware components. Instead of 'taming variation' and 'transcending chance', therefore, as the exacting science of mechanical prototyping sought to do, digital prototyping suggests almost infinite possibilities for construction types and functions. Measurements, reproducibility and perfection of a 'product' that can be made en masse are less pressing concerns for the unbounded realm of the digital prototype than is the potential for continually inventing new structures and applications.

These differences impact the ways in which prototyping applies to aesthetics in contemporary art, and also how prototyping varies from traditional aims and ends of iconographic mimesis. For all the variation possible in the appearance and output of current types of prototyping, the physical computing aspect of the digital prototype permits its reduction in an essential manner to the core device of the microcontroller or processor, which delivers the code to the rest of the hardware framework. This hidden hardware implement is the unspoken medium of the construction and the very framework for its iteration as interactive – and yet it most often has nothing to do with the final appearance of the work of art. Thus, rather than resembling life through any kind of imitation or mimetic approach through biomechanical simulations, robotic demonstration or other types of uncanny mimicry that might allow the prototype to approach the important legacy of the engineered automaton, the approximation of life in digital prototyping is achieved by a small, two dimensional hardware system that permits a new performance of life that is not based on iconic proximity. As a radical reiteration of the image, if you will, the microcontroller does not so much imitate life as it invites the potential for life itself to adapt or respond to the device's array of activities. In this way, digital prototyping in contemporary art could be seen as supporting a new understanding of mimesis, and that smart hardware may even upset the lasting hegemony of the mimetic icon due to the transformative kinds of knowledge and communication it promotes.

Conclusion

To what extent has the expansion of physical computing practices in art prototyping in the last decade effected significant and potentially lasting changes in the roles of artist, art object, aesthetics and audience? At minimum, it can be said that the continued development of interactive art practices has destabilized the hegemony of iconic mimeticism and its counterparts of iconoclasm and aniconicity by granting a constructed type of awareness and agency to the art object that is distinguishable from other modalities of meaning such as aura and signification. With its embrace of technology as an ongoing state of becoming, a development that evokes the durational tangent of life itself, interactive digital art unseats the formerly exclusive dominance of the artist and the spectator to some degree – although the level of autonomy of the art prototype is still debatable. Beyond the modernist claim for the autonomy of the art object through a break with mimetic representation through distortion or erasure, contemporary interactive art does not negate the doubling strategies of iconic mimesis but rather exceeds them in its performance of the characteristics of life.

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Public Making: Artistic Strategies for Working with Museum Collections, Technologies and Publics

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Abstract

This paper discusses the principle of 'Public Making', a strategy of conducting a creative process while working in and with the public to build artistic work. By first laying out a conceptual and theoretical framework around our intentions, this essay goes on to describe our practice through a significant program of work carried out during 2014. Our work included an artistic residency, two installations and a durational performance. The paper culminates on reflections into how Public Making opens up the artistic process and allows for multiple forms of participatory engagement to occur. This work was carried out on a variety of occasions with various cultural institutions including museums, heritage sites and arts organisations. This concept of building and making in and with the public attempts to open the 'black box' of creation allowing publics to engage with technological methods alongside an artistic process.

Keywords

Making, Public, Constructions, Technology, Building, Artistic Responses, Museum Collections, Heritage, Performance.

Introduction

This essay describes a program of work we have embarked on honouring a principle of 'Public Making'. By this phrase, we wish to highlight a dual sense of 'making-in-public' and 'making-with-the-public' to capture how we have conducted ourselves as artists working with museums, heritage institutions, arts organisations and their publics. We create works on-site, in compressed time-scales, with varied participation from visitors in response to heritage collections and the specifics of the site of our activities. We intend to make the process of making come alive for the public and our other collaborators and connect the works made to our labours in a visible, accountable fashion. Our works have a provisional, open character which crosses between installation and performance and which assemble multiple heterogenous elements, materials, technological idioms and creative practices. In so doing, we have ambitions to open up a creative space where the 'objects' of artistic production are seen to be contingent assemblages not only, as is common, through forms of critical theoretical discourse but through publicly accountable work with a specific material character. The potential for digital and allied electronic technologies in Public Making is specifically discussed. Our work started as a specific approach to working with museum and heritage collections but, as we shall show, it has begun to inform our overall approach as artists who present and perform work in a number of different settings.

New Technologies and Museum Collections

To set the context for how our work has unfolded, let us characterise and briefly review some of the research connecting new technologies and heritage collections. It is often argued that new technologies and innovative archive and collection digitisation can enhance a museum's reach, improve visitor experience and bring collections to life that may otherwise be under lock and key [e.g. 6]. Increasing acknowledgement of this has lead to a number of funding initiatives that investigate new forms of public engagement with museum collections. For example, Tyne and Wear Archives and Museums (TWAM) in Newcastle upon Tyne in the UK commissioned singer Richard Dawson and electronic duo Warm Digits to create musical work in response to the museum's unseen collections [8].

Such commissions are thought to contribute to the development of new forms of public engagement with museum collections, as well as being opportunities to unearth archival material that is not usually on public display. Both of these qualities are thought to have the potential to affect a community's perception of its heritage and the relevance of local history to the contemporary life of a place. Warm Digits' appropriation of images portraying the building of the Tyne and Wear Metro transport system, for example, raised questions around the utopian ideology informing development of Newcastle-upon-Tyne in the 1970s, the impact of such ideologies on the character of the city today and its relationship to the ongoing 'cultural' redevelopment of the city.

Digital technologies are often seen to have a key role in opening up collections and facilitating access to cultural institutions by social groups who traditionally may have not engaged with such resources [amongst many examples, see 8]. Along similar lines, a number of examples exist in the New Interfaces For Musical Expression (NIME) and International Symposium For Electronic Arts (ISEA) literatures of researchers working with cultural institutions or designing exhibitions using new technologies to explore

new artistic possibilities or to revisit cultural events of historical significance.

Interesting though many of these endeavours may be, they often manifest an instrumental character which position the public, their formation and their transformation as an effect of the ingenious design of technical artefacts and systems. Technology is 'deployed' to create or bring about effects. These could be changes of value, appreciation, senses of belonging, identity or whatever. Reciporically, archived, collected or other 'museological' material is seen to be technologically rendered or virtualized as a necessary step in this. Hence, the very many digitization endeavours the world over in the last 20 or more years.

We want to explore an alternative creative space and a different footing for technology in relationship to publics and collected materials and objects. Rather than see technologies as a means to engender extended, yet still institutionally or pedagogically acceptable heritage experiences, we want to open up possibilities for more disruptive technological uses and less reverential orientations to curated objects and archives. For us, this involves opening up the 'black boxes' (cf. Latour [7]) of technical systems and collected materials, tolerating a wider range of creative appropriation, and presenting our own work as a publicly available and contingent enterprise.

Objects, Things and Materials

To aid this, our work has been specifically informed by some recent critical contributions to archaeology, anthropology and material culture. Ingold [4] for example notes how commonly we are presented with ready-made objects without access to the means by which they were produced because, say, they are part of an archeological record or they are part of an industrial production process we cannot inspect. The means of their making is lost or hard to recover. For Ingold, drawing on Heidegger, there is a profound difference between 'objects' on the one hand and 'material' and 'things' on the other. Through the examination of the lived practices of 'makers' of all sorts, Ingold argues that we can approach artefacts as *materials* that have inherent potential, rather than objects with fixed cultural meaning.

In our work, our intention has been to reconfigure artefacts drawn from museum collections and find new ways in which they could be understood and engaged with, in particular, through creative appropriation. In this fashion, we seek to question some traditional thinking around heritage and museum practice, which presents artefacts and objects *from the past*, rather than framing them in the context of their presence in contemporary culture and their 'perdurance' [4] into the future. In doing so we aimed to enable alternative forms of engagement with the collection for both us as artists working with them and our publics, and consequently a deeper, more varied, and perhaps heterodox, understanding of how the materials came to be the objects they are in the museum's collection. Through Public Making (in public, with the public), we sought to create a stage in which 'objects' could be reworked as 'things' with varied material potential.

Sensory Engagement, Juxtaposition and Design for Appropriation

In a number of landmark pieces of work in Human Computer Interaction, Gaver and his colleagues at the Goldsmiths Interaction Research Studio have advocated strategies for, variably, 'ludic design', 'ambiguity as a design resource' and 'design for interpretation and appropriation'. The intention of much of this work is to explore designs which are open ended and amenable to a number of interpretations of their point and value, rather than engage in more classic forms of 'user-oriented design' which tend to privilege the function of interactive artifacts. In a recent paper, [3] Gaver et al. describe a series of 'indoor weather stations' as a means for furthering this concern to address, in an oblique way, some of the concerns in 'environmental Human Computer Interaction (HCI)'. Drawing on this work, we sought to create ambiguous pieces which did not didactically mandate any particular interpretation of museum artefacts but allowed them to be imaginatively appropriated.

To facilitate this, we employed two main strategies. First, we *juxtaposed* the artefacts with other materials and data so as to highlight questions of variability of interpretation and the varied timescales (and 'spacescales') in terms of which phenomena can be understood. In our case, this involved juxtaposing geological and fossil samples drawn from a collection with real-time atmospherical and meterological data and simple simulations of geological and meterological processes. Several of our sonic and visual displays are oriented around this concern. Secondly, we were concerned to *extend sensory engagement* with artefacts and present relevant phenomena in novel sensory forms. In some ways, this is an extension of the practice that many museums conduct of 'handling sessions' where the look and feel of objects is brought to attention. In our case, however, we were concerned to go beyond what is normally the didactic business of such sessions and make, for example, geological textures and meterological data available in ambiguous sonic forms. In this way, we hoped that public encounters with museum objects, and our work extending their sensation in juxtaposition across time and space-scales, would facilitate new imaginative trajectories for the collections we were working with.

A Program of Public Making

This essay draws upon a program of work which included three practical, creative interventions by the authors in 2014. First, *Interglacial*, an initial artistic residency carried out in partnership with the Pacitti Company, Ipswich and London, UK – an arts organization dedicated to supporting live art and performance, and for exploring artistic strategies for engaging with publics and local institutions.

Second, *Erratics,* a follow up visiting residency at the Pacitti Company building on the themes and concepts explored in the first. As we have hinted and will shortly discuss in more depth, both of these residencies took as their point of departure an engagement with artefacts drawn from a museum's natural history collection. Third, *Salient/Re-Entrant,* a durational performance at the Fort Process one-day music festival in Newhaven Fort, Sussex, UK, organised by promoters Lost Property. Here, we began to extend our approach from museum and heritage contexts to that of a contemporary music festival. The context and presentations for this work varies, but our commitment to Public Making occurred throughout.

During the residencies, which comprised of two three-day periods, we creatively responded to a number of museum artifacts. This work culminated in two multi-channel sound and image installations open to the public. The first residency explored making, material culture and various forms of data visulisation and sonification. A concise description of our explorations in *Interglacial*, focusing on its relevance to sound making technologies, was published in the NIME proceedings in 2014 [2]. The second residency, *Erratics*, built upon these concepts but deepened our allusion to critical themes in material culture, exploring the trajectories of objects and materials and the layering of processes and forms of knowledge.

During our time on both the residencies we built a number of constructions using various forms of technology engaging with specific themes suggested to us by the museum collection. The artefacts were explored in and with the public in a number of ways. One of our participants had a practicing background in evolutionary anthropology and helped us explore and understand possible uses for some of the Neolithic hand tools in the collection. Another, a visual artist, began mapping the objects to geographical location. By locating where certain artifacts were found and identifying what material they comprised of we could compare these objects to geological maps that were also present. We began physically spanning the journey of these objects and their materials. A young person who had a particular interest in the digital video game Minecraft also visited us. With him, we explored the similarities between the museum materials and materials used in the game, giving us an alternative perspective on our work.

Our Constructions at *Interglacial* and *Erratics*

Over the course of the *Interglacial* and *Erratics* residencies, we created a large number of works, devices and bodies of material. By way of overview before more detailed description, let us list the following:

- Sonic Microscope and Image Sonification
- Live Proximal and Remote and Historical Weather Data
- A Sonified Weather Station
- Gadgeteer Ambient Atmospherics
- Rock Harmonium
- Field Recordings
- An Erratic Texture Generator
- Explorations in Cymatics
- Mark Making Devices
- An Algorithmic Glacial Composition

Sonic Microscope and Image Sonification. One participant of our Public Making cohort brought a digital USB microscope to our first session. She had used it in some of her own work around forensics to take close up images of fictional evidence at a fictional crime scene. Using a number of image to sound making techniques we made these microscopic images into sonic instruments. The first method was to pixel scan the live video feed using PureData-Gem. The live image was restricted to a square pixel canvas (500x500) and then scanned horizontally and vertically. Taking the greyscale of each pixel the data was mapped to a wavetable and sonified to a number of drones. The changes in timbre were effected by the differing surfaces of the museum samples we were examining. A highly textured surface would create a dense, complex waveform with tight harmonics, while a smooth, flat surface would create more simple, single tone wave shapes. Taking inspiration from Andre Smirnoff's text 'Sound in Z' [1] we built our own version of the ANS Synthesizer using the sonic microscope. In this construction each pixel line related to a different oscillator. The gain of each oscillator was controlled by the amount of light in each pixel. The image was scanned vertically and became a graphic score adding visual stimulus to the ongoing soundscape. The Sonic Microscope was presented on a table with a number of rock samples so participants could explore sonic and visual textures at leisure.

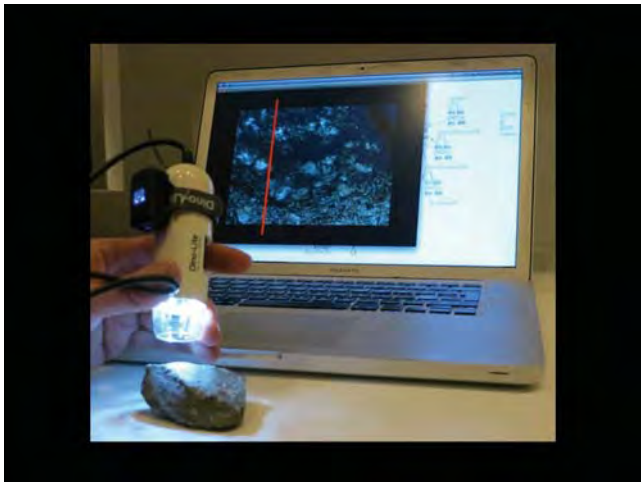

Figure 1. The Sonic Microscope examining a geological example

Live Proximal and Remote and Historical Weather Data. To provoke thought around changing weather and contrasting climate conditions, we decided to compare live weather data from a local weather station and a station situated at the other side of the world. Using Python to scrape data from wunderground.com (Weather Underground), we took numerical data from a weather

station in Lowestoft, UK and compared this with data from Auckland, New Zealand. We also implemented historical data from a database ranging between 500AD to the present day. The database consisted of paleoclimatological reconstructions of temperature and rainfall from Central Europe. These data were translated into colour and sound using PureData-Gem and presented on a screen with code windows open and inspectable.

Weather Station. Outside we deployed a weather sensor kit to give ourselves a localised perspective on immediate changes in weather. Using a SparkFun weather station we took readings of wind speed, wind direction and rainfall and relayed these to a number of stepper motors striking constructed sound sculptures. The stepper motors were placed around the indoor space in which we were working giving a spatial quality to the sound. Changes in the weather could be heard on the various sound sculptures which consisted of sand, grit and other related geological and metrological material.

Gadgeteer Ambient Atmospherics. To contrast to the remote and outside atmospheric data gathered in our previous constructions, we decided to take some readings from changes inside the immediate space. Using the Gadgeteer prototyping system with a number of sensors attached, we picked up atmospheric data from the room. Ambient light level, humidity, barometric pressure and moisture sensors were interfaced and parsed to Max/MSP for sonification. All outputs of the sensors were connected to an additive, fixed spectra synthesizer resulting in a contained but ever changing sound.

Figure 2. Electrifying a geological sample

Rock Harmonium. To explore the texture and consistency of a number of non-precious rocks from the collection we set up a low voltage circuit powered by a 9-volt battery. The circuit was connected at one side to the battery and the other to a loudspeaker with the various rocks in between acting as resistors (see Figure 2). As current passed through the material varying resistances resulted in noisy splutterings amplified through a mini-speaker. The rocks were set side by side each with an on/off switch giving the construction more performativity so visitors and fellow public makers could play the construction with ease.

Field Recordings. While mapping the various artifacts to specific locations on the maps, we decided to collect a number of site relevant field recordings. Once collected the recordings were processed in a number of ways including granular synthesis, transducer to surface explorations, and various forms of manipulated playback. We approached the collected recordings as another fluid element that could be layered alongside the physical and sonic material.

Recording Water, Ice, Sand and Rocks. We set up a number of informal recording sessions were we performed directly with the raw materials aided by members of the public. To create our own mini glaciation we decided to place a piezo contact microphone in some water and freeze it. The whole of the freezing process was recorded and played back alongside the various site-specific field records we had made previously. We also recorded the opposite change, the ice melting. Subtle cracks, squeaks and groans appeared in the record following a number of gain and filtering processes. We performed with a number of rocks, dropping sand and small rocks into resonant bowls attached with contact microphones. Using a number of non-precious rocks, we set up a lithophones and recorded a number of participants playing them. The lithophones, alongside the Rock Harmonium, allowed new visitors to enter the space and experiment with our constructions almost immediately.

Erratic Textures. In the town where we were working, there are a number of glacial erratics which were dredged and deposited by the riverside when the town's dock was cut in the 19th century. Erratics are rocks which are not indigenous to the area where they are found but have been carried there by glacial movement. One of us has been taking photographs of the surfaces of these rocks over a period of several years, documenting their changes with variations in daylight, the seasons, the growth of lichens and mosses on their surfaces, and changing layers of graffiti (see Figure 3). In PureData-Gem, an application was built which layered four of these photographs at a time, combining the layers with various forms of image subtraction, differencing, multiplication and compositing. The photographs changed their contribution to the composite to yield slowly changing textures which were sonified, using the scanning method described above, and projected. Random selections from a corpus of several hundred photographs were made to create an open-ended 'erratic texture machine'.

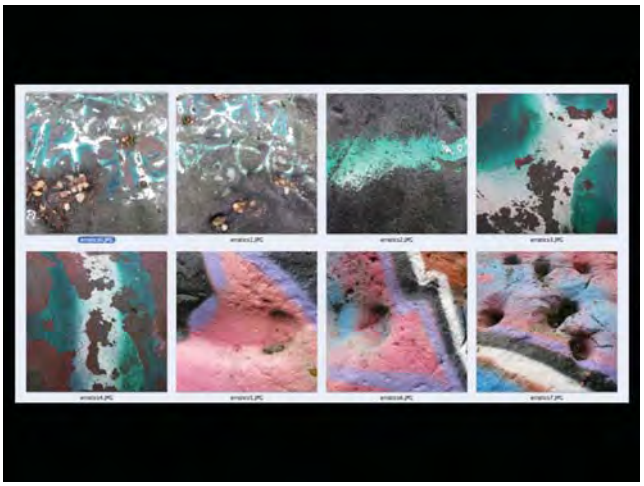

Figure 3. A selection of close up images taken of the Ipswich erratics

Cymatics. Using a range of audio transducers and thin materials for a diaphragm, we set up a number of cymatic experiments using rock, salt and sand as grains. By playing various recordings and live sound synthesis through the apparatus, we created a variety of cymatic formations. This acted as a contrast to our image to sound experiments by imposing sound onto physical matter.

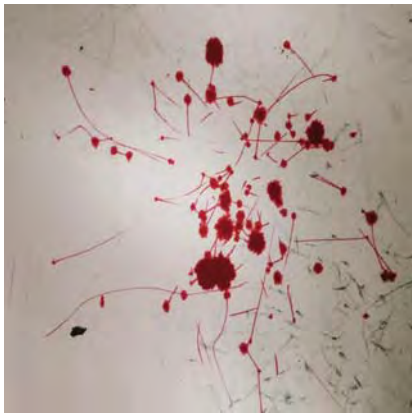

Figure 4. Marks made in response to streams of weather data

Mark Making. As a development of the weather station to stepper motors construction, we decided to attach mark making tools to the motors to create further ever-developing line drawings. Biros, charcoal, pencils and felt tip pens were all attached to various prepared stepper motors which continued to make marks on large pieces of paper laid out on tables or the floor.

Glacial Composition. The corpus of sound files we had made over the course of the two residencies were categorised and variably mixed to create a live, electroacoustic composition. An eight channel granular synthesis/brassage/collage application was built in PureData to process the sound files and algorithmically vary the mix. The combination of categories of sound files contributing to the mix at any one moment was varied to create different impressions of the scale and duration of imagined glacial, meterological and land formation processes, spatialised over an eight loud speaker sound system. The conceit of this was to present a series of thousand year epochal glacial processes compressed into a listening experience of tens of minutes.

Putting It All Together I: A Sensorium

During the making process we attempted to create a working space which could be easily navigable by visitors. Keeping a clear path through the room and setting space between the various construction 'stations' allowed visitors to travel through the environment with ease. We also tried to differentiate areas between 'partially complete' instruments and more finalised constructions. This enabled us to have making tables dedicated to work 'in development' whilst other channels of the installation continued. The various objects from the museum collection were placed on a desk near the entrance to the space. By setting up the environment in this way, our intention was to create a physical trajectory through the installation environment relating to our ideas around material trajectories. A structured exhibition feel quickly emerged as more responses were added to the environment.

Figure 5. A sensorium of constructions

Putting together the work in this way created the form of a 'sensorium', a configuration of overlapping and intertwined sensory experiences. This ecology of activity could be simultaneously experienced as a whole alongside a more detailed exploration of its parts. The environment was built from a collection of 'islands' or 'stations' each demonstrating a differing construction or response to the archival material. Most stations were associated with one or two loudspeakers which were positioned into groups of three, creating a 'lattice' of listening spaces. Whilst visitors navigated the space, complex crossfades between stations could be experienced, allowing ones position within the sensorium to directly inform one's own experience of the composition. In this way each visitors had the opportunity to zoom in and out of each construction and experience the piece as a whole or focus on individual stations. To reinforce the sensory space, the room was darkened, lit by small lights, computer screens and projectors.

Putting It All Together II: An Erratic Assemblage

During *Erratics* we experimented with another way of connecting together the constructions we had made. An assemblage was made combining different constructions with each, in some way, re-inscribing, re-analysing or re-presenting output from another construction. In this way, a chain of re-inscription could be created.

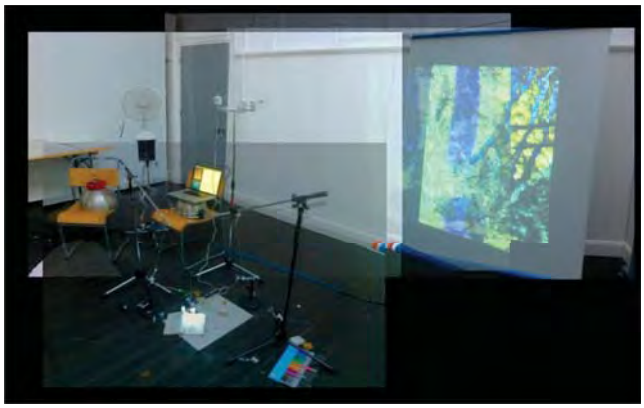

Figure 6. An Erratic assemblage

In Figure 4 a fan influences a weather station which is programmed to move a number of stepper motors which move a pen suspended above a piece of paper. The inscription is surveyed by the sonic microscope which sonifies the marks on the page. The fan also blows against a piezo ribbon contact microphone which is connected to a small amplifier. The sound from the piezo ribbon and the movement of the pen also influence the changes of algorithmically generated erratic textures. In this way, complex chains of re-inscription and re-materialisation could be explored.

By putting the work together as an assemblage we reinforced the spatial qualities of our sensorium. Presenting constructions so they were interacting with each other allowed for further layerings of materials to be configured within the space. Having presented the work in an installation setting, we decided to apply thoughts and conceptions around the sensorium and sonic assemblages through another form of artistic presentation, a durational performance.

Fort Process

Fort Process took place over a single day in September 2014, within Newhaven Fort, situated on the South Coast of England. The fort, built under the instruction of Lord Palmerston between 1865 and 1871, was intended to defend England from the threat of invasion from the French. Its thickly armoured walls, varied spaces and underground tunnels make the fort an extremely suitable venue for a festival of music and sound art. On the day, many of the architecturally interesting spaces accommodated sound installations, performances and visual works from a variety of artists, musicians and makers. Our activities took place in one of the old storage rooms, originally used for the keeping of armaments and explosives. We took this opportunity to build on our museum-oriented work and realise a form of a Public Making performance. Over an 8 hour period we built, performed and manipulated a collection of self-made instruments incorporating into our work sonic, physical and conceptual material collected from research explorations around the Fort. Alongside the DIY constructions, we also performed with various commercially available instruments including a modular synthesiser made up of a selected collection of modules and an OP1 synthesiser from Teenage Engineering. The piece was physically presented to the public in a variety of different ways. We took various roles as performers, from informal conversations around our process, to more recognisable performances in front of watching and listening audience members. We intentionally decided to set up our performance environment without a stage, allowing fluid movement of audience and performer around the physical space. A variety of sound sources were placed around the space creating a spatial, sonorous environment which audience and performer moved through.

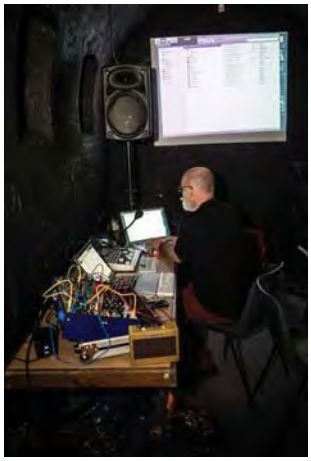

Figure 7. *Salient/Re-Entrant:* performing at *Fort Process*

Our Constructions at *Fort Process*

As the public visited us during our performance at *Fort Process,* we deployed and created a number of constructions, devices and systems. In addition, we re-used some of the constructions from *Interglacial* and *Erratics*. Our work, *Salient/Re-Entrant,* alluded to military tactics and features of the architectural and landscape formations. Newhaven Fort features an architectural salient at the front of the structure used as a defense device in case of invasion. Our constructions were based on themes around military technology, communication devices and acoustic exploration of the site. As a contribution to a musical festival organised around timed performances, we decided that our work should have a baseline or background of semi-prepared constructions against which on-site making could take place. For example, *Fields*, which we will shortly describe, was assembled and implemented on-site

with new sound material collected at the fort but was not programmed from scratch. In contrast, our experiments with Sound Ranging emerged as a blank PureData patch edit screen was filled, all the while folding the testing of the patch into the ongoing performance. *Salient/Re-Entrant* saw the following being made and/or configured:

- *Fields*
- *The Granular Grabber*
- Contact microphone experiments
- Sound Ranging
- FM Radio Transmitters
- The Granular Engine
- A Collection of PureData Raspberry Pis
- Field recordings

We describe these now in more detail.

Fields. Using a wireless router connected to a localised server running from a MacBook laptop, participants could connect with their personal devices (smart phones and tablets) to a Wi-Fi network. Once connected, devices are forwarded to a webpage loaded with a number of sound files and virtual synthesis 'instruments'. The connection allows us to perform the sounds and instruments from the centralised server, outputting sound through the inbuilt speakers on the personal devices. Sounds chosen to diffuse included field recordings collected from the site, a sawtooth synthesiser and a white noise generator. Granular synthesis was implemented to allow more performativity to the sound file playback. Parameters such as pitch, grain size and density could be easily controlled using the system's web interface. Each time a new audience member entered the space they could connect and intersect the performance. Audience members often explored the space holding their own personal device, creating dynamic sound diffusions and interesting sonic spatialisations. When a number of participants were connected it resulted in a 'textural shimmering' throughout the environment. The Fields system creatively embellishes the network latency that occurs between devices. This was enhanced using our randomised grain technique, which opens up the possibility for each device to play the same sound file at different positions, resulting in a very densely textured and layered output. The system provided a successful curiosity, as people were connecting, others would be intrigued and ask how to join in. Sounds continued to play from the device even when participants had left the space, creating an interesting boundary to our performance. This bespoke musical diffusion system is an on-going collaboration between Sébastien Piquemal and one of us [9].

The Granular Grabber. Using PureData and the inbuilt microphone on a MacBook Pro, a system was built which momentarily recorded sound from the immediate environment and played it back in a variety of ways using a single voice granular synthesis instrument. Techniques including pitch shift, grain length and position were implemented. A recorded moment, consisting of a sample of around 5 seconds, would occur between 20 to 60 seconds using a variable time delay. Each moment was played back in a slightly different way using the various granular techniques. The Granular Grabber, sampled the environment throughout the duration of the performance, it created a temporary, never repeating juncture of the sonic space.

Contact Microphones. Various contact microphones were placed around the space to amplify particular surfaces and reveal certain unperceivable sounds. Most successfully this was implemented on a steel ramp at the entrance of the space. As audience members entered, the slight movement from the ramp resulted in a large gestural amplified sound which was presented in front of them from a portable amplifier.

Sound Ranging. A crude software simulation of a military sound ranging technique was created. Two microphones were placed far apart in our performance space and approximate measures of the difference in onset of a sound at the two microphones were made. These measures were then, in turn, used to vary the sounds that were released into the performance space. In this way, how the space reacted to different sounds varied the character of the sounds in turn.

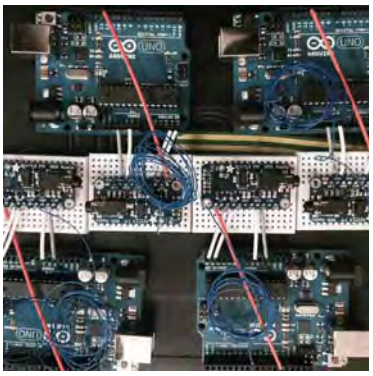

Figure 5. A collection of Arduino controlled FM transmitters

Radio Transmitters. Both the Granular Grabber and the Contact Microphones were broadcast throughout the space using the Adafruit FM radio transmitter. This module allows a live audio feed to be broadcast up to 10 meters. A number of small, handheld radios were dotted around the environment allowing further textured sonic distributions to occur alongside the audience's phones and tablets. One radio was placed near the entrance of the venue. This provided new visitors with a moment of 'grabbed' composition before physically entering the space.

Granular Engine. A number of field recording collected from the site were loaded into a multi voice granular synthesis patch built using Max/MSP The patch is able to play clusters of 'grain clouds', creating a dense, textural sound that counterpoised the smaller, more delicate sounds

from the phones and radios. The patch was controlled using Open Sound Control (OSC) via a bespoke TouchOSC interface on an iPad. Various interaction controls were implemented including volume sliders, toggle switches and a number of XY pads. Grain pitch and duration were readily available controls to provide a rapid way of creating a suitable drone to suit the ever-changing sound environment.

The PureData Raspberry Pi. Using a collection of Raspberry Pis running the Raspbian Operating System (OS) made by Debian Wheezy it was possible to run a number of smaller computers which could be dotted around the space. Each Pi was running a contrasting synthesis patch built with PureData. The patches were programmed through the Secure Shell (SSH) protocol using Apple's Terminal so that extra keyboards and monitor screens were not necessary. The Pi's were then run 'headless' and multiple smaller sound sources could be placed around the environment with ease.

Field Recordings. A corpus of field recordings was created by us on-site during the performance. The Fort contained a number of characteristic sound environments: tunnels, wind-swept fortifications at the top of a cliff, a carponier in which the sounds of the sea were oddly reflected, amongst others. These recordings were used in *Fields*, *The Granular Grabber*, the Granular Engine and played back alongside our other instruments.

Discussion

We have presented how we have developed a vast range of devices, constructions, activities, experimental strategies, working with a variety of materials and forms of sonification, visualization and inscription. We have worked in public and incorporated members of the public into co-creating pieces with us. Our work attempts to make the practice of artistic production a publicly visible and potentially participatory affair. We began by exploring strategies for responding to museum collections as a source of artistic material and built upon this work to create performable installations and make a contribution to a music festival.

This paper documents our constructions and outlines the critical principles behind our notion of Public Making. Elsewhere, we have begun to analyse the public's response to the situations we create and document how our work has enabled people to make imaginative connections with the collections we have drawn upon and, from time to time, critically think about museums and allied institutions [2]. Working in public has also enabled people to critically engage with us as we do our work, interrogating our techniques, our motivations and aesthetic values in ways which go beyond what is typically possible in formats like, say, artists' talks. In contrast, in activities such as those we promote, the work itself is concurrently visible and enables discussions of technology and value to be concretised and given sense in terms of specific acts of making.

We hope also to have given a hint at how strategies of Public Making can help further a critical heritage and artistic discourse – one which connects a range of heterogeneous technologies and materials, including the digital, to recent concepts from studies of material culture such as [4] and approaches to digital design such as [2]. Our explorations of Public Making are at an early stage and rather than the phrase defining a precise set of techniques or any kind of rigorous method, for us it points more to a set of values we believe important to disseminate – values to do with the visibility, accessibility and accountability of artistic work. These are values, for us, which increase in their importance in a global culture with tendencies to technological fetishism and the obscuring of the means by which materials are sourced, things made, and values taken for granted. For us, Public Making is a way in which the 'electronic artist' can disrupt this tendency.

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Against the Looping Stupor: Regaining a Perspective on DIY

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Abstract

DIY (do-it-yourself) has taken on expanded meaning beyond re-appropriating communication and media typical for underground cultural movements since the seventies. DIY has been extended by the so-called 'bedroom generation' during the nineties, metaphorically opening its bedroom walls to the digitally connected world. Twenty years later the same and the subsequent generations seem to be trapped in an endless technologically-driven self-referential narrative. Furthermore, the virtual disappearance of the walls has been conceptually replaced by the borders of the screen to which they're constantly referring. The previous ability to question dominant cultural code and enable alternative 'processes', has been obfuscated by the easiness and almost instantness of producing virtual and physical products. This as generated an vacuous loop of self-gratification. Confronting the media strategies of contemporary DIY is then necessary in order to break out of this loop and find again a strategic perspective.

Keywords

DIY, publishing, book scanner, 3D printing, CCTV Camera, selfie

Personal Zines: Network VS. Images

Let's take one of the most classic products of DIY publishing: the zine. Zines as we know them were created in the sixties thanks to the spread of the mimeograph machine allowing self-publishing by diverse groups, from science fiction fans in United States to political opposition groups behind the Iron Curtain. In the seventies the punk movement started to use them fully, as a proper medium, encouraging the networking and the re-appropriation of visual practices, inspiring the mass production of zines in the subsequent decades. Among them is the incredible mail-art zine production meant to establish a network of artists, exhibitions, shared practices and gestures around the world through the postal network. Or the practice of assembling fake magazines (from "Il Male" [1] in the 70s to "The New York Times Special Edition" [2] in late 2000s) triggering controversial social reactions and so rising public awareness about how printed media work.

But if we look at the current printed zine scene, after the internet revolution, there's an absolute majority of visual, personal zines. In the recent survey book "Behind the Zines" [3] we find dozens of zines whose main editorial strategy seems to become catalogues of images, with certain aesthetics, taste and sometimes interesting visual paths and twists, but still remaining an endless plain sequence of images and very short texts. The potential of inducing social changes and opportunities, opening up paths for agency by the reader, is then largely missed, focusing on the product appeal and becoming then more "self-gratification" motivation.

And although some zines now seems interested in processes that can be triggered by readers, there are rare exceptions. For example, among the most recent 'visual' zines, there's a new one called "City Strips" and its issue #1 titled "The Amazing City" [4] is comprised exclusively of panels from the Amazing Spiderman series in NYC, from 1963 to 1974, which is comprised exclusively of panels from the Amazing Spiderman series in NYC, from 1963 to 1974, reconstructing the view of the city in that years through silent comic panels depicting representing architectural elements. In its own silent narrative, it's definitely inspiring readers to re-appropriate images, defining their own consistent algorithm of selection and re-assemblage from celebrated copyright protected comics with a broader scope than just collecting them.

Figure 1. City Strips, Issue #1 The Amazing City.

Personal Collection: DIY Book Scanner VS. 3D Printed Objects

In the 'digitising everything' collective hysteria which aims to have every conceivable cultural object available at our fingertips through any personal screen, there are at least two different perspectives: digitise to share and digitise to produce. One recent very symbolic development is an open source hardware tool for scanning: the so-called DIY book scanner [6], which is made clearly made to share. A community of 4.000 people is developing and documenting hundreds of variations of this fast book scanners made mainly with cameras (much faster than the moving light and CCDs used in classic flatbed scanners), sophisticated free software, Rasperry Pi boards and structures made out of cheap parts of wood and metal. In their most sophisticated versions they can scan a 150 pages paperback book in less than 15 minutes and eventually make the text searchable with more patient and software-assisted effort. This tool is meant to be an instrument to construct your own digital library and to share it with anybody at any level, explicitly contrasting the current logic of commercial cloud-based service to decide what type of content you'd be allowed to buy. DIY scanning and sharing of publications are an intimate act and there's a quite large scene made by counter-cultural and political hackers that are actively facilitating the re-appropriation of the elements of libraries, including historical counter-cultural ones like leftist archives and anarchist documentation centres. Furthermore the sharing of the scanned materials can be done publicly through open platforms like archive.org, or deciding and planning which "digital territories" will be able to personally access them.
On the other end the 3D printer is instead intrinsically built to produce. There's still a huge liberating potential in the enabling of personal manufacturing: it'd would eventually empower the single person to break the laws centralised and controlled production of physical goods, being able to create what is needed in a single piece (vs. mass production with its consequent mass created waste), or what is needed by local communities instead of thinking in terms of global markets. However, this perspective remains largely unrealized.

In fact there's a massive amount of objects meant to satisfy, again, this self-gratification loop. The process in this case, meant as re-appropriation, manipulation and production is usually overcome by aesthetic fascination, in a looping stupor of the "objet trouvé" which slowly materialises in front of our eyes during its printing process. So we can find plenty of examples of 3D printers used to make extremely refined objects, aimed to pure aesthetic enjoyment. The Japanese artist Aki Inomata well represents this approach, in his series "Why Not Hand Over a 'Shelter' to Hermit Crabs?" [6] where he prints in 3D transparent shelters for crabs which incorporate iconic cities' architectures. The 'craft' element in 3D printing is mostly unavoidable, but here (and often in so many 3D printing-based projects) is where it starts and ends, leaving the very potential of this technology, which is of being networked and infinitely programmable, mainly unexplored.

But there are exceptions. "The Free Universal construction kit" [7] by Golan Levin, for example, is empowering users to combine incompatible toy construction kits from different industrial copyrighted ones, establishing an open platform to collectively overcome corporate imposed limits, sharing the results. But also the conceptual work of the Japanese artist Megumi Igarashi, aka Rokudenashiko uses 3D printing to manufacture a product with controversial meanings. Her project "3D MK Boat" [8] consisted in printing in 3D several objects (including a usable kayak) with the shape of her own vagina. She's implicitly inviting women to replicate what she did, enhancing the abstract geometric aesthetic of the body and pitting it against the absurd Japanese obscene laws (she has been even arrested and then released a couple of days later).

In both these projects, the networked process is indistinguishable from the crafted art object, which finally becomes a proper medium of communication to embody physical and cultural contradictions. Here "creating" a three-dimensional object from an abstract descriptive computer file is not ending with short lasting ecstatic contemplation of the just produced object, but it's a process instigating other processes, acts, gestures and the evolution of the embodied cultural meanings of object itself.

Figure 2. Golan Levin "The Free Universal construction kit"

Personal Image: DIY CCTV Camera Resistance VS. Selfies

Another crucial aspect of the personal information environment is the digitalisation of our own faces. In the

'digitising everything' trend, face is a quite sensitive element, as it's our most private and at the same time most public part of our body. Nowadays it's even more public than ever, with the extreme proliferations of surveillance cameras that record and increasingly detect and recognise our facial biometric data.

Despite a de facto social acceptance of cameras all over public and private spaces, there are still gestures of resistance, especially in the art world. Ai Wei Wei, for example, in 2013 published a short visual manual about "how to block a surveillance camera" [9] with detailed instructions about building a DIY device that would have let people to spray paint on camera's optics without being exposed and recorded. And in an even more radical gesture, Leo Selvaggio has started the "URME Surveillance Project," [10] where he makes and sells at production cost rubber masks of his own face. The challenge then is to be detected and recorded in plenty of places sometimes in the very same moment and in the same space, putting the control paradigm literally out of control.

The portrait has always been a mirror of our presumed superior image (compared to animals, for example), and now it's more and more dissolving in recombinable pixels. The phenomenon of selfies, in fact, seems to be absolutely iconic of the "me me me" generation, seemingly more interested in being recognized from the world as 'cool' and trapped in more and more suffocating self-gratification loops (which indeed are at the core of any social network). In the selfie, the portrait becomes immediate, endlessly repeatable, replicable and enjoyable, especially when it's then part of the (less and less controllable) cloud.

Self-gratification loops are triggering various digital obsessions. Psychologist define this kind of loops "operant conditioning' [11]. It's about how what we do depends on either the reward (or the punishment) of what we have done last time (which is indeed a seminal concept in behaviourism). Experiments with animals prove that if they're rewarded only sometimes and at random intervals they're way more motivated to work hard than if they're having regular rewards. It's what is defined as "variable interval reinforcement schedule." [12] The intrinsic logic is that even without knowing when and if the next reward will arrive the subject is motivated to work hard longer because "next time" should still be the right one, since no evidence can definitely prove that rewards have been stopped altogether. So we can become trapped in looking for a reward in the next perfect selfie, or in the next fascinating 3D printed object, or in the next image among the many printed in a zine (as well as in the next Facebook post, email, news, etc.).

Selfies can also be treated with a different approach, closer to the personal history through self-portraits than to the disposable quick shots with a smile/grimace. Japanese artist Chino Otsuka, for example, makes this practice a surreal one in her series "Imagine Finding Me." [13] Here she modifies with Photoshop pictures of her as a kid, seemingly integrating a recent picture of her. The visual result is impressive and destabilising, as she can confront herself with memories in the same photographic and visual space, as if she was physically able to meet her own past. This photographic historical paradox pushes us to reflect on the very nature of the representation in portraits and the implicit meanings that can be carried within pictures. Furthermore the processual nature of the composition gives space to other possible strategies to be shared and widely applied (what would happen if people started to modify pictures creating thousands or millions of such paradoxes?). It can be referred to a famous quote by Brian Eno is: "stop thinking about artworks as objects, and start thinking about them as triggers of experience.".

Conclusions

These comparisons between different artist's printed products, scanning vs. printing devices, and among self representation mechanisms can be abstracted to a higher level. It'd be surely worth considering how much personal information we just give away to corporations without even being able to retrieve them after a trivial technical problem. Giving up the chance to enable 'processes' in exchange of 'self-gratification rewards', means embracing on one side the corporate cloud oligarchy in its multiple embodiments and on the other side the serial digital craft, ready to suck, chew and metabolise our own data in slick elegance. Even at the abstract technical level, there are still other forms of resistance, like Danja Vasiliev's "Superglue" [14] project of a simple visual web authoring and almost plug-and-play personal server toolkit which would finally let you host your online data in our own physical space.

Together with the above mentioned shared projects and techniques it could significantly contribute to focus on the processes involved in our digital gestures and refuse the seductive laziness to receive everything we need digitally and emotionally through obscure remote services. If the virtual windows of the early internet personal world have mostly become global virtual mirrors, perennially reflecting our gestures and manifesting within the giant collective cloud, we'd reclaim our right to select and share only the data and the culture we want to share (from the present and the past), reinforcing our own networks and finally enabling meaningful processes that would start making significant cultural and social changes.

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Redundant Technology: Disrupting Lineal Narratives

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Abstract

The cathode ray tube (CRT) found in television sets, radar, oscilloscopes and legacy computer monitors, like many redundant technologies have been integral to Installation and Video Art since their first documented use in galleries in the early 1960s. Despite a steady decline in their production since 2005, the recent use of CRT's by video and installation artists continues in the work of artists such as Justene Williams (*Crutch Dance,* 2011), Pia Van Gelder (*Apparition Apparatus*, 2012) and Tivon Rice (*Burn-In Portrait # 1*, 2007-2010). Most of the literature in the field of CRT's in contemporary art, such as Miller (2013), Ratti (2013), Stumm (2004) and Laurenson (2005) focuses either on the material logistics of the use of CRT's and future curatorial implications, or their utilization as 'electronic canvases' - conduits for pre-recorded/transmitted images. This paper explores the use of the CRT in video installation art in an attempt to distinguish, categorize and define modes of disruption to the mainstream lineal narrative of media consumption caused by artists using what are commonly deemed obsolete or redundant technologies.

Keywords

Cathode Ray Tube, Materiality, Recycle, Remediated Technology, Waste Cycles, Disrupted Technological Development, Redundant Technology

Introduction

Artists have utilized CRT's either in their contained 'shell', or television encasing or as "tubes" removed from their cases, as in the works of Gary Hill. On the flip side many artists have used retro fit-outs, where new tubes or flat screen plasma or LCD technologies have replaced faulty CRT's, as in many of Nam June Paik's works. [1] Regardless of how they have been utilized, the actual physical form of the CRT remains crucial to the functioning of many works that rely on them as core components, particularly in a historical and sculptural sense, incorporated into the apparatus of modern art works.[1] This is the case with Gary Hill's installation *Between Cinema and a Hard Place* (1991), where upon instruction from the artist, the Tate Modern in London purchased a stock supply of the exact same models of CRT monitors used by Hill in the original work for conservation purposes.

> The work consists of twenty three monitors of varying sizes, the outer shells of which have been removed…Hill indicated that the cathode-ray-tube monitors are fundamental to the meaning and aesthetics of the work, and therefore replaceable with others of the same type and dimensions, but not different format....[2]

The fact that the CRT is replaceable at all in the works of prominent artists alludes to the primacy of content in many, if not most moving image based works. More importantly, it highlights the impermanence of technology, it's movement through cycles of redundancy, development and renewal.[3] Hill, in allowing for the replacement of the core elements (the CRT) in *Between Cinema and a Hard Place (1991)*, would initially seem a kind of purist preservationist of the historical and material importance of the work, yet in many ways it serves as a reminder of how that very historicity is bound by restrictive conditions dictated by its material economy and production system.[4][5] It is calling for a degree of precision and historical accuracy in the preservation of art, but simultaneously admitting the failure of technology to allow this to happen without ostensibly reproducing retro technology for the sake of future preservation. The physicality of the work becomes a secondary consideration. From a media artists' point of view, this may well be an unavoidable restriction. The materiality of the artists' toolset is cast aside when the machine begins to fail or break-down, the specter of failure becomes a natural extension of the media artist's ritual when making new work. [6]

Video art differs from video installation art in this regard, making the use of CRTs for displaying video art works more of a novelty. A cursory survey of most video art based archives indicates that moving image based works made when CRTs were the prominent, most readily available technology for display, can be viewed on other formats without interfering or disrupting some form of reference, homage or direct link to the CRT or even television itself. In other words, most video art could be displayed via a projector, LCD or plasma screen, or digitally on the net, without objection from the artist.[7]

[1] Increasingly as physical (real) vintage items themselves - material manifestations based on virtual fetishization of the old/antique - remediated forms.

High-Res Futures: The CRT in the modern world

We are entering an era of vastly improved moving image capture and playback formats. Video resolutions of up to 8k and extremely high frame rates, are the consequences of an ever expanding market place for cheaper and more accessible video technology and vast amounts of funding for materials and military research underpinning this growth. Their development was originally a response to the inaccessibility of film, and its associated costs, but also the proliferation of television and the electronic image. Video and media installation artists are embracing new technology, developing new works that utilize the immersive capacity of higher resolutions with an enthusiasm comparable to that of film makers and artists riding the "Electronic Superhighway" and embracing the CRT and video in the 1960s and 1970s.

Whether consciously or not, a preference for higher resolution displays and projections has prevailed, helping to explain the proliferation of projection based work in the 1990s and the widespread use of plasma and LCD screens from the late 1990s onwards. Recent works such as Adad Hannah's *Two Views*, 2011, indicate a continuing sensibility with regard to the types of screens video installation artists choose. The work consists of two plasma screens, two window frames, two painted renditions of a scene, two taxidermied birds and a set of props, neatly packaged into a crate which is unfolded and installed as a small pseudo-film set in a gallery. A scene from Hannah's teenage years was re-enacted and shot on HD video and then replayed via a HD media player on the Plasma screens themselves. Aside from the simplicity of the work and the possibility of the box or packing crate as a metaphor for how our memories are stored, the materiality and technicality of the piece seem integral to the artist's vision.[8] Works such as Hannah's indicate that the use of higher resolution LCD, LED and Plasma monitors carry as much concern for materiality as the deliberate use of CRT's in early 21st century media art practice, re-iterating a concern with materiality, or object as integral to the overarching aesthetic of a work. It is this concern with materiality, meaning and aesthetic considerations that we can apply to developing a paradigm for viewing the CRT in contemporary work.

Figure(2 (photo courtesy of the Artist 2015)

There are many modes of CRT usage in video installation art, yet there are three basic ones that could be classified as modes of *disruption*. They can be applied to most legacy or outmoded electronic objects used in artworks as well. They are; 1) *Sculptural*: where the work utilizes the CRT as a deliberate sculptural form which is crucial or central to the works overall *raison d'etre* and aesthetic, either as a functioning electronic device or as an unpowered physical object, taken out of it's habitat and hence disrupting narratives about technology which profess a linearity, or specific trajectory as normal; 2) *Time Based*: where the CRT is utilized for some form of moving image portrayal or playback, be that through live broadcast or playback as its sole function, replacing more modern technologies, which are more efficient and streamlined, hence disrupting our expectation of how an image is to be viewed in the present – decontextualizing the viewing experience and 3) *Spatio-Temporal*; the dynamics between 1 and 2, but also where the CRT(s) used in the art work evoke(s) an awareness and acknowledgement of the spatiality afforded to it (them) with regard to the degree of immersion experienced by the spectator in a given space. This is where the artist utilizes the CRT as a deliberate strategy of disruption, where the CRT stands out as a statement against (or for) waste, and the apparatus or systemic complacency that allows this waste to occur. These descriptions are not intended as complete, unequivocal modes of CRT usage, but rather, as explorative guides in helping us to develop a better understanding of their usage in contemporary art. But more importantly, as ways in which the use of the outmoded can be disruptive. Each of these classifications could be broken down further into sub-categories, in media archeological exploration, specifying age, cultural significance, size, or shape, screen dimensions, fragility, and a plethora of other criteria. For the purposes of this paper, as an exploration of the CRT as redundant technology in contemporary art disrupting mainstream lineal narratives of media consumption, I will briefly focus on and develop the three basic modes mentioned above; *Sculptural, Time Based and Spatio-temporal.*

The cathode ray tube; sculptural and spatio-temporal

The history of the CRT spans back to long before artists began using them in art works and before the Television first started mass production in the 1940s. Its physical origins emanate from scientific experimentation in the 1870s. It is composed of two main elements, a glass blown tube with a phosphor coated larger end, and an electron gun at the narrower end. The cathode ray is named after the negative electrode from which it is discharged, *the cathode.* The cathode rays (e-beams or streams of electrons) are fired from a cathode metal electrode to an anode one, illuminating a phosphor coating on the face of the larger end, which lights red, green or blue on impact in the case of color, or a monochrome surface for black and white. The invention of

the CRT paved the way for television. The exact origins of the television are contentious in that the original patent taken out for the concept in 1923 by Vladimir Sworykin was never brought to fruition. It took the curiosity and experimentation of a 14year old North American teenager Philo Farnsworth, to initially devise the idea of transmitting images over the same airwaves utilized by radio, using John Logie Baird's mechanical television, first demonstrated it in the United Kingdom in 1926 as a template. In 1928, in a Lab funded by investors in San Francisco, Farnsworth demonstrated the first fully electronic image replication device utilizing a CRT. In its purest form, projecting from the idealistic intentions of Farnsworth the television could be said to be as close as we have ever come to time travel. The invention of radio and telecommunications in the 19th century allowed for information to travel vast distances immediately, creating a new degree of mediated experience. Visual literacy was being reinvented and translated simultaneously. If film allowed a moment of time to be captured, to be held still and grasped, re-evaluated and re-contextualized, then television allowed time to be shared across vast spaces in real time, and questioned space itself in a way not previously possible. According to Fredric Jameson "…visual media are challenging the dominance of older linguistic media. The most powerful form of this 'critical and disruptive challenge' is video whose 'total flow' threatens the physical and temporal differences that constitute linguistic meaning…" [9] Linguistic meaning was being redefined through the development of a new visual language.

The use of the CRT as a core component in many contemporary works in terms of its *spatio-temporal* qualities, historicity, and materiality, in many ways embodies an homage to its historical development and experimental technological roots. To some this may be described as retro-appeal, to the artist however, it may be a deeper search for meaning in the history underlying their practice, what Jussi Parikka(2012) refers to as "Media-Archeological Time Machines".[10] For example, North American artist Tivon Rice's works *Burn-in Portrait #1* and *Burn-in Portrait #2 (2007-2010)* where CRTs, removed from their cases, have self portraits "burnt" into the phosphor via a three year long exposure process. Rice exposes the CRT screen by playing a looped still of a portrait on a DVD player repeatedly over a three year period until the image is 'saved' or etched onto the phosphor on the screen. Once the image is burned into the CRT, Rice removes the DVD player and the monitor stands alone as a portrait piece independent of its transmission source.[11] The CRT is essential to this work, a case where an attempt to weigh the historical significance of the materials used against a "more elastic approach, which accepts the substitution of certain elements, and allows for the work to be brought "up-to-date"[12] as advocated by Pip Laurenson, becomes almost impossible, at least without replicating the artists process and hence remaking the work altogether.

Figure(4) Tivon Rice, Burn-in Portrait #1 (2007-2010)

Works such as Rice's *Burn-in Portrait #1* are exemplary versions of new work utilizing outmoded technology. [13] The re-assigning of use value or degree of re-purposing, and the possible re-ignition of demand for what are becoming increasingly items of nostalgic pastiche to some, yet historical homage to others, seem representative of a shift in cultural values assigned to items of historical value in general. By freezing an image on a CRT, Rice is freezing the television, burning into and destroying its reason for being by damaging it, in many ways disrupting a flow of technological development. Yet he is simultaneously reaffirming its function as the bearer of images, regardless of the type or mode of image, he is at once rejecting the moving image and announcing the primacy of any image or more specifically the portrait, on what Kaminer terms the "insignificant", the obsolete, redundant, (discarded) object.[14] Drawing on an "object as memory repository" use of the CRT and other obsolete technology maybe inadvertently developing new cultural meanings and associations with the re-used objects.[15] The dominance and scope of digital technologies has rendered most analog technology seemingly redundant and cast to the care of enthusiasts and collectors, for whom these items acquire a new value. The proliferation of faux-vintage apps on mobile devices has surpassed the vintage technology market in the west in terms of scale and reach, but also alludes to a wider trend "…to create a sort of "nostalgia for the present," an attempt to make our photos seem more important, substantial and real" [16] In fact to give all media, audio, written, video, a nostalgic appeal so as to ground it in some form of remediated historical legitimacy. [17]

Figure(5) Electronics factory in Shenzhen 2005

We are primarily concerned here with how the use of CRT's in contemporary art affect what seems to trend as lineal narratives of consumption as espoused by mainstream media consumption and neo-capitalist production cycles. By *lineal narrative* I mean the monumental shift away from the CRT. It's phase out in the West as it's production remains constant in the developing world, creating a dual system of significance - a parallel meaning, based on emerging and declining technologies.[18] By placing the CRT in a historical context and continuum of technological development we begin to reveal a deeper significance behind their use in contemporary art.

Time based Low-Res Futures

For many artists' life itself is the frame. Song Dong's *Waste Not* (2009-2013), is an installation piece where the artist places ten thousand items ranging from plastic buckets and kitchen utensils to electronic goods, which belonged to his parents, spanning decades, categorically on the floor of the gallery. Each item used and collected by his parents, to be passed on to their children in times of need. Placed near the center of the installation are five old (CRT) television sets. For Song Dong the significance of all of the objects lay in the memories they contain and represent. For him they are very definitely historical objects. The televisions themselves represent our ability to interpret, relay or even to propagandize our lives back to one another. We implicitly accept their role, or function by switching them on. Switched off, they are things collected by Dong's parents, before, during and after the Cultural Revolution in China. They are suddenly integral and significant, a very pertinent part of a broader social story, of hardship, repression, fear, escapism and entertainment. Yet they are simultaneously a part of the insignificant materials that surround them. There is an eerie quality of beauty in the way these once treasured items are arranged and displayed. A proud yet disturbing presence of hoarded goods, things we have come to see as waste rather than functional objects with a value, but more importantly a use value which formed part of a human being's very existence, one which contradicts and disrupts a lineal narrative of technological development, where the human cost of production is conveniently subsumed into the apparatus.[19] As the CRT is slowly phased out of production it will become increasingly difficult to view as merely a functional object in contemporary art. It's obsolescence will either heighten the degree to which a referential materiality becomes essential to the art, as in the work of Rice and Hill, or signal it's non-essential nature and hence the primacy of immateriality in any given work. Whether by choice, intention or accident, the use of redundant technology in early 21st century art practice remains a disruptive and important practice, jilting/glitching the inevitability of technological progress, with questions about the ways humans value and categorize waste and propositions about ways to re-value and reconsider what is outmoded, obsolete or redundant.

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Change: The aporia of conservation and subversion

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Abstract

The ubiquitary, psychological and social phenomenon of repetition represents an integral factor to analyze human behavior and social processes comprehensively. A strong desire to repeat and conserve appears to be part of the human and social nature, which is based on various factors. In the following paper the reasons for these conservational processes and their functions and dysfunctions are outlined. Further, the paper discusses why we occasionally have to destroy what we desire to preserve, as we will otherwise endanger what we aim to secure in the first place. Because change is inevitable and this inevitability requires subversion.

Keywords

repetition, social systems, psychological systems, neurological systems, conservation, behavioral code, repetition compulsion, path dependency, change, subversion

Introduction

Social systems, no matter whether society in total, the art system, the scientific system, the political system, or any other form of socially constituted organization, establish rules to secure their existence. These rules aim to absorb uncertainty and to increase stability and are commonly stipulated in the form of behavioral codes. A behavioral code dictates formally or informally which kind of behavior is desired and should be repeated, and which is not permitted and will therefore be sanctioned. Niklas Luhmann identifies the behavioral code as *the* regulative element in any kind of system of action. [1] The more formalized a system is, the more precise its rules are formulated. This necessity to secure the system's continuance can however lead to a level of inflexibility, which consequently endangers what was aimed to be secured — the system itself.

Uncertainty is effectively crucial to the long-term survival of any kind of system. This might sound paradox, but change is probably the only constant in any kind of existence and conservation can hence be rather problematic as it limits the options to adapt to a changing environment. Nevertheless, conservation is what systems are aiming for per definition.

Preservation is particularly disruptive when it applies to structures that might have been crucial to survive at some point, but become dysfunctional and even harmful somewhere further down the line, as it then demands to repeat what should be changed. One might conclude that these structures can quite easily be identified and modified in the following, but this isn't the case. So what are the reasons that conservation occurs when adaptation would be required?

Repetition, Repetition compulsion and the demand of change through subversion

Repetition represents one of the most basic functions within complex systems and aids to make complexity manageable by leading towards stability and reliance. To manage complexity is one of the most challenging problems any complex system has to face — whether it's a person, society or any other type of social system. Often misused as a synonym for complication, it means something distinctively different. When a problem is complicated it is difficult to determine the right solution for it, but when it's complex, there is no such thing as one sole right solution but one is rather frequently confronted with a bundle of functionally equivalent solutions. [2] This prevalently leads to the assumption that once a solution is deemed suitable for a complex of problems, the safest way to act in future situations is to be to repeat it over and over again when presented with the same question. Of course this assumption fails to factor in the changing environment and moreover constrains reconsideration of the past decision-making process and these can be rather critical.

But repetition is not solely a social process. Psychological systems — being the necessary precondition for any social system — have a tendency to recreate situations that are neither productive nor enjoyable for them. Psychologically this kind of behavior is specified as *repetition compulsion*. Sigmund Freud, who introduced the term repetition compulsion, identified it as a fundamental principal of human nature to create situations in which a person can relive life- or relationship occurrences over and over again, even if they run entirely contrary to what he calls the pleasure principle. [3] Psychologists are suggesting that repetitive patterns are a consequence of the attempt to deal with certain experiences and conflicts — so they again do have a functional character up to a certain degree — yet they can reach a point of being fiercely deconstructive. This compulsory behavior is apparently of such a strong force that it is even equipped to overrule the human need for pleasure exhaustively, which emphasizes how difficult it is to overcome. [4]

The source of repetition starts at an even deeper level —

at what for all we know is the precondition for consciousness itself— the human brain. What Freud described as the facilitation of neural activity, but was originally more of a speculation of his due to the state of neuroscience at this time, is now defined by neuroscientists as *synaptic plasticity*. Synaptic plasticity describes a phenomenon, which makes neural connections stronger the more often they are used. [5] Widening and strengthening of neural pathways and synapses occur due to changes in behavior, environment or neural processes and lead to increase or decrease the activity of certain synapses. There is short-term and long-term plasticity and it is strongly linked to what we commonly call memory and learning. The more often a manner of processing a certain stimulus is reinforced, the more its cortical representation is strengthened and enlarged. The fact that a neural pathway can be stronger and is therefore more likely to be used than another has to have consequences for the concept of repetition. [6] In layman's terms one might say that once a thought, a feeling or some kind of behavior occurred before, it's likelier to occur again in similar situations and increasingly so the more often that happens, and that because this is easier for the brain to process.

Assuming that the human brain facilitates repetition by its biological configuration and that it is fundamental to the human psyche to trigger events that allow to relive and consequently deal with what has happened before even when this isn't pleasurable, it becomes obvious on which strong grounds repetition is operating on. Our bodies being the material basis and our consciousness the necessary precondition for any social system, these repetition facilitating processes have to have significant consequences for society.

Not only structures within social systems aim to preserve the status quo, but even positions such as certain jobs or political positions within these structures are established solely to conserve it. This necessarily implies that they also aim to decrease the possibilities for change. After all, these positions lose their right to exist once what they are preserving is dissolved, so it is in their strongest interest avoid losing their purpose. Of course it must be added that isn't per se negative to act conservatively — just like new isn't always better, but it reveals that to create something new one has to conquer strong conservational forces.

We also have to conclude that established rules and structures probably even conserve something that has been dysfunctional from its start and is nevertheless repeated. In Economics this phenomenon is called path dependency. Path depending processes are characterized by three essential attributes — non-predictability, inflexibility and potential inefficiency. [7] These characteristics, that are used to explain why even detectably inefficient processes or products are entrenched due to positive reinforcement based on various forms of hazard, can also apply to other social processes. Hence even small events can sometimes lead to the perpetuation of inefficient and inadequate operations and the establishment of rules that endanger the system. So it is not only the preservation of those rules that are no longer efficiently applicable, but even the conservation of those which have never been optimal for what is aimed to accomplish, that change has to tackle. Unfortunately, to identify these required adjustments is difficult and even more so to reveal them because the difference between right and wrong is ambiguous. Assuming that social processes aren't based on an objective ontological truth, but rather on a symbolically constructed reality, these processes lead to contingence and complexity, implying an overabundance of possibilities and a non-sufficient amount of determinacy. [8] Following these suppositions, it is necessary to change the perception of the symbolically constructed reality and moreover to determine what is insufficient, which is far more complicated than to disprove something under the precondition of an objective right or wrong process or solution.

As soon as the reality constructions resulting in an established code of behavior and formalized structures get so limited that the system can no longer flexibly react to a changing environment, the continuance of the system is uncertain. These formalized structures then function just like repetition compulsion and seriously endanger the system altogether. After all a system needs a certain degree of uncertainty to survive as it would otherwise face solidifying. Dysfunctional codes of behavior and uncertainty absorbing decisions consequently demand deviant actions to enable a reconstruction of reality and fundamental change. These deviant actions are usually permitted within the behavioral code, given that they question the solidarity to not only the rule they run contrary to, but to the system itself.

Subversive actions however are essential to any kind of change and necessarily increase in extend the more fundamental the required change is. Subversion must not be mistaken for simple destruction. The term subversion is etymologically based in the latin term subverto, which means to revert, to overturn or to push over. [9] In Italian dictionaries an even more productive interpretation of the word can be found and so the Italian term sovversivo can be translated as "to overthrow an established order, or the destroy with the aim to create something new." [10] Subversion can therefore be construed as a strike against traditional structures to design and initiate something new.

Change itself inherits an internal contradiction, an aporia of conservation and destruction. When change occurs parts of what is changed are preserved — otherwise it would be simple destruction — and parts need to be deconstructed. To allow the implementation of change consequently requires structures that are capable to adapt and which legalize a certain amount of deviant and therefore innovative behavior and even a certain amount of destruction. This proves to be challenging since it requires continuous inquisition of present and past decisions, to revise and to act situatively and to allow complexity to build up instead of solely reducing it, yet it is just as much a necessity as stability is. When subversion is criminalized, uplift is prevented and the survival of the system is at stake.

Conclusion

Repetition is an important function to systems that engage in, or are a precondition for, social processes and even for theses processes themselves. Repetitive phenomena clearly can have a functional character. They allow the brain to learn, the human psyche to deal with experiences and social systems to increase stability. To phrase it more general, they aid to manage complexity and to handle contingency, which are two challenging problems in a postmodern society — for the individual and for society itself. But to reduce complexity can also lead to oversimplification and solidification, which both come with dangerous side effects. To detect dysfunctional and yet repeated processes is difficult due to the nature of complexity and to overcome them one has to tackle conservational forces. However, if these solidifying processes and structures are held on to the existence of the system itself becomes endangered. In this case subversive practices are essential to generate change. To quote Berthold Brecht: "Change the world: it needs it." [11]

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Author Biography

Sophie-Carolin Wagner, born 1984, studied Economics and Social Sciences at the Vienna University of Economics and Business from 2004 until 2010, where she graduated at the Institute of Change Management and Management Development under the supervision of Prof. Helmut Kasper. Starting in 2005, she studied Digital Art at the University of Applied Arts Vienna under the direction of Prof. Peter Weibel and Prof. Tom Fürstner, from which she graduated 2011. Subsequently, she started her PhD studies under the supervision of Prof. Peter Weibel and Prof. Elena Esposito and graduated with highest distinction in 2014.

Sophie-Carolin Wagner investigates the epistemological consequences for communicational processes in functionally differentiated systems, i.e. the effects on the asserted division between a system and its environment, and the contingent nature of decision-making due to increasing levels of complexity and concomitant limits of probability.

Floating Identities：Me, Her and Us – An Interactive Site-Specific Art Installation Based on Adler's Inferiority Complex to Conclude the Detachment and Reform of Modern Females

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Abstract

According to Alfred Adler's theory of "Inferiority complex", all individuals were born with different levels of sense of inferiority. People are usually unsatisfied with where they stand so they try ways to make up for what they do not own, thus forming a chain of compensation. This concept is focus on exploring the variety of symptoms caused by the compensation mechanism in females. This project use common psychological conditions usually seen in females to portray different levels of self-awareness. Include the viewers by taking them through a journey of mental stages using interactive demonstration, so they can experience the difference in intensity during different stages, leaving the viewer's options to interpret and imagine themselves in such stages which in turn offering them a chance to rebuild and reform their confidence. Through qualitative analysis, we conclude the three mental stages, which are "space", "process" and "introspection". After reviewing the relationship between the three stages, we then observe and construct the psychological stages of denial, rebuild, reform, and reconstruction of self-relationship. The conclusion and achievement obtained are hoped to have the value of feasibility for future reference.

Keywords

Alfred Adler, inferiority complex, inferiority and compensation, modern females.

Introduction

People today are immersed in a media-dominant world with information explosion, prompting great impacts and changes in our overall consciousness and behaviors. Psychologically, excessively high self-expectations are common sources of pressure, creating challenges on social and peer relations, mental conflicts, work-induced stresses, or anxieties caused by environmental factors. Discourses of the feminine body in the modern capitalist society have imposed stricter social and cultural constraints and disciplines on women compared with any other time periods throughout history, which have led to both tangible and intangible pressures on women as they engage in social activities, work, family, and even in their personal lives. Women are, therefore, forced to constrict their own bodies in accordance to society's various consumer and entertainment standards 1 . Via the perspective of a female artist, the aim of this research was to investigate the feminine innermost state of being. By examining and categorizing literatures pertaining to the current urban set-ting, media ecology, and contemporary interactive art, viewpoints were then applied as creative elements to create an interactive installation artwork based on post-modern feminine perspectives. Inferiority complex observed in today's urban women who are objects of the act of looking was used to explore oneself and with the process incorporated in the artwork. By taking on the mindset of a fl neur in the city, viewers were encouraged to uncover and analyze the true values within themselves through this process of exploration and to use the opportunity to once again gaze within their own frames of mind.

Literature Review

Alfred Adler, Inferiority Complex

Adler placed significant emphasis on inferiority and argued that a varying level of inferiority is felt by each person because nobody is content with their present state of being, and inferiority is a normal condition experienced by all, as it also motivates us to be the best we can be. It is a collective human nature to want to pursue a sense of superiority however, Adler also postulated that whether or not a child suffers from any physical defects, every child experiences the feelings of inferiority as the result of being depended and controlled by adults. When this sense of inferiority is used by children as excuses for their inaction, the inferiority then develops into a psychological inclination, especially with children, and driven by such feelings of inferiority, people can be motivated to strive for higher and better developments. If the sense of inferiority continues to persist in one's life, it will evolve into an inferiority complex. If the inferiority complex can be compensated through a correct approach, success and perfection could be attained, with the feelings of inferiority resolved. On the contrary, if an inappropriate objective was defined and an incorrect approach opted, the person's life may then feel useless or become a case of failure. Challenges are then avoided, with a false sense of confidence and security gained from avoiding difficulties. This sense of superiority is used by people to steer clear of feeling inferior, and the continuously mis-

taken compensations could then lead to severe inferiority complex, as internal issues that should be resolved are concealed by the false sense of inferiority. Figure 1 shows the structure of inferiority and compensation as described by Adler. Some modern cosmopolitan women have been known for their pathological pursuits of the perfect self, with extreme or demented ways used to achieve superficial looks to compensate for the inferiorities they feel for their physical looks. Makeup and plastic surgeries are used by some to conceal their true selves. These insufficiencies and compensations of various forms are unable to fulfill or overcome feelings of inferiority, and Adler referred to these abnormalities with inferiority and superiority as inferiority complex and superiority complex, resulting from over compensating one's inferiority and superiority.

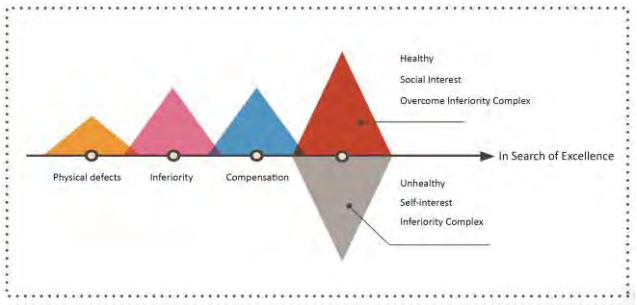

Figure 1. Inferiority and compensation conformation

Consumer Society

Tracing back to the origin of consumerism, it was first dictated by supply and demand, with objects of equal economic values traded between two parties, with desired objects obtained through trades and ex-changes. Along with scientific and economic developments, consumption also rapidly expanded. Pat-terns of modern consumer culture have gradually taken shape through distributions of mass communication and the modern way of life, with consumer culture arising from capitalism. Consumer culture was initially formed due to the decadent lifestyle touted by capitalism, as a way to satisfy the needs of commercial capitalist developments 1 . The purpose of modern consumption has long surpassed economic parameters, with complex and deficient icons of desire incorporated. Undeniably, a consumer society brings great material satisfaction and convenience to people's lives, and different material needs and desires are within reach through monetary consumptions. Life is based on the connection between people and the world, and it includes the surrounding environment and people's subjectivity; however, a woman's awareness of herself is reflected by the situation that depends upon the organization of society 2 . However, qualities of consumer culture are especially noted in women. Linda McDowell (2006) argues that with cities defined as consumer domains, gender is not only interjected in commercial institutions it has also positioned women as consumers 3 . From the ways that gender culture engages in consumer society, throughout the course of history, consumption by women, various rejections targeted at women have extensively been taking place in public domains, with one of the core elements of Western patriarchal culture sees women as objects to be looked at, with women accepting the (male) voyeuristic gaze. Women have long been regarded as the other in male-dominated society, placing them in a secondary position. Although women, like the entire human race, are individual entities that enjoy independent existence, they are, nonetheless, dominated by men and forced to take on the identity of the other 4 .

Gazed Cosmopolitan Women

In today's era of information explosion, the portrayal of feminine bodies as decorative objects in media advertisements or commercial marketing has become increasingly more common. Liesbet van Zoonen (2001) argues that the feminine body is constantly exploited in popular culture for the sake of "art", and it has become women's destiny to be gazed, with the act of looking reserved only for men 5 . Women may engage in the act of looking, but it wouldn't be through their own eyes. The following was proposed by Jacques Lacan (1978) regarding the gaze, "The subject is presented as other than he is, and what one shows him is not what he wishes to see. It is in this way that the eye may function as object a, that is to say, at the level of the lack (-Φ)" 6 . Many feminists have also indicated that this notion of "to-be-looked-at-ness" may have negative effects on women. Wendy Chapkis (1986) has pointed out that cultural messages for looking beautiful and skinny have provoked negative impacts on how happiness and femininity are grasped by her and other women 7 . athryn Morgan (1991) argues that blind pursuits of beauty and the massive cosmetic surgery industry are indicative of society's colonization of women's bodies 8 . With the rise of consumerism, not only are women positioned as consumers, they have also be-come the object of looking and gazing, with the female image increasingly used for marketing and displaying purposes.

With women regarded as objects of the gaze in society and men always the ones doing the looking, it signifies that women need to live up to the looks and the standards of the gazers. Although women are in possession of their own bodies, however, as a subject being gazed upon, the ability to look at themselves seems to have been lost in women, causing the ones being looked at becoming hyper-critical of themselves, with concerns whether or not they have lived up to the expectations of the ones gazing. This has impelled the women being looked at to have a constant fear of not being good enough, prompting feelings of inferiority. Consumer society has pushed the progression of social culture however, it has also produced more gazing forces in the environment it has created, causing the subjects being gazed to be in a constant state of judging oneself. The objective for the artwork created for this research is to investigate this specific condition and to propose it as its creative intent. A process of self-awareness was achieved with art used to represent suppressed psychological states.

Through the application of interactive technological art, inner states were exchanged as physical engagements were conducted by the spectators. As the spectators' personal narratives and the artwork's storytelling quality interconnected, introspections and dialogues with oneself were made possible. A layer was expanded which was specifically designed for looking at oneself and also for being looked at, with further considerations placed in al-lowing the audience to take on the possible identity of being a creator and to reinterpret and reflect on the relationship between themselves and others.

Artwork Planning and Design

Creative Concept –Floating Identities: Me, Her, and U

Floating Identities: Me, Her, and Us, showcased in the digital exhibition *The Five Wardrobes She Has*, began by awakening the feminine self-awareness and further examined the process and the stages with urban women coming to the realization of their sense of self. The core of the exhibition saw the wardrobe as a micro social domain for women, with the wardrobe acting as a metaphor for the feminine inner private state of mind. As a connecting bridge between women and their self-awareness, being inside the exhibition space also brought the audience into the consciousness behind the creative endeavor. The exhibition was comprised with five wardrobes that linked together different personal experiences of the feminine consciousness. Extending from the exterior to the inner state, personal interpretations of one's surroundings were conducted based on continuous introspections, deconstructions, and reconstructions between the self and others. The foundation of the exhibition, *The Five Wardrobes She Has*, was the feeling of inferiority mentioned in Alfred Adler's individual psychology, and how this common psychological feeling of not being good enough can motivate people to work hard and strive to improve. Compensation is used as a way to overcome inferiority, a motivational force to push for higher standards. Compensation is derived from feelings of inferiority however, the success of the compensation will depend on the approach opted. Interactive technology applied in this artwork was used to spark possible extensions from transformations and developments intended by the artwork's creative core. It began with realizing the self as a complete entity and then further encouraged the audience to reevaluate their surroundings and also themselves

Planning of the Creative Space

The artwork of this research, *Floating Identities: Me, Her, and Us*, was presented in Exhibition Space One (Fig.2) during the digital art exhibition, *The Five Wardrobes She Has*. Following is a list of the reasons behind the planning of this artwork based on the actual site and also the presentation and the concept behind the artwork:

Artwork Placement in Exhibition Space One

The exhibition space was elongated, with only one entrance. Audiences could only enter and exit from this entrance, which made the display in Exhibition Space One the first to be seen by the audience. After seeing the entire exhibition, the audience once again passed by and exited from Exhibition Space One, and thus, the position of this space was similar to being the gateway of this exhibition. As described in the creative concept, the inferiority complex theory was the foundation of this artwork therefore, in addition to spatial reasons and with the exhibition acting as a guide to lead the audience from dwelling in their clothes to stepping out of their garments, by being the first display in the exhibition, the artwork sparked the audience's awareness of their feelings of inferiority. Furthermore, the use of clothing as a compensation mechanism was also symbolic of the audience's elevated position in seeing the exhibition as a whole, after they have experienced the process of seeing their own inferiority and compensation.

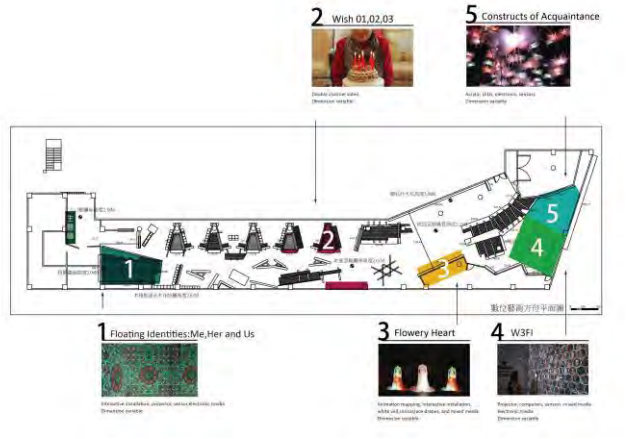

Figure 2. Creativity space planning map

Artwork Installation in Exhibition Space One

Different from other locations in the exhibition site, Exhibition Space One was an elongated room, which provided advantageous benefits for the set-up of the projection and also allowed the audience to slowly enter into the exhibition space to see the artwork. A space for better self-introspection and interpretation was also offered to the audience due to the space's enclosed quality. The audience could freely experience and see the installation in the space, and the location also matched the artwork's design of treating the space as the audience's internal micro urban setting. Separated from the surroundings outside of the exhibition space, the audience was slowly guided into a private domain. A metaphor for the audience entering into their private inner states to search for help through com-

pensation was formed via the imagery of entering into a wardrobe to look for a piece of clothing.

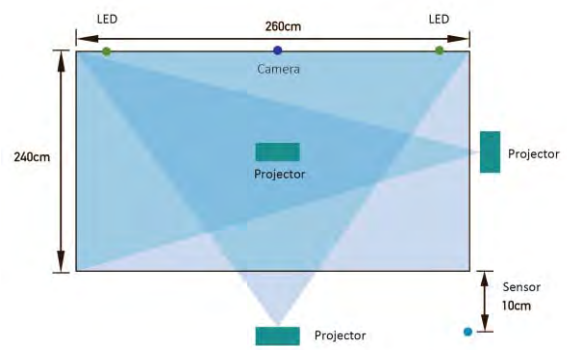

Figure 3. Creativity space product planning map

Artwork Research Methodology

A fortuitous relationship was derived from the experience connected with the exhibition space. A structural formation based on the trinity of the artwork, spectators' memories, and culture was created by the spectators through the meticulously created scenario presented in the exhibition space, resulting in an open and unexpected journey [9]. After the artwork was put on display, interviews were conducted with the audience, with contents of the interviews collected and categorized for qualitative research, which were compiled to show the feasibility of the artwork and examine its values and possible contributions. From the direct and in-depth interviews with the audience, it was anticipated for more understanding to be garnered for their experiences and thoughts with seeing the artwork, which could lead to further discussions about the artwork. Female audience members were the targeted subjects of the interviews, with the interviews conducted after they have concluded seeing the exhibition and their feelings towards the exhibition documented. As the interviews led to more in-depth discussions, it was anticipated for information of greater scope and depth to be gathered. Contents of the interviews were then transcribed verbatim, and from the information collected, further analyses were conducted to formulate the artwork's significance and also propose a conclusion.

Public Display of the Artwork

The completed artwork was showcased publically at the digital art exhibition, *The Five Wardrobes She Has*, presented in 2014 at National Taiwan Museum of Fine Arts' Digiark. Interviews with the audience were recorded to garner further understandings for the public's viewpoints, suggestions, and feedbacks. Observations and results from the interviews were then organized and used to assess and formulate a conclusion for this artwork.

Artwork Production And Development

Artwork Media Content Design

Floating Identities: Me, Her and Us was positioned as the opening artwork for the exhibition, which was intended to guide the audience to recognize the self they have concealed inside. When the audience entered the dark long corridor, it signified that by entering into the wardrobe, the audience was transformed into "her", the female protagonist of the artwork, as a search was embarked to piece together the clothing fit for the self. The flickering white light represented scenario changes. With the internal state that had been concealed for a long time opened up, one's deep inner subconscious, which was previously intentionally hidden, drifted, scattered, collapsed, and then was collaged together, but it still wandered with a soul of restlessness and feelings of inferiority. Only by directly facing one's inferiority could we encounter our true selves.
Description of the Story Behind the Artwork:
She is the happiest person right now.
I am not her,
The woman that we all don't know.

Her, someone with five wardrobes
Is shielded by a garment
that best suits the identity she holds today.
She is looking for self-worth in the eyes of others;
This is her destiny,
To live inside her wardrobe.

She is the most self-conscious person right now.
I am her,
The woman that we all know.

Figure 4. Excerpts of creative situation

Artwork Interactive Mechanism Production

Interactive Image Production

Created with Adobe After Effects, the duration for the animation used for the artwork was 1 minute and 30 seconds long. The animation began with the use of a high chroma image as its base, and the dazzling ever-evolving kaleidoscopic effects were the results of change of angles designated on the timeframe of the animation, along with position and size alterations of the image. An ever-evolving mode and display rotations were used to portray the identi-

ty shifts experienced by modern urban women in a consumer society as subjects being watched, as women go through rapid external changes. The fundamental image used for the production of the interactive image is indicated in Figure 4, with animated images produced based on this backdrop image. Figure 5 shows the variety of images used in the animation.

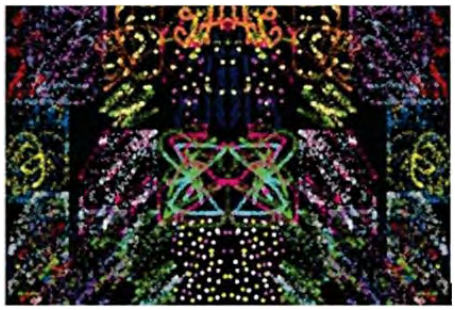

Figure 5. Interactive image base diagram

Interactive Model Production

The interactive model was created with interactive program writing and sensor device production. The installation was initiated when a user walked by the sensor, and after the prearranged flickering of the light came to an end, the image then shifted from its original rotating display of animation to a recording mode. An omnidirectional image of the viewer in the space was then displayed, which represented the stage in the artwork that involved the self being watched. The flickering light that went off after the sensor was initiated acted as a warning for the audience and also a blank space, which was followed by the omnidirectional image of the self.

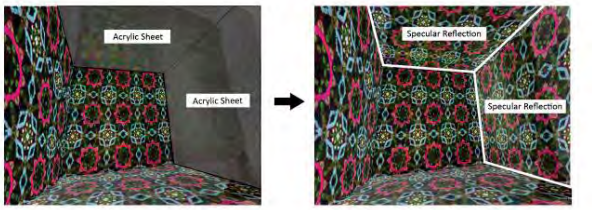

Figure 6. Space mirror diagram

Interactive Model for the Audience

The ways that modern urban women exist are quite different from their male counterparts. Cosmopolitan feminine identities are often constructed based on the viewpoints of others, meaning they are formed under the expectations of the subjects doing the looking and also the self. In the more reserved Asian society, people are less willing to blatantly talk about their inferiorities, with inferiorities often talked about through the spectator perspective, as feelings of inferiorities are endured and even accepted.

Through the "her" in the eyes of others, a complete self was constructed via the artwork. When the audience entered the exhibition space, they were asked to remove their shoes and to begin withstand inferiorities through looking, which also represented the detachment of the physical subjectivity of the self. This acted as the first step for the audience to be segregated from the existing surrounding. The interactive model was ultimately attained when the audience standing in the center (the participant) and the audience on the periphery (the spectators) simultaneously coexisted in the space. This space acted as a symbolic micro urban setting. With cosmopolitan women regarded as subjects being watched, the psychological state of inferiority when faced with spectators' voyeuristic gazes was examined. Figure 7 shows a relational diagram of the interactive model.

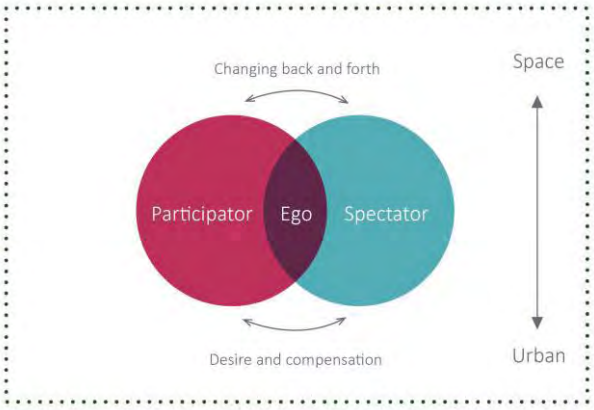

Figure 7. Interactive mode diagram

Exhibition of 'Floating Identities: Me, Her and Us

The artwork was exhibited in the digital art curatorial exhibition, *The Five Wardrobes She Has*, in 2014 at the National Taiwan Museum of Fine Arts Digiark, The following segment contains information for the exhibition and its planning details, which included interviews conducted during the exhibition with members of the audience and also experts.

Figure 8. National Taiwan Museum of Fine Arts Digiark entrance images

The artwork for this research was exhibited in *The Five Wardrobes She Has*, presented at the National Taiwan Museum of Fine Arts Digiark. Following are some images of the exhibition and audience's engagements.

Figure 9. Overall display live picture 1

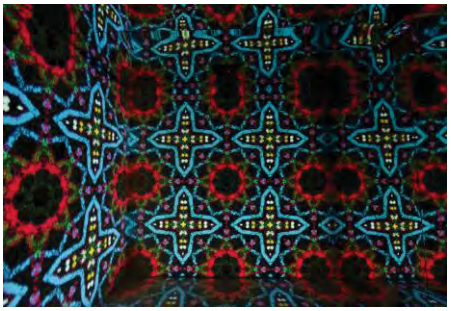

Figure 10. Overall display live picture 2

Figure 11. Overall display live picture 3

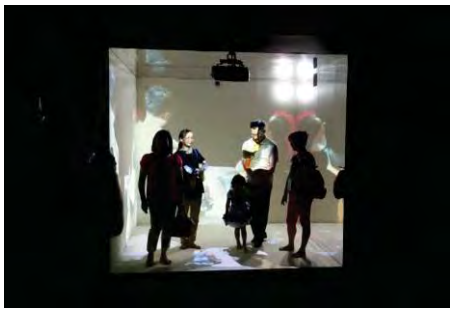

Figure 12. Overall display live picture 4

Interview Results for the Artwork

By organizing and analyzing the interviews with the audience, it was observed that the experience with seeing the exhibition for the audience could be largely divided into three phases: space, process, and introspection.

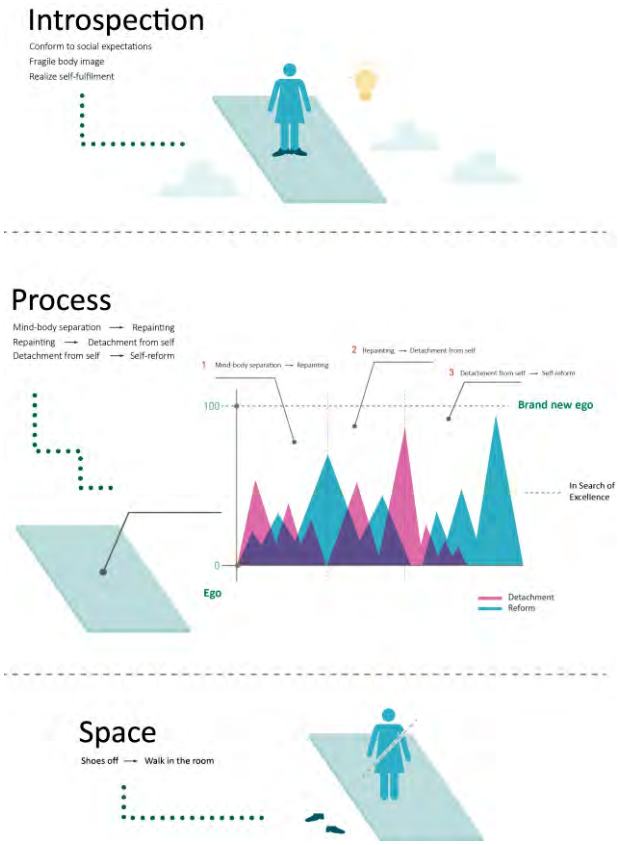

Figure 13. Theoretical framework conceptual diagram

Space

Through the visual structure created with the creative space, a separation from one's physical body was engaged in by the audience when they entered into the urban setting created in the space. It was postulated that this separation was a process of detachment, with the surrounding forcing the audience to break away from oneself in the artwork setting. The psychological feeling prompted by this detachment and also impacted by the ambiance in the space was then observed by the audience. From feelings that were driven by curiosity to being attracted to the visual colors, the audience also felt more calm and collected due to the private nature projected by this personal space. This shift in emotions also drew the audience closer to the artwork, as they felt more at peace to see the artwork. This stage also acted as a psychological preparation for the audience. The physical separation experienced in this phase guided the audience to become more prepared psychologically and to better engage in the setting for the imagery that the artwork intended to convey.

Process

Physical Separation to Re-colorization: Audience Reconstruction of the Self's External Garment after Physical Separation from Oneself

After the audience went through physical self-separation, a detachment from the shallow layer of the internal state was experienced. The audience then entered the exhibition space feeling restless due to the separation the restlessness was also be sparked by personal memories that were being recalled. This opportunity became a critical element for the next stage. Because of the restlessness caused by the separation, the audience began to seek out possibilities for reconstructing an external garment however, the reconstruction at this stage was merely a forced result caused by the surrounding, a passive reconstruction.

Re-colorization to Self-Detachment: Audience Reconstruction of the Self's External Garment to Experiencing Self-Detachment

This process of detachment differed from the first separation that the audience experienced due to environmental factors. This detachment symbolized the process of separation between the audience and the self. After the step-by-step reconstruction of the self's external garment and also with the initiation of the interactive installation, through separation of the visual image, it was observed from the detachment experienced by the audience during this phase that rapid reconstruction and detachment had lowered the audience's psychological sense of security, leading to feelings of restlessness. The audience began to feel concerned for how others were looking at them, with worries how others might look at their imperfections.

Self-detachment to Reconfiguring Oneself: Process of the Audience's Self-detachment to Reconfiguring Oneself

This involved a more in-depth internal detachment after the audience had already experienced self-detachment. By putting on their shoes and walking out of the exhibition space, the act represented a role switch, with the audience now in a state of watching others and themselves. The opportunity for reconfiguring oneself required the thinking process prompted by role switching. With the shock of realizing that control over one's thoughts had been lost, gradual steps were then taken to reconfigure the self.

Introspection

By reflecting on the previous experiences, the audience came to realize through this process comprised of different stages that this sense of inferiority inside was actually a curve that existed both internally and externally, and it also held specific viewpoints but was also wavering. As thoughts occurred both internally and externally, a process of introspection was attained through shifting detachment and reconfiguration and along with changes with one's viewpoints and thoughts. Following are further explanations of this process:

Hoping to Live Up to Society's Expectations

The process of reconfiguring the self through physical separation to re-colorization was a procedure that guided the viewer in reflecting on both internal and external aspects. From observations made during this phase, the viewer's attempts to hide and unwillingness to be watched by others unveiled the duality that was present in the self. Since the moment of self-detachment, the audience then began to compare and struggle in a back-and-forth manner, and the theory for the reason behind this was because of one's fear of becoming an anomaly in the group, with concerns for damaging one's interpersonal relationships. Through reconfiguration prompted by environmental factors, the person then further hoped that his or her inner and external components could all live to up others' expectations.

Image in Life's Fragility

Induced by environmental factors, an external garment of self-protection was passively reconfigured by the audience, and the self was detached once again during the process of re-colorization and self-detachment. Through rapid detachment and reconfiguration, the audience realized in this phase that the identification and one's image in life constructed based on the looks or standards of others was quite fragile, with an existence that was unstable and elusive.

Restoring One's Self-worth

The process of self-detachment and reconfiguring oneself sparked thoughts in the audience that were driven by changes in one's personal power. Distinctive roles of the "participant" and the "spectator" were presented, and when the audience took on different roles of looking at others or being watched, psychological changes were also induced. The self the exited the exhibition space wandered in and out of watching others and also watching oneself, and through this method of introspection, the role of the self was positioned at various heights and depths. This represented the turning of oneself into a 'they-self dwelling in a new level, as one gradually strayed away from needing other's acceptance, with one's self-worth ultimately restored.

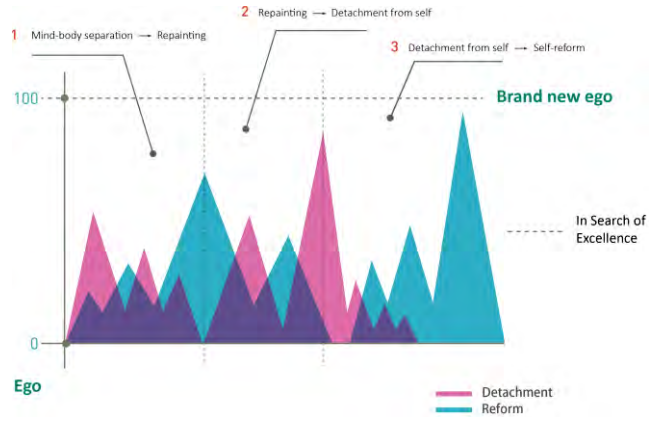

Figure 14. Process category Chart

Conclusion and Recommendations

As today's society rapidly develops along with technological progression, people's lives have grown increasingly more convenient and advanced compared to before. However, pressures have also escalated with society's advancements, becoming a critical challenge for people today. From which, feminine roles in society make it easy for women to become subjects of others' gazes. Through this research, it is discovered that as women become objectified in life, recurring internal detachments and reconfigurations are commonly observed in women, and as proposed by Adler's inferiority complex, this repetitive compensation mechanism is used to motivate self-improvement.

Through interactive art, spiritual mindsets of modern day people are interpreted during this research. With advantages provided by the art form, interactions extended beyond just people and art it also occurred between people and even between people and their own internal states. Prompted by the interactions between the viewers and the artwork, audiences were encouraged to partake in the experience and to further engage in the artwork. Interactive mechanisms of various layers guided the audience in experiencing and altering their thoughts, while rights were reserved for them to freely interpret and associate. Dialogues with oneself were also encouraged, and through power exerted from the self, connections and emotions were formed with the artwork and even others, with an opportunity for the audience to reconfigure and restore themselves provided. Results from interviews with the audience were organized based on the psychological experiences faced by the audience during the exhibition, which were divided into the categories of *space*, *process*, and *introspection*. Within these stages, psychological emotions and compensations experienced by the audience during the exhibition were further sub-organized to result in a clearer categorization of the transformative process that the audience went through internally, as a motivational force for the viewer and the self was also constructed.

Retracing the journey of this creative research, following are concluding remarks based on the creative aspects of this interactive artwork.

Spatial Design

Although confined by the exhibition space's limitations in size, spatial advantages of the limiting space were, nevertheless, well utilized. The space's private and enclosed qualities were especially incorporated to express and convey the perceptual experience intended by the artwork to the audience. The way that the exhibition space was presented was analogous to a piece of clothing created for the artwork. Through the progression phases and the ambiance onsite, the audience was able to concentrate more easily and to better immerse in the artwork.

Process Design

Not only was the interactive model between the viewers and the artwork included in the design for the process involved in the artwork, but interactive models between the viewers and others and the viewers and themselves were also provided. Through progressing interactions that moved back-and-forth, ways of seeing, and changes with one's thoughts, conventional advantages for interactive art were preserved, and furthermore, the intangible interactive models applied also enhanced the awareness of the viewers and allowed for their own interpretations.

Audience Introspection

Thoughts and feedbacks from the audience were made possible through the interviews conducted after they've experienced the exhibition. Motivational forces behind the audience' introspective thoughts were discovered and categorized according to analyses conducted on the contents of the interviews, which also elevated to become a force to inspire for self-improvement. The introspective process created great impacts not only for the audience but also for the spectators.

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On Internet Art: A Critique of the Imperceptible Interface

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Abstract

In this thesis, I examine the role of network-based art practices as an aesthetic critique of our engagement with interface technologies that are increasingly seamless and, indeed, largely undetectable. Despite our incessant customization of web content, we are unable to observe the computational processes that make this information manifest. I investigate what network-based art practices reveal about the changing nature of subjectivity in relation to this imperceptibility. Internet art, I argue, constructs temporary, physically variable structures that rely on retromediation and technological anachronism so that actions inherent to networked space are, by necessity, thrown into question . These practices, I argue, function as a critical interruption of the ruling tendencies and assumptions of screen-based operations, namely, transparency and interactivity. The complexity and speed of new technology are the cause of both euphoria and anxiety. Drawing on Žižek's concept of interpassivity, I examine current notions of user agency, arguing that the strong correlation between imperceptibility and distraction demands a reconsideration of subjectivity, mediation and technology.

Keywords

Network, Interface, Interruption, Interpassivity, User-Agency, Internet Art

Introduction

In this text, I assert that there is more to Internet art than mere design and aesthetics. Internet art, I argue, first calls attention to the spatial reconstruction caused by the interface, and second, subverts the habitual and programmatic nature of technology's use, which bears significant implications for subjectivity. Technology causes societal change on both macroscopic and individual levels. By failing to address these macro-level changes, we also fail to develop an informed attitude about the changing nature of subjectivity. In particular, we fail to develop a sense of subjectivity that allows us to distinguish between mediated space and reality. I argue that Internet art (often referred to as "net art") prompts a reinterpretation of the network and, particularly, the interface. Net art creates the conditions necessary for critical reflection by disassembling the elaborate technical ensemble of the interface into its smallest symbolic parts and then reassembling them into a visual language. The work indicates a break, or disruption, from a procedural flow. Net art promotes the interface's revelation of itself.

On the Interface

The interface is an apparatus that affects the way its users perceive, acquire, and disseminate information, both online and offline. With respect to computing, an interface is the program through which we mediate software, hardware, or peripheral devices such as monitors and keyboards. "In semiotic terms, the computer interface acts as a code that carries cultural messages in a variety of media," notes new media theorist Lev Manovich. "The interface shapes how the computer user conceives of the computer itself. It also determines how users think of any media object accessed via a computer." According to Manovich, the interface is not merely a neutral part of the computational process; rather, it has the capacity to impose its own logic on media. "[F]ar from being a transparent window into the data inside a computer," Manovich writes, "the interface brings with it strong messages of its own." These messages are the semiotic content of the interface, and they endow it with a cultural grammar. They carry a set of prescriptions about the interface's use, directions that the user nearly always follows without notice.

Mobile devices, such as the cellular phone, laptop, and tablet, enable us to mediate through interfaces in many different environments. This is partly how the interface permeates every aspect of life, making all media aesthetics uncannily uniform. The interface is a program through which we traverse freely all the time, and yet, it seems invisible to us. Indeed, design foretells, in a conscious manner, a new ethos of personal computing, characterized by the disappearance of technology products themselves. Rather than existing as discrete entities, they promise to coalesce fully into other objects, surfaces, and spaces.

The term "design," both a noun and a verb, derived from the Latin *signum* meaning "sign," has multiple definitions. Once we become aware of design as a construct, technology becomes demystified. Czech media theorist Vilém Flusser writes at length about the technological image and its ability to change the way that we see the world. "A machine is a device designed to deceive; a lever, for example, cheats gravity," he asserts in The Shape of Things. Under Flusser's assumptions, de-sign is a function that requires a certain degree of cunning or artifice. He maintains that design tends to deceive nature through technology, replacing the natural with the artificial. Continuing this line of argument, one could say that mediation through a purely artificial environment can radically alter the level of everyday micro-behaviors, affecting autonomy and tactility at once. The interface supplies us with a series of embedded distractions that inhibit a complete perspective, placing us instead in a constant state of reaction.

Interface design assumes technology can, or should, seem immaterial. While the goal of designing a purely transparent interface is unobtainable, innovation nevertheless seems to require that an interface interfere with the user experience as little as possible. This design principle encourages the user to forget about the presence of the medium and to believe in the directness of immediate transmission. In the words of media critics Jay David Bolter and Richard Grusin, "[O]ur culture wants to multiply its media and to erase all traces of mediation: ideally, it wants to erase its media in the very act of multiplying them." It is the very "logic of immediacy," according to Bolter and Grusin, which "dictates that the medium itself should disappear."

The extent to which the interface suffuses everyday life is attested by the development of what is increasingly referred to as the "Internet of Things." This phrase describes the communication between the Internet and uniquely identifiable objects, effectively enabling the Internet to reach into dimensions of physical space. The term "real-time" describes the instantaneity of information technology. Real-time computing requires the operating system to respond to commands without perceivable delay. These two forms of computing development illustrate how the complexity and speed of new technology can cause both euphoria and anxiety. The increasing demand for instant feedback and response provides a new sense of urgency that segments our attention and imposes low-level, reactive panic. In a hyperconnected society, the operation of an interface is a highly orchestrated event—requiring the user to dedicate a significant amount of perceptual and mental resources to the very act.

Just as twentieth-century modernism was determined by technologies of manufacturing, mass media, and lens-based imagery, the most pressing matter determining contemporary culture may well be the sheer omnipresence of the Internet. The Internet's reach was extended by the popularization of Web 2.0, a second-stage development of the World Wide Web characterized by shared information, user-generated content, and the emergence of social networking. The Internet underpins the whole apparatus of communication and data processing by which our hyperconnected culture operates. Without it, we would have no email or chat software, no computer-aided industrial production, and none of the invisible, "smart" design-interfaces through which we increasingly mediate identity, relations, and the world.

We must cautiously examine the nature of our exchanges and connections through web technology. To ignore this responsibility is to approach technology with an upward, or somewhat magical, bias. We must call into question the extent to which reciprocity characterizes our actions within a space where we mythologize technological immateriality. And how does this exchange affect subjectivity, agency, and the determination of the material environment in its sensorial dimensions? The great philosopher of communication theory, Marshall McLuhan writes in his comprehensive study *Understanding Media*:

> All technological extensions of ourselves must be numb and subliminal, else we could not endure the leverage exerted upon us by such extension. . . . No society has ever known enough about its actions to have developed immunity to its new extensions or technologies.

McLuhan warns prophetically that we are as much a product of our tools as they are of us and, more critically, that technology routinely outpaces our ability to locate or interrogate its effects. Interface invisibility contributes to a sense-distorting, technological bias that, in McLuhan's terms, has been accepted subliminally throughout most of modern history.

On Internet Art and the Interface

What is at stake in Internet art is not only what it produces but how it is produced. Although the terminology used to chronicle this work remains largely undeveloped, the discourse about how best to perceive web technology as a platform for the circulation of artwork is not new. Public astonishment surrounding the rise of computer networking in the late 1980s was coupled with an enthusiasm for dispersed authorship. Indeed, dispersed authorship and anonymity contributed to the preemptive exclusion of the Internet from the fine arts as a widely accepted medium for art practice.

Nevertheless, in the early 1990s, Internet artists began to connect through a *Nettime* mailing list, developing novel methods for the production and exchange of their work. The original "net.art" movement included an assembly of European and Russian net artists and writers. Among these artists were Heath Bunting, Vuk Cosic, Jodi.org, Olia Lialina, and Alexi Shulgin, whose contributions and audiences remain almost exclusively online. The use of an online platform resulted in the long-term failure to document net art or, at least, to connect it to other art-historical practices. In many cases, "net artists" relocated themselves to more installation-based grounds as "media artists." This relocation essentially traded the web browser for the traditional gallery space.

Computer coding can be the force behind movement across digital space; it can even lead to the formation of images and three-dimensional objects. That said, the degree of code manipulation unique to network-based art ought to challenge our approach to the interface and enable a new perspective on computation. For instance, *Post*-Internet art refers specifically to works that are consciously created with the assumption that the network's omnipresence is a given. The name refers to a set of assumptions rather than a time "after" the Internet. These assumptions indicate that the centrality and omnipresence of the network is a given and that the Internet is no longer a novelty, but a banality. Post-Internet artwork employs much of the visual rhetoric of outdated Internet branding, stock imagery, and various technical glitches in order to highlight the ways a networked system functions and malfunctions. Post-Internet art seems to celebrate the obsolescence of early web technology in displays of anti-aestheticism and anti-design.

If Duchamp redefined art through the act of selection, we have all become descendants of his aesthetic revolution insofar as our hyperconnected culture is predicated upon selection and remixing. Internet art may appear to be little more than a whimsical endeavor characterized by a derivative aesthetic of popular media and network branding; however, I argue, it constitutes nothing short of an anti-environment in an era of imperceptibility. By this, I mean that it offers the user a perspectival awareness of an interface-mediated environment that would otherwise remain unnoticed.

From a historical perspective, it might be tempting to view the determining role that the Internet has taken within visual arts communities simply as an extension of the dissemination of the arts in pre-existing mediums (i.e. print media, film, radio, TV, etc.); however, the Internet seems to represent something absolutely new in terms of flexibility, immediacy, and autonomous production. The Internet has demonstrated significant community-building potential since its inception. It can support, expand, and even create its own publics through publication just as print media and other forms of linear communication have in the past. However, Internet media come into being a priori as dissemination and reproduction and thus, quite unlike print media, incite a nonlinear distribution of thought.

Network-based art plays both a unique and necessary role in subverting the programmed nature of interface technology. In McLuhan's view, such intervention is the singular ability of the artist, as the artist responds to cultural and technological challenges before their transforming impact occurs:

> The ordinary person seeks security by numbing his perception against the impact of new experience; the artist

delights in this novelty and instinctively creates situations that reveal it and compensate for it. The artist puts on the distortion of sensory life produced by new environmental programming and creates artistic antidotes to correct the sensory derangement brought by the new form.

Internet art functions as an antidote to interface mediation, one that might subvert cultural attitudes toward—and assumptions about—seamless technology.

Network-based art practices function principally as an aesthetic critique of our relationship with digital media. As Belgian RFID analyst Rob van Kranenberg notes, "We are entering a land where the environment has become the interface." The interface, however, is not necessarily impenetrable, solid, or static. It can be breached, and intervention of the interface is critical to our continued perception of a physical, material world. One critical difference between Internet art and traditional art is that the work generally will not disclose itself without specific modes of engagement with interface technology. Internet art constructs variable modes of anachronism and anti-design, reconstituting the user's expectation for otherwise transparent interface mediation. Planned obsolescence and nostalgia have made the gap between new and old technologies both smaller and more dialectical. Although obsolescence and retromediation used to be closely connected to the factor of linear time, this factor has become more fractal, resulting in a transformation of the anachronistic, or avant-garde, tendencies of Internet Art.

It could be argued that, in light of both hyper-connectivity and real-time computing, obsolescence is always immanent. This can be observed in the rapid migration and subsequent demise of those image objects on the web known as "memes." In her study of the post-medium condition, art critic Rosalind Krauss suggests that obsolescence is necessary for the production of inventive New Media work. It is precisely its obsolescence, she claims, that allows us to see the apparatus for what it really is, in all its dirt and glory. Many network-based art projects are precisely about reality: the artist constructs a deliberately outmoded space, be it online or offline, wherein the navigation and perception central to the interface is subtly controlled and manipulated. By confounding the narrow conception of the interface and its functions, Internet art offers the potential to recognize the machine as an apparatus.

As American curator Steve Dietz has stated, "art is different after New Media because of new media—not because New Media is 'next,' but because its behaviors are the behaviors of our technological times." Agamben's articulation of the contemporary, as one who firmly holds his gaze on his own time, predates Deitz's observation. For Agamben, perceiving the obscurity of one's own time is not a form of passivity, but instead a singular and active ability. Contemporariness can be found in a relationship that adheres to time through disjunction. Thus it is that the avant-garde must pursue the primitive and the archaic. The radical momentum and conceptuality of net.art was, initially, a way for artists to critique the social and economical drive behind the development of new technologies. To call net art a genre is to suggest that it is intelligible as a tendency—a tendency to exploit medium-reflexivity and to interrogate the perfect use and function of technological convention and expectation. As a form of anachronism and anti-design, network-based art can aid in the understanding of interfaced mediation, making the invisible visible and undeniable, subverting media constructions and providing the perceptual conditions for subjective autonomy.

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Slow Media Art - Seeing Through Speed in Critiques of Modernity

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Abstract

The "Slow Movement," originally associated with conservation efforts in food consumption or city planning, has rapidly spread to many other areas of culture and commerce. This paper anticipates future articulations of "slow art" in general and "slow media art" in particular, as a path to new critiques and perspectives on the modern desire to "slow down." As a term, Slow Media Art offers some unique opportunities for considering contemporary appeals to slowness as based in both sensation and structural understandings of social order. When viewed in light of the history of artists' ambivalence toward modernization, and with an eye to recent scholarship on media abstention, the notion of slowness proves a useful frame for foregrounding the essentially relational nature of speed. Within such a frame, the many paradoxes and contradictions within appeals to slowness appear rather as efforts at positioning by modern subjects in relation to one another; the move to "go slow" is almost always a move to "go slower than" someone or something else. Slow Media Art, through its deep engagement with sensation, duration, and speed, helps bring such relations, and their motivations, into view.

Keywords

Slowness, duration, mobility, critique, locative media, environment.

Introduction

The Slow Food Movement emerged in Italy in the 1980s, when a group of political leftists began to see in gastronomy a potential site for resistance to globalization. Founder Carlo Petrini and others saw in locally-sourced wine and cheese not only a way of staying free of the potentially unhealthy ingredients found in industrially processed foods, but a way of asserting pleasure as political - even against the more instrumental tactics of their peers on the left, who sometimes appeared preoccupied with productivity in their politics. [1] This movement grew into an international and organized phenomenon, with the Slow Cities movement close on its heels, and drawing from some of the same leaders. Others have adopted the approach with increasing speed. Application of the terminology through manifestos and polemic essays have not always seen follow-up in the form of organized movements, but the ready appeal is telling, nonetheless. Slow Reading, Slow Science, Slow Computing, Slow Scholarship, Slow Tourism, Slow Web, Slow Church, and Slow TV have all seen attention in news and social media. A World Institute of Slowness offers "slow branding" and "slow consulting."

Reduced reliance on fossil fuels in response to resource scarcity, unethical labor, and climate change will undoubtedly require new approaches to the movement of people and goods around the planet. Such changes will require transformation not only of infrastructure but of expectations, perception and language – a divestment not only of material dependencies but of what Brett Bloom has referred to as "petro-subjectivity," a sense of self and being infused with "the logic of oil relationships." [2]

Slowness rhetoric captures some of these changes and motives for change, but also brings other complexities and even apparent contradictions that have often accompanied the experience of modernity. The Slow Food Movement itself, for example, in Italy relied on appeals to decentralization and deregulation in face of perceived oligarchy and nationalism, which activists saw as a threat to important regional distinctions in the name of state-determined efficiencies. [3] In this case, the interests of Slow Food advocates overlapped with those of private enterprise; the season of success and growth for the Slow Food movement in Italy also coincided with a privatization of the public sphere and consolidation of markets, birthing media magnates such as Silvio Berlusconi. [4] In Italy, as in many instances, the pursuit of slowness bore structural affinities with reaches for a very different kind of modernity.

Slowness is neither modern nor anti-modern. Appeals to "slow down" have come from those looking to return to social orders deemed lost to technological or societal "progress." But appeals to slowness have also come from those looking to experience a distinctly modern and a-temporal space of perception and action, set free from the more linear narratives of techno-utopian or imperial progress. [5] There can be no easy mapping of appeals to slowness to any one political end, any one understanding of modernity or counter-modernity. Across the spectrum of values held by adherents of slow living, we see only one common trait – that of a desire to connect the human experience of speed to some shared social or political order.

Slowness might well become a key concept within humanities' debates on the future of our planet, allowing as it does

for the interrelation of subjective and objective parameters of societal and ecological change, of philosophical and physical aspects of human actions, and of both biological and technical processuality. Few other contemporary appeals to socially responsible living attempt to connect structural change so directly to affective experience. Sure, the field of "cause-related marketing" may be on the rise, and creators of corporate brand identities have aspired to create associations between sensation and political action at least since the 1960s. [6] But few of these go as far as appeals to slowness. The sensory may serve as the site of identity construction in such cases, but the Slow Food movement and other appeals to slowness go to much deeper lengths to enact a "visceral process of identification" with a cause. [7] Such efforts look to connect broad structural change in such spaces as global food manufacturing or labor to the most local experience imaginable – that of the biological, internal experience of time.

This reach across sensory and structural domains, bridging the affective and economic, the ephemeral and the infrastructural, makes any discussion of slowness very much like a discussion of Media Art. If sensory, temporal departures from dominant approaches to time or speed have marked the work of many a modern artist, Media Art in particular has made such approaches a steady subject of exhibition, scholarship, activism, and meditation. Modern art, and in particular Media Art, offers a rich history of experiences with which to understand and contextualize the growing number of calls to slow down. After an overview of approaches to slowness in media art, we will then look to contextualize this work in light of a longer history of the "aesthetics of refusal," from 19th-century Romanticism to contemporary "media sabbaths." With this overview in hand, we will then conclude by asking how slow media art might help in understanding the slow movement's paradoxes and promise.

Duration / Deceleration

Works that take the experience of duration as a subject are an obvious entrypoint for this study. John Cage's *As slow as possible* (1985), for example, presents a literal implementation of slowness into a work's duration. In this composition, Cage invites the performer to play each note as long as he or she manages to do so. In 2001, a group of people in Halberstadt decided to explicitly build a new organ for the historical Burchardikirche, to play *Organ2/ASLSP*, Cage's 1987 adaption of the work especially for organs. As an organ can play sounds constantly, they decided to extend the piece to a total duration of 639 years (which was the actual age of the historic pipe organ of that church, in 2001), using weights to hold down the respective pedals. Technical means thus allowed for a structural or conceptual extension of time ad infinitum, while at the same time eliminating its dependence on the human factor (the endurance of the performer), and thus the sensorial aspect of the creative process.

While Cage's piece addresses analogue, acoustic media, comparable 'deceleration' projects have been conducted with regards to audiovisual media. One example is Douglas Gordon's *5-Year Drive-by*, a 1995 video installation deconstructing John Ford's Western *The Searchers*. Next to a highway in Utah's Monument Valley – the location of the outdoor scenes of *The Searchers* – Gordon installed a video projection screening of a part of *The Searchers*, stretched to its narrated length. As the story covers a five year period, he reckoned that in this movie one second of cinema time equals six hours of real time. Each frame had thus to be played for approximately 16 minutes. Though technically this is an extreme case of slow motion, the viewer driving by will most likely experience the installation as a projected film still, or metaphorically, a frozen moment in time.

What we have here is thus not only a case of extreme deceleration, but also a conceptualization of different levels of mediated and experiential time. While driving by at motorized speed, the audience witnesses a frozen film frame. This still image is, however, embedded into a processual performance of what Paul Virilio calls "delayed time," a represented event, recorded, stored, and replayed via media technologies. [8] At the same time, this frozen moment of delayed time presents a staged event, which had been sped up for the sake of representability. By slowing down the film, Gordon relates the representation back to the represented. The various processes of mediation involved do however not lead to a recovery of the story's (imagined) real-time existence, but to a highly conceptual deconstruction of represented time, resulting in still-images perceived at high-speed. This dissociation of temporalities – that of the viewer and of the artwork's structural logics – is likely what leads Lutz Kopenick to reject consideration of such works in his study of aesthetic slowness. [9] The artworks in these cases have less than ever to do with the composition of "contemporaneous" moments for viewers, and thus fall outside Koepnick's excellent survey. But we find in such breaks a helpful collection of examples for use in exploring the disconnected temporalities advocates of slowness seek to unite.

Local / Sustainable

For the Slow Food movement, speed is a concern not only in relation to the immediate bodily experience of time and sensation, but in relation to the material processes by which food reaches the table. Appeals to slowness are often structural as well as sensory; for some, to eat food from known origins rather than from convenient but distant sources is to eat more "slowly." At least one art project that addresses this approach to slowness is the *Milk Project* by Esther Polak, Ieva Auzina and the Riga Center for New Media Culture. Starting in 2004, and across a number of different presentations for gallery and online exhibition, the project presented a GPS-generated map that "follows

the milk from the udder of the cow to the plate of the consumer, by means of the people involved." [10] In part anticipating more contemporary interactive documentary projects such as *Bear 71*, which attempt to root journalistic or essayistic prose in location-specific presentation for screens, *Milk Project* created opportunities for informed conversation about the people, places, and paths through which food passes on its way to the consumer. At the same time it engaged in intense conversations with the various local actors involved, combining the use of (then) sophisticated media and visualization technologies with a dialogical approach to audience. As such it both reveals the complex local and global infrastructures on which food consumption depends, and offers a renewed experience of consumption in light of awareness about certain origins of production, and the actors involved.

Similar projects with such an obvious connection to the slow movement are the *Fallen Fruit Project*, which creates dynamic, participatory maps of gleaning opportunities in urban settings, or even aspects of the branch of Human-Computer-Interaction known as "Ecovisualization." [11] Such projects approach slowness not primarily as a matter of sensory experience, but as an approach to consumption that new technologies might even help facilitate.

Disruption / Irritation / Meditation

Teri Rueb's *Drift* (2004) was a locative art project, in which the visitor was lent a handheld computer with integrated GPS locator technology and attached earphones, and sent walking into the Wadden Sea at the coast of Northern Germany. Though equipped with (at that time) "high-tech" devices, walkers unexpectedly experienced long periods of narratival silence, within which natural sounds of the landscape dominated: birds, wind, water, ship-motors, and their own movement audible on the sandy ground. On sudden and intermittent occasions, however, participants would hear footsteps, which they recognized were not their own, and a voice began to talk about walking, scenery, and journeys. Walkers may have heard a complete train of thought, but sometimes the voice broke off suddenly and the sound of footsteps also slowly faded away. The reason is that the geo-locations of these aural texts were not fixed, but rather wandered across the Wadden Sea in correspondence with the North Sea tides. Searching and wandering were thus not only the subject matter of the texts, but also modes of experiencing the work. By using locative technologies to interconnect processes of mediated and non-mediated movement (of data, matter, and humans), Rueb invited visitors to engage with expectations of the ubiquity of dataspace. Where even at that early stage of consumer-grade GPS technology, most applications promised permanent connectedness, *Drift* counteracted geospatial accuracy and foregrounded a state of disconnect, of lost signals.

Other early locative media practices followed suit through "slowing" the persistent processes of orientation offered by locational technologies or GPS. In their work *Rider Spoke*, for example, Blast Theory invites people to cycle aimlessly through a city and to meditate on their life while inconspicuously guided by media technology and a networked dataspace they built up themselves. Encouraged to stop at places, they chose to answer questions played to them via headphones, these answers are located via WiFi fingerprinting, and thus through an emergent mesh of locational data created by the participants themselves. Many a technology-assisted *derive* took place in locative media's early festivals and exhibitions, from Pixelache to New York's *Psy Geo Conflux* events.

Though in part such refusals or disruptions conjure the much longer histories of reflexive interruption in modernism that run from Brecht's Theatre of Alienation to contemporary noise and glitch aesthetics, such interventions in geospatial technologies bear special meaning in light of the Slow Movement's reactionary refusals of ubiquity. Where the Slow Food or Slow Tourism movements pursue a less mediated, more sensorily-rooted relationship to locality, projects like *Drift* or *Rider Spoke* use the promise of mediated ubiquity as a foil, a field against which to experience the seeing, hearing, walking figure anew. Even before the wide availability of GPS technologies, theorists of sound described the ways in which mobile headphone-assisted listening rendered space and place more homogenous, and downplayed differences of locality. [12] Just as the slow movements look to jar consumers into noticing the distinctive differences of their local environment, interruptive projects like Rueb's disturb the usually seamless space of mobile listening.

Rueb and Blast Theory achieve slowness through both refusing a "fast" ubiquitous technology and through turning closer attention to the proximate. A similar path lies in Beatriz de Costa's *PigeonBlog* project, wherein she and collaborators devised a pollution sensor network not determined by a gridded, proscribed ubiquity, but rather by the contingent paths of the birds that bore the sensors on their flying bodies. Slow media art in such cases embraces interruptions in ubiquity, both for what they turn us from and what they turn us toward.

Abstention / Ineffectiveness

Other media artists take a more polemical and even performative approach, refusing not only the promises of temporal, spatial ubiquity offered by contemporary networked technologies, but the very definitions of effectiveness or success by which engineers or even activists design such systems.

For example, iKatun's 2009 project *Not Going to Copenhagen* invited participants into an act of refusal - not only against air travel, a recurrent target of the Slow Movement, but against participation in an act of trans-national political "problem-solving." On the occasion of a global summit to

address climate change, iKatun's project highlighted both the irony of a climate-change summit that required such large expenditures of fuel, and the implied "solutionism" of events organized around "fast" technical and political approaches to deep social problems. The artists invited participants in their project to, rather than attend Copenhagen, post images to the web of what they might be doing instead of such travel, thus conserving at least some amount of fuel and energy. As in some of iKatun's predecessors - the dandies of Baudelaire's Paris or the merry drunken bands of Debord's derives - participants in "Not Going to Copenhagen" appear to revel in sloth and apparent political ineffectuality. Drinking beer, admiring their cats, or generally just sitting around, those who posted images of themselves "not going to Copenhagen" clearly are enjoying the contrast of their efforts with their effects. By not going to a climate summit and instead having a party at home, they have, by some economies, done more for the earth's climate crisis than those who did attend. Where others hope for quick fixes, iKatun created spaces for slow, hard questions about the definition of political and ecological effectiveness itself.

Similar questions about effectiveness arise in Aram Bartholl's *Dead Drops* project, which takes the promise of effectiveness offered by Wikileaks' securely anonymized file sharing service to an absurd level. By embedding the normally hyper-portable flash memory stick in the mortar of an exterior brick wall, *Dead Drops* offers the sort of resistance to mobility present in previously mentioned locative media projects, but also interrogates the "quick fix" offered by the potential of a newly available, unregulated commons. In the case of *Dead Drops*, a file found on the drive may very well be untraceable, but storage and retrieval requires a very public and technically awkward commitment to coupling a computer to an exterior wall. Bartholl's project challenges the very aesthetics of efficient technical achievement and information sharing. Secure and politically effectual file-sharing in a "fast" world seems to require clean aesthetics, and a more seamless, disembodied experience of uploading and downloading. The same practices in Bartholl's slower world requires a walk to the object, and a public, awkward commitment to the uploading process that exposes one to all manner of problems.

Remoteness

But such abstinence and withdrawal from predominant approaches to effectiveness can also be a means to work remotely and profit from solitude as a means of autonomy. In 1992 Slovenian artist Marko Peljhan inaugurated the *MAKROLAB* project. Together with his team, he created an artistic research lab to be installed at remote places. The lab functioned as an autonomous communications and living unit, self-sustained in terms of energy and water supply. The artist invited small groups of people to co-share this very basic environment for a certain amount of time, working on individual research projects which took the unique working situation and location as a challenge, an advantage or even as an object of research. Research projects ranged from the investigation of weather and bird-migration patterns up to research on mobility and data-traffic in hertzian space. The slogan Peljhan promoted for the project was one of "insulation – isolation." He worked on the premise that "individuals in a restricted, intensive isolation can produce more evolutionary code than large social movements." [13]

Here, we might also call to mind Julian Priest's 2009 and 2011 *Slowflow (Te Ia Kōrero)* project, which invited technologists on a five-day river trip in New Zealand's Whanganui River via traditional indigenous canoe. [14] Such a journey away from technological mediation is both propelled by modern technological rhythms and made possible by them. Both Priest's and Peljhan's projects embrace the potential of globalized mobility as a way - perhaps increasingly the only way - to achieve a slow enough pace to gain new knowledge of oneself, others, or the world. Two of the more prominent preoccupations of media art - research and community - here appear as both under threat by some aspect of everyday ubiquitous technologies, and perhaps only now achievable through traversing the world using global-scale networks and travel infrastructures.

Ambiguities and Contradictions

Many more projects could come into the frame here, from the design experiments of Dunne and Raby, to Martin Howse's *Earthcode* projects, Graham Harwood's coal-fired computer, or even the "local science" brought to light by the decidedly anti-corporate and even domestic genomic work of Critical Art Ensemble or Faith Wilding. The intent of this essay is not to offer a thorough overview of such practices, but rather to bring to light the ways in which art in general, and media art in particular, offers some helpful routes into addressing the challenges of slowness as a critical stance. For across these projects, several themes come into view:

Firstly, we see a theme of the variable interconnectedness of "slow sensation" and "slow operation." To achieve a differently-ordered sensorium may or may not require a change to the ways we operate as a social, economic order. Our brief survey reveals examples of slowing through abstinence from normative technological operation, and slowing through embrace or even amplification of such operations.

Secondly, and closely tied to the first, we see a theme of contradiction, paradox, and even irony. For most all of these gestures contain some degree of freedom - from too-rapid sensory, social, or material flows - made possible by participation in some other current of sensation, information, or resources.

Thus, like many aspects of the Slow Movement, much "slow media art" risks easy dismissal as a "mere symbol" or inauthentic gesture, the equivalent of an industrial "greenwashing" of an otherwise toxic product through different packaging or language. Or, viewed from another angle, such projects take the form of a pointedly and critically ambiguous gesture, the equivalent of yesterday's situationist slogans that critiqued mass culture through embodying it.

A brief discussion of two additional contexts can help us to unravel such contradictions, and possibly find a way through them to meaningful, sensory engagement with the plethora of modern ethical and ecological problems offered by speed. Firstly, historicization will help us identify the aesthetic pursuit of slowness within a longer continuum of modern art and thought. Secondly, a look to contemporary scholarship on media refusals will help us understand the sort of subjectivities that make the pursuit of slowness possible and attractive.

Slow Art in the Rear-View Mirror

Though the motives have been manifold, artists have activated strategies to slow down, back out, or distance themselves from mainstream trends throughout modernity. Looking to American traditions, for example, scholar Leo Marx identified such a stream of "pastoral" aesthetics throughout the literature and art of that country, perhaps quintessentially manifest in Henry David Thoreau's early 19th century experiment at Walden Pond. [15] Certainly the apparent contradictions of a retreat from society just a short walking distance from town, and made possible by relative wealth, share much in common with questions raised by the above mentioned projects.

In the United States and elsewhere, romanticism has been an ever present counterpart to modernization. Sociologist Colin Campbell has argued that the romantic impulse to delay satisfaction and regard modernization as a challenge is in fact a crucial component of capitalism. [16] Certainly throughout the 20th century, artists associated with movements as diverse as Suprematism, Minimal Art, Land Art, and Performance Art have claimed concepts of simplicity, deceleration, remoteness and persistence. And it is important to note that art movements propagating inwardness and those propagating speed could well exist parallel in time - or even in the statements and work from the same artist - as in the parallel cases of Suprematism and Futurism.

Also, during a period often referred to as the Neo-Avantgarde, we can find projects as diverse as the durational performances by Ulay and Abramovic and the political-ecological projects by Joseph Beuys addressing slowness in various ways. Ulay and Abramovic did some formally minimalistic but bodily and psychologically highly demanding durational exercises such as sitting in front of each other and looking at each other for a period of 7 hours, in *Night Sea Crossing* (1981-1997). Beuys' project of planting 7000 oaks in the city of Kassel, each together with a basalt stone, contrasted very slow geological processes to comparably fast biological ones. Though it took "only" ten years to position 7000 stones with their paired sapling, the project is still a work in progress that constantly evolves - due to biological growth, but also due to urban change.

Looking to media art's close precedent in networked art and Fluxus, quite a few works can be related to what we suggest calling slow art. Shiomi Mieko's *Spatial Poems* (from 1965), for example, like the Art's Birthday events or iKatun's project, invite participants to simple actions for one another around the world, performed locally, but documented as a global event. Anticipating the "media refusals" of contemporary slow media art, Yoko Ono's 1964 event score *Hide and Seek* invited people to virtually disappear: "hide until everybody goes home / hide until everybody forgets about you / hide until everybody dies." [17]

From the pastoral hermits of 19th century painting and poems through the 20th century's avant-garde polemics, the projects themselves were as diverse as their philosophical, political, and societal frames of reference. Their frames of reference ranged from eastern philosophy (see the influence of Daisetz T. Suzuki in disseminating the philosophy of Zen to western countries) via phenomenology (especially in Minimal Art) to deep ecology (see Joseph Beuys engagement in environmental issues and the widespread reception of the Club of Rome's "Limits to Growth" study in 1970s art and culture), amongst others.

This diversity of artistic motives and frames of reference is paralleled by a diversity of discourse traditions, explanatory models and historical narratives within which historians have situated such work. Still today, narratives of modernity and post-modernity often adhere to paradigms of innovation and – in the case of modernity – of progress. While postmodernism is generally considered to be critical of art's foundation on originality and linear development, the postmodern art world still largely follows a logic of speed. In recent decades, processes of globalization and mediatization have further fostered an ever accelerating pace of life and culture, within which the arts often seem to be playing upfront. [18] However, as a reaction to the excessive demands of contemporary society, not only artists, but also scholars and curators have started to engage in questions of sustainability, ecology, and social change. [19,20,21] Parallel to this, projects such as the above mentioned started to be subsumed under a common heading in the last decade. If we just pick some exemplary exhibition projects from the last seven years, they started to carry titles like:

- *Moments in Time. On Narration and Slowness* (Munich, Lenbachhaus, 2000).

- *Timeout. Art and Sustainability*, (Kunstmuseum Liechtenstein, 2007).
- *Weather Report. Art and Climate Change* (Bolder Museum of Contemporary Art, CO, 2007), *Slow Paintings* (Museum Morsbroich, Leverkusen, 2009).
- *Uncontainable Exhibition* (17th International Symposium on Electronic Art, Istanbul, 2011).
- *Die Kunst der Entschleunigung. Bewegung und Ruhe in der Kunst* (Wolfsburg 2011/2012).
- *Machine Wilderness Exhibition* (18th International Symposium on Electronic Art, Albuquerque, 2012).

While historians and curators might tend, like many of the artists themselves, to contextualize slowness or deceleration as a counter-trend to modernism and globalisation, German curator Markus Brüderlin, for example, argues that one of the reasons for artists' recent interest in slowness is actually an adherence to the "project of modernity," through its associated qualities of clarity and pureness. [22] This view is echoed by US artist and art historian Suzi Gablik, who holds that "any remapping of the modern paradigm has both a deconstructive and a reconstructive dimension," relating attempts of what she calls a "reenchantment of art" to the latter. [23] Also, the celebration of local practices as a catalyst for sustainability is not undisputed. The Croatian sociologist Rudi Supek, for example, was already arguing in the 1970s that a valid approach to ecological problems would necessary have to be "planetary" and thus to operate on a global scale – as opposed to a concentration on local activities [24]. What results from this first, cursory overview of artistic and theoretical approaches to slowness, is that there is an urgent need to do away with too simplistic binaries, to delve deeper into the different motivations for creating "slow art." The same also applies to the evaluation of the concept of slowness within the framework of the information society.

When seen against the background of a multifaceted history of slowness within modern and contemporary art, the above mentioned examples of "slow media art" clearly evidence the urgent need for a more differentiated view on concepts of slowness. We have to ask, for example, if slowness always has to be a critical attitude (in the sense of counteracting paradigms of innovation and speed), or if there are other, individual and aesthetic motives for claiming slowness as an artistic concept. We also have to investigate conflicting aspects of slowness, such as its practicability in the face of the global art market. We need to scrutinize the various claims for slowness at stake in artistic practices throughout the last 200 years, as well as the narratives and theories accompanying these practices by means of comparative analysis. On the other hand, we can clearly see these projects getting heightened attention and being subsumed under a common heading in the last decade. "Slow Art" appears to be a fast concept, and is only picking up speed.

On Media Refusals

Help in answering some of these questions might come from emerging work on media consumption and identity, especially in cases of "media refusals," "technology sabbaths," or other public instances of withdrawal from such platforms as Facebook or email. Though not always explicitly claimed as part of the various slow movements, such acts fall within the same counter-modern impulse, an attempt to wrest either freedom or control away from the rhythms of consumption associated with networked communication.

Laura Portwood-Stacer has helpfully exposed the role of taste in such public professions, and therefore of class construction. In Stacer's work we see how consumers perform their habits of use, through claiming or refusing the status of participants, and how such performance serves as a prime site for the construction of subjecthood. [25] In an age of proliferating platforms and rhythms of digital media consumption, identity formation stands to form as much in choices about media participation as in the more traditional alliances offered through music or movie fandom.

Scholar Nathan Jurgenson has also helped clarify the role of refusal through arguing for the inseparable nature of our online and offline lives. Even when we're offline, Jurgenson explains, our online selves are still present, shaping perception, action, self-understanding. [26] In his view, there seemingly can never be a full retreat; to argue otherwise requires a "digital dualist" view of the world, a new kind of Manichaeism that ignores other important work done in sociology, critical theory, and race and gender studies on how self-hood emerges across heterogeneous spheres of action.

Such work helps shift the conversation away from hard distinctions between participation and refusal, inside and outside, fast and slow - and more to the movement itself, the relationships between states. If for Stacer refusals are less significant than the contrasts of class or taste they serve, and for Jurgenson the distinction between offline and online less significant than the imagined differences and divisions lived out in action, then perhaps the "slow" might be better examined as the "slower." Speed itself is relative, and nothing can seem slower or faster except in relation to other things. The figure needs a ground. If the "faster" ground against which advocates of "slow science" or "slow tourism" wish to appear different is sometimes hard to find, perhaps slow media art will help make such relations more apparent, through the often inescapably material, sensory nature of the work.

As scholars of mobility remind us, we're only able to perceive ourselves as mobile because of others' relative im-

mobilities. [27] Perhaps the exercise of agency over our "media speed" is itself worth considering as a differential phenomenon, a site of differential power. To use a much older example, both Benjamin and Baudelaire wrote about the Flaneurs of Paris who took turtles for walks on leashes as a way of showing that they could choose to go slowly in the bustling metropolis, where perhaps others could not afford to make such a choice. When it comes to "going slow," we should be careful of mistaking ourselves as prophets when in fact we may just be dandies.

As evidenced by the histories, theories, and artistic precedents acknowledged here, the drive to slow down is likely to only grow as a desire within art, media, scholarship and commerce. Though we would no more discourage such desires than we would seek to quell our own pleasure in the pastoral or even the romantic as a part of life, we hope to see "slow media art" as not first a fast term for instrumentalizing anti-modern critiques, but rather as a provocation to understanding our own contingencies and relational velocities in a world of flows.

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[Session 41]

Navigating Communities and Data

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Aesthetics of the Digital Ruins and the Future of Art Conservation

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Abstract

This paper is a shortened version of "Corrupted Memories. Aesthetics of Digital Ruins and the Museum of the Unfinished" presented in *Uncertain Spaces: Virtual Configurations in Contemporary Art and Museums* (Lisbon, 2014). It addresses the aesthetics of memory emerging on the horizon of digital culture, aiming to understand their critical potential towards the proposition of new parameters for historic conservation, archive and museum systems in the digital age. Based on art works by myself and other artists, I suggest that glitch, recyclism and other similar movements/genres point to critical views of contemporary culture and memory. Instead of celebrating a progressive stable future, their peculiar "ruinology" allow us to deal with the social and emotional perception of loss, without betting on an imminent process of disappearance and planned obsolescence. I contextualize my approach in the contemporary "documentary overdose" produced in social media environments, and the "forgetting architecture " that prevails in it, due to permanent updates and discontinuities.

Keywords

Digital ruins, Glitch, Media Art Museums, Planned Obsolescence, Aesthetics of Memory, Digital archive

Memory and Aesthetics

Since the 1990s, we have been witnessing the emergence of transnational policies relating to memory. Unconnected events, such as the 50th anniversary of the end of the Spanish Civil War and the beginning of the Second World War, the Fall of the Berlin Wall, the end of Latin American dictatorships and of apartheid in Africa, have been celebrated together through the recognition of special anniversaries and various commemorations worldwide. In parallel to the discussions that these events have aroused, new architectural works have been constructed, together with new designs for cities, while new commissions have been made for works of art, and countless books and films have been produced, both relevant and frivolous ones. In short, we could say that the most disturbing feature of this 21st-century culture of memory is that it simultaneously stresses both the multifaceted and the banal aspects of these celebrations. Everywhere, there are critical discourses and superficial products created by the complex network of the culture industry. Memory has become both an intellectual challenge and a commodity for easy consumption. **1**,**2**
Although the aesthetics of the spectacle of memory is a recent phenomenon, we cannot say the same thing about the relationship between artistic practices and memory. Classical funerary art, such as the tombs and sarcophagi of the walls of the Medici Chapels in Florence, sculptured by Michelangelo and his disciples, the famous Renaissance portraits and the way in which they expressed a "choice of how and by whom one might be immortalized" **3**,**4** , as well as the prestigious iconography that accompanied the whole fabrication of Louis XIV's public image **5** , are just some examples that serve to clarify this hypothesis.

Until the end of the 18th century to talk about aesthetics of memory is to talk about strategies of keeping to posterity the image of some individual through the arts. Throughout the 19th century, in Europe and in American cities, as national independencies are accomplished, despite prevailing the construction of monuments devoted to celebrate individual personalities, the aesthetic of memory expand to urban scale. In the context of the transformations that followed the Industrial Revolution, the arts mingle with architecture and with planning itself, embodying new roles as to operate as guiding references for the collective memory.

As we see, until then there is a direct relation between the monopoly of power and the monopoly of memory and its forms of artistic expression. This monopoly, however, is not absolute. In contrast to the celebratory aesthetics of big names and glorious acts, rise up other points of view. The romantic images of the ruins, which envisaged in the past a supposed state of sublimity higher than the present misery is one of them. We must not forget, though at that time not so relevant, the innovative approaches by Baudelaire, who preferred painters of customs and physiognomists, as Charles Meryon, to the great masters of his time, for his ability to "extract the eternal from transitory". **6**,**7**

The aesthetics of memory that offered an alternative to the works of art produced within the central apparatus of power only became consolidated from the 1960s onwards in the field of contemporary art. In their diversity, it is possible to say that there are two basic components: site-specific practices that involve a profound reconfiguration of the paradigms and concepts of public art, and a whole 'wave' of artists whose work is dedicated to the theme of archives, an aspect that we focus on here. This is because it is possible to glimpse, in these archival arts, procedures

that will be incorporated and reviewed within the digital arts, especially those taking place in networked environments.

From the notebooks of the German artist Hans-Peter Feldmann to the works of the Brazilian artist Ros ngela Renn , but also including the artistic production of Marcel Broodthaers, On awara, Christian Boltanski, Bernd Hilla Becher, and even younger artists such as the Brazilian artist caro Lira, there are countless ways in which contemporary art, as Osthoff suggested in the title of her book, transformed the idea of the archive "from a repository of documents to an art medium". **8**

These transformations range from Feldmann's deconstructions of media to new approaches to history, as in the case of Lira, who has documented life in the concentration camps built for the isolation of poor sick people in Fortaleza (Ceará, in Northeast Brazil) in the 1940s, Boltanski's personal memories of Nazism in France, the European process of de-industrialisation registered by the Becher couple, to the appropriation of anonymous personal memories that became raw material for the fascinating narrative rearrangements of Ros ngela Renn . Among other projects by this artist, I should like to highlight here *The Last Picture* A ltima Foto (2006). In this work, the whole history of photography and its relationship with the contemporary tourist industry are questioned, along with its tendency to privatise the landscape. In order to realise her project, Renn invited 43 professional photographers to photograph the monument of Christ the Redeemer in Rio de Janeiro, using mechanical cameras of different formats that she had collected over several years. The project *The Last Photo* consists of 43 diptychs, each pairing the cameras with the last photo that they registered. Conceived at the time when odak announced it would stop selling the films traditionally used in cameras, this project raised a disturbing question: are these cameras capable of storing the history of photography that the digitalisation of images has changed the direction of? Moreover, with the increasing corporatisation of nature and of what we can see, how much longer will we be allowed to photograph Christ the Redeemer for free? Are these also our last photos of this famous landscape? How long will this statue remain accessible to our eyes?

For Ranci re **9** , the fight for visibility is one of the main topics of the political struggle that is taking place in the contemporary world. And, in that sense, the game of archival appropriations, which calls into question the monopoly of memory, also contests the images of power that are projected into the public sphere. But, since the beginning of the 21st century, this public space has also become an informational space **10** , and, in that sense, it allows us to ask this question: what are the aesthetics of memory in the age of the digitalisation of culture?

Digital Ruins

The above question seems absolutely essential to me. Never before has so much been said about memory as nowadays, and yet it has never been so difficult to have access to our recent past. This is undeniable. Few words have become as commonplace in the 21st century as 'memory'. Being confined until recently to the fields of historiography and neurological and psychoanalytic thinking, memory has become a basic aspect of everyday life. It is now considered to be a form of quantifiable data, a measure and even an indicator of someone's social status. There is a 'memory' fetish, as if it were a 'thing': How much memory does your computer have? And your camera? And your cell phone? That much? Is that all?... Memories are bought, memories are transferred, memories are erased and get lost.

We are not only experiencing a super production of memory, but also a documentary overdose. Every minute, 100 hours of video are uploaded to ouTube and 27,800 photos are uploaded to Instagram. As for Facebook, another 208,000 photos are posted in the same amount of time (every 60 seconds). In a recent presentation made by an analyst from ahoo , it was claimed that as many as 880 billion photos were supposed to have been taken in 2014. **11**

Where does all of this go?

It is common sense to say that the Internet never forgets, but the digital culture does not allow us to remember. We produce and publish on petabyte scales, using services that can disappear at any time. Our equipment crashes at the speed of a simple click and a strange nostalgia for an unlived past invades the circuit of popular consumption. How to deal with memories so unstable that they become depleted together with the lifespan of our equipment, and whose different types do not correspond to the cataloguing models used by museum and archive collections? What memories are we building on networks, where the more immediate present seems to be our essential time?

These are questions that artists are asking themselves. On the one hand, they question the overdose of documents, through projects related to database aesthetics and to the processes of information curatorship. Good examples here are the recent studies undertaken by artists/researchers such as Lev Manovich and Aaron oblin, among others. On the other hand, they place in circulation approaches to digital ruins that provide a possible parameter for thinking about museums and archives at the present time. My point of departure is that the imminence of loss and the potential impossibility of restoration and retrieval have become the 'default', and not the exception, in the digital storage ecosystem. To learn how to deal with this permanent state of absence can be crucial for a new understanding of the basis of historical preservation. After all, as Henri-Pierre Jeudy wrote in one of his essays about historical conservation, "a contemporary aesthetics of abandonment would consider the ruins of modernity to be something other than a disaster". **12**

This path makes it possible to think of the ruin as an opening to the future and to consider it within critical paradigms that operate as an aesthetic counterpoint to our linear visions of progress. It also allows us to rethink technology from points of view that are immediately less euphoric and less conservative, frequently contextualising it in relation to perspectives of instability and social disarrangement. Artists working on these themes and thinking about these questions seem more inclined to approach technology and the future in a more critical, more ironic and less desperate way. For me, a major point of reference in this discussion is Ernesto Oroza, a designer and artist who was born and grew up in Cuba, with a degree from the Instituto Superior di Dise o Industrial de la Universidad de Habana. He now lives in the US and is the creator of concepts that have proved particularly meaningful for my reflection on historical conservation, such as 'architectures of necessity' and 'technological disobedience'. Both are different dimensions of a vast 'ruinological' process ('ruinology' is another concept I'm borrowing from him) and, in order to understand them, we must remember that in 1991 Cuba's economy began to implode, after the announcement of Perestroika. The Special Period in Time of Peace Per odo Especial en Tiempos de Paz] was the Cuban government's euphemism for what was the culmination of thirty years of isolation. This isolation had begun in the 1960s with the US boycott.

Oroza studied the mechanical devices created by the Cuban population for their survival from the 1990s onwards and began to collect some of these machines. Later he was to contextualise them as 'art' in a movement that he dubbed *Technological Disobedience* Desobediencia Tecnol gica . He stresses the subversive potential of those creative machines, saying that technological disobedience is a concept that allowed him to "summarize how Cubans acted in relation to technology. How they disrespected the 'authority' held by these contemporary objects". By doing so, they desacralized technology and ruins at the same time. Every time I see these devices, I remember the statement of the Brazilian artist Helio Oiticica at the opening of *A Nova Objetividade Brasileira* (*The New Brazilian Objectivity*) (1967) – one of the most important avant-garde exhibitions of the 1960s and, furthermore, held during the military dictatorship: "Of adversity we live " (Da adversidade, vivemos).

This point of view is important if we are not to surrender to a simplistic analysis that would be compliant with the scarcity or precariousness existing on the one hand, and at the same time not to romanticise the way in which technology is produced and delivered to us daily. These questions arise in different ways in many artistic works, but I will concentrate here on *Chipped Movie #1: Minhocão* Cinema Lascado 1: Minhoc o (Beiguelman, 2010) and *Broken Things* Das Coisas uebradas (2012) by Lucas Bambozzi.

The videos of my series Cinema Lascado focus on devastated urban environments, where raised viaducts have led to social fractures in the cultural territory of the cities in which they were built. This is the case with the *Minhocão* ("Big Worm", officially known as the Costa e Silva elevated highway) built in 1969, under the Brazilian dictatorial government. In Minhoc o, images follow on from one another through a movement scanning the landscape, mixing hi and low tech, combining HD video with the technique of animated GIF1. The result is a series of sequences that deconstruct the space, which is then recreated as visual noise, guided by the predominant colors of the surroundings. In an intermittent way, it plays with saturation and suppression to reconstruct the perception of the surroundings and the city, the old and the new, up and down, the tool and the device.

Conceived by myself to be a video installation showing the *Minhocão* simultaneously from above and below in an art gallery, in the context of the *arte.mov* Festival in S o Paulo, the final project is the result of a sequence of accidents, which included problems in the recording of images, software bugs and browser crashes. If, at first, my intention was to make an incursion into the urban ruins of S o Paulo (or to discuss the lack of urban planning in the city as a process of sociocultural ruination), within a few weeks, the project had become a parallel and overlapping aesthetic discussion about the making of technological ruins today.

When I arrived at the gallery to set the piece up all the artists had already defined their own spaces and there was only a very small room with very tall walls left for me. The only way of showing the piece was to pile the two videos on top of one another. This final 'error' situation led me to re-edit the video that portrays the bottom of the viaduct upside down, which produced the effect of a continuity of the vertical lines in the video installation. The accidental way in which I arrived at the final set up of that piece signalled not only my first contact with the glitch aesthetic, but the discovery of how similar the materiality of the code corruption was to the noisy social attributes of some of South America's big cities, above all São Paulo. Long afterwards, when reading Rosa Menkman's book about the glitch aesthetic, I recognised myself in many excerpts, which could have been used as epigraphs or explanations for my own work. She says: "As an exoskeleton for such (post-utopian) progress however, the glitch does not just take place on a critically ruined surface. The choice to accept the glitch, to welcome it as an aesthetic form, means to accept a new critical dialectic that makes room for error within the histories of 'progress'". **13**

Brazilian artist Lucas Bambozzi has been exploring these ambivalences in different works. In *On Broken Things* (2012), he deals with the flow of communication turned into waste around us. The piece is an autonomous machine, which makes its own decisions based on the

[1] The title in Brazilian Portuguese *Cinema Lascado* could be translated into English as *Chipped Movie*, but it loses its double meaning. *Lascado* refers to the Palaeolithic age, to thin slices, in trouble and in some contexts, to very good. The way it was produced combining techniques from the 'paleoweb' with the post cinema is behind its name ('lascado').

intensity of the electromagnetic fields that hover above us. The project refers to the tensions found in the relationship between consumption, consumerism and planned obsolescence, avoiding a paternalistic discourse about an allegedly ecological practice based solely on individual goodwill. It is a physical simulation of a continuous mechanism, which operates between the networks, and the real world, where autonomy eventually expires and everything becomes obsolete, leading us to realise that we live in the era of the 'Internet of Broken Things'. Bambozzi explains:

> "*On Broken Things* is an installation-machine, whose autonomy makes use of the electromagnetic flows existing in the space where it is installed. Insistently, in a dramatic and ironic way (if such things can be described as machine attributes), it repeats the action of smashing obsolete mobile phones. The machine has as its input the variations in the reading of the signals circulating in the airspace (Radio Frequency signals, or fields/waves known as Extreme Low Frequency ELF or Electromagnetic Fields), whose saturation in certain environments can be troubling in several ways. From these data, the system accelerates and performs movements that culminate in a destructive action of the equipment stored on the machine, which for many may be a kind of revenge of the consumerism associated with technologies that we observe today". **14**

The piece was commissioned for *Tecnofagias, the 3rd 3M Digital Art Show (2012)*, curated by myself, an exhibition that was held in one of the most important Brazilian contemporary art centres, the Instituto Tomie Ohtake. This was the first digital art show to have been held there and, in spite of the fact that the exhibition as a whole was remarkable for the institution and attracted large audiences, this piece in particular greatly excited the visitors to the exhibition space. Besides the crowds of people protesting about the destruction of mobile phones, it was common to hear them making comments, sometimes with a certain nostalgia, pointing to the phones as they came down the ramp towards their 'execution': "wow, I used to have that model"... "I remember that one"... "My mother gave me one of those", etc.

Museums of the Unfinished

Obsolescence, loss, broken devices and "files not found". This seems to be the more perfect picture of the digital culture and the aesthetics of abandonment that prevail in its realm. Maybe the imminent disappearance that is constantly to be found everywhere all the time justifies the apocalyptic tone that is suggested in the most basic commands for handling digital editing programmes, which invite us to 'save' files all the time, and not simply store them. Networks have no time. A system of permanent urgency prevails over them. The most recent publication is supposedly more relevant than the previous one. Now is what counts. And this 'now' has an increasing intensity. Try to find that very important comment posted by your friend thirty days ago on Facebook, that photo you 'liked' in some remote day of 2012, or that remarkable event in which you shared a video back in 2008. Don't even try it.

It is true that all data can be tracked. Scandals related to electronic surveillance, such as Prism, involving the US government and companies such as Google and Facebook, can confirm this. But this is far from meaning that we have the right to remember whatever we want about ourselves whenever we want. Not that the models existing for the traditional cataloguing and retrieval of data are better, or even that they are the only possible ones. They are historically engendered and are related to forms of power and to the political, social and cultural authorities that define the criteria for conservation, the ways to institutionalise memory locations and to decide what is or is not left to be told as history. It is not a coincidence that the protagonist of one of the most brilliant short stories by Jorge Luis Borges – *The Book of Sand* El Libro de Arena – chooses precisely the National Library as the place for losing the book that tormented him. Putting it on a random shelf was like hiding a leaf in a forest. It could never be found again.

But this human scale restrained by institutions is now shaken by an overdose of documentary production that is unprecedented in history. If there is any question about this statement, let us make a comparison between the volumes of data stored in the world's largest library collection – The Library of Congress of the United States – and the Internet Archive Wayback Machine, an independent service that archives web pages daily. The Wayback Machine contains 3 petabytes of data (equivalent to approximately 700 thousand fully loaded DVDs and this is only part of the 9 petabytes of the Internet Archive as a whole). **15** If the Library of Congress had its entire collection of books scanned (32 million volumes), there would be 32 terabytes archived, considering 1 megabyte per scanned book (Lesk 2005). The Wayback Machine was created in 1996. The collection of books from the Library of Congress dates from 1815. The Wayback Machine grows at the rate of 100 terabytes per month, which is almost three times the size of the whole book collection of the Library of Congress in bytes accumulated over almost two centuries.

In an anthological essay – "The Historiographical Operation" – Michel de Certeau wrote a concise History of Historiography and summarised what this operation consists of in a few lines: "In history, everything begins with the act of separating, gathering and turning certain objects that were otherwise distributed into 'documents'. However, this separation is always done after the work of the archivist, who is responsible for the selection and organization of documents that will be kept at the expense of those that will be discarded". **16**

But, given the media avalanche we produce every day on Facebook, Instagram, Twitter and other similar social networks, how do we choose what will be stored? And what if they were simply deleted by a system error or a discontinuation of the product? How to deal with so much unstable and fragmented information produced by us and about us? Is all this information really relevant? And what can we do when it suddenly becomes unavailable? Could

museums be a solution in a context like this or should we remember Adorno, who wrote a long time ago: "Museum and mausoleum are connected by more than phonetic association. […] They testify to the neutralization of culture." **17**

It is clear that in the age of the documental overdose we are living in, "accumulating data is like breathing: involuntary and mechanical. We don't choose what to keep, but what to delete." **18** Nevertheless, it must be stressed, all that we cannot keep is on the probable horizon of permanent loss. And this includes personal memories, private and professional information, relevant data, a lot of futility for sure, and culture, art, and uncountable (perhaps fundamental?) unfinished works. Of course it is important to prevent loss, but it is impossible to store everything that is produced nowadays.

Until practically the end of the last century, according to Michel Melot, one of the world's leading authorities on archival and library science, budget constraints "in their wisdom" prevented institutions from literally overflowing. In an article suggestively entitled "Des archives considérées comme une substance hallucinogène", he pondered what would happen if every citizen became a collector and a curator and we could keep absolutely everything in the name of future historians. We would arrive at a paradox, he concludes: "History finally produced solely for historians and also blocked by them, like the surgeon who immobilises his patient in order to operate on him". **19** After all, as we have learned in another short story by Borges ("Funes the Memorious" [Funes El Memorioso]) thinking is generalizing, not only archiving and adding more and more data. After all, as we learned in another short story by Borges ("Funes the Memorious" [Funes El Memorioso) thinking is generalising, not only archiving and adding yet more and more data.

Just as important as paying attention to the instability of the cultural system we are living in, and understanding how it demands new preservation methods, is realising that these are only provisional and palliative solutions. Due to the continuous speed with which technologies are discarded in shorter and shorter periods of time, the solutions provided for the time being are bound to create the same problems we seek to resolve. The transposition and adaptation of works to new equipment or their reprogramming does not result in definitive solutions. On the contrary, these procedures indicate the need for continuous updating, which, at some point, may also produce a quite distinct result from the work created by the artist in a given historical context. From now on, loss, change and even replacement will be more and more part of our conservational practice.

We are facing a noisy 'datascape', which goes far beyond our screens. Its signals and inputs/outputs are everywhere, and they amount to much more than just some reading or coding mistakes. The peculiar 'ruinology' of the art works discussed here is a constituent part of this digital epistemology. Because of this, they can point to alternative directions for thinking about the emerging politics of memory in the age of new monuments, museums and archives. As Robert Smithson wrote, "Instead of causing us to remember the past like the old monuments, the new monuments seem to cause us to forget the future. (…). They are not built for the ages, but rather against the ages". **20**

Paraphrasing his words, then, we could say that, instead of celebrating a progressively more stable future, by preserving fragments of the past, museums of digital art should be the museums of the unfinished, the unrepaired, and the unretrieved. By doing this, they will allow us to deal with the social and emotional perception of loss without counting on an imminent process of disappearance.

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Infiltration, Decontextualisation, Appropriation And Hoax, *Medium Reflective* Artworks In The Age Of Electronic Crowds

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Abstract

This article analyzes different tactics used by contemporary artists usually interested in exploring our relationship with media and technology. It starts by acknowledging a desire for interactivity and transparency in contemporary society, art reception and in product and interface design. But it also recognizes a very particular techno-social context in contemporary occidental societies – the existence of an *electronic crowd* in which everyone appears permanently interconnected, receiving, producing and sending information. This context is considered here as a potential ground for artistic intervention and different *medium reflective* artworks/interventions are analyzed as examples of such aesthetic potential.

Keywords

Tactical Media; Infiltration; Friction; Transparency; Détournement; Public Space; Appropriation; *Medium Reflective Artwork*; *Electronic crowd*.

Introduction

The activist impulse that characterizes the advent of interactive arts at the beginning of the 20th century seem to have faded away in many contemporary interactive art forms. If the first propositions played with the tensions between touch and anti-touch traditions in art and society, contemporary interactive forms have transformed museums and galleries into complex polysensory installations, engaging spectators in playful and cheerful experiences. As different analysis have already highlighted, very often, such experiences favor play and physical operation over critical reflection. [30] Moreover, technology seems to be foregrounded in many of these experiences in ways that resemble scientific demos or arcade games. This *technological correctness*[1] is nonetheless rejected by some artists favoring error, glitch and friction over transparency and immersion. The use of errors as aesthetic functions is not new, although, as the work by Jodi and Netochka Nezvanova suggests, with the progressive introduction of machines and electronic media in the field of art, error has become not only a subject to explore but also a form of critical media aesthetics. [31]

> "As our digital culture oscillates between the sovereign omnipotence of computing systems and the despairing agency panic of the user, digital tropes of perfect sound copies are abandoned in favour of errors, glitches become aestheticized, mistakes and accidents are recuperated for art under the conditions of signal processing." [32]

Following the observations made by Peter Krapp and other theorists we agree that audio-visual glitches, noise, system crashes and other undesired forms of electronic failures have been integrated as aesthetic elements in art and design propositions. Yet, they seem to have been somehow absorbed and commodified and are now part of our cultural landscape. The book *Glitch – Designing Imperfections* for example, provides us with a catalogue of imperfect or abnormal images that are the result of deliberate accidents created by artists and designers. In the field of music creation, Kim Cascone also detects an *aesthetic of failure* in the field of contemporary electronic music composition. Using noise as material, the avant-gardists Luigi Russolo, John Cage and Karlheinz Stockhausen are seen as strong influences in the introduction of noise and malfunctions into our contemporary electronic soundscapes. [33] According to Rosa Menkman, glitch transforms the artwork into a form of "unstable utterance of counter aesthetics", a critical media object that gives the opportunity to "critique the conventions of the medium". [31]

[1] "Art itself is becoming TC. In fact, media art is frequently cited to vindicate the TC trend. We are invited to marvel at computers' improved capabilities and resolution and to be seduced by their evolutionary speed. Typically, the user of the artwork by mapping his or her actions to causal effects in the environment thus, TC art cannot be divorced from the desire to police the user by offering some kind of token control. The special effects themselves become the object of the artwork and the main incentive for its contemplation – a phenomenon we might call the "effect" effect." [27] The term "Technological Correctness" is cited as originating with art critic Lorne Falk.

But is this opportunity still possible? What happens when the *aesthetics of failure* become assimilated into our cultural audio-visual landscapes? Are errors and glitches still failures that break transparency and make media opaque?
There is no simple answer to such questions since each situation needs individual consideration, although one might acknowledge that visual and sound glitches have been accepted and become ubiquitous, as well as the media that produce them. Today not only are they part of our mainstream soundscapes but they have also been assimilated as visual strategies for graphic design in magazines, posters or motion graphics and have also been displaced to the physical world of matter, becoming materialized in the form of sculptures or daily objects.
But what happens if these malfunctions, glitches and noise are applied to interactive experiences? Is there a potential for aesthetic experience that goes beyond the representation and the use of visual and sound glitch and noise?

Artists such as Jodi, Christopher Bruno, Mathias Gommel or Samuel Bianchini have been integrating this kind of tactics in which errors of communication, glitches and other types of failures become elements of aesthetic elements of friction. A delicate balance between error, frustration and artistic intention is established and the aesthetic experience emerges from this moment of doubt. We could provide different examples and analysis of artworks and performances representatives of this idea yet, we would like to focus on the core idea of this article: how artists use the *electronic crowds* simultaneous as space and medium to create and present aesthetic experiences.

When speaking about *electronic crowd* we are referring to the ensemble of humans and their media outlets. More than never, contemporary public and private spaces present a complex network of agents and agency between human and technological actors. We are permanently connected to each other and to things by means of all kinds of electronic devices, screens, speakers and terminals. We argue that these can be potentially used by artists not just as vessels for visual or sound contents but instead can be disrupted and subverted in order to provoke critical awareness or different types of critical distance. In works such as the *Image Fulgurator* by Julius Von Bismarck or *Newstweek* by Julian Oliver and Danja Vasiliev the artists act anonymously, hidden in the middle of the crowd or behind the screen, subverting and transforming the normal use of our technological extensions (the digital cameras and the computer/internet) into opaque objects that aim to provoke detached reflection. In both works, spectatorship is a condition that emerges involuntarily and even if the spectator is not really able to manipulate the work's structure, he or she still needs to act and to operate his or her device, in order to access the work.

The article analyzes *infiltration*, *decontextualisation*, *appropriation* and *hoax* as potential tactics for an artistic practice in a time in which each one of us has become an image producer and where the interest in production, participation and action is greater than the interest in contemplation. Such strategies aim to render visible the transparent *digital maelstrom* surrounding us by asking: what lies behind the scenes of this customary media façade that ultimately envelops all the ramifications of the social, personal and political?

Making, acting, interacting: the new paradigm

For some decades, a shift from a contemplative paradigm to an "active" paradigm has been observed in very different fields of our society and we believe that has been fomented to a large extent by technological development. According to Boris Groys in art reception, the *vita contemplativa,* which some time after Kant was considered superior to a practical attitude, has been discredited and replaced by what he names *vita activa*. [3] Erkki Huhtamo also observes a shift from a society that was essentially tactiloclasmic, to one that is gradually becoming participative and accepting the physical touch. [2] These transformations have been somehow represented in the field of art by authors such as Marcel Duchamp and Naum Garbo that demand spectator's physical participation in the sense-making process. At the same time, outside the field of art, the emergence of the self-service store, the penny arcade and other services have given people more authority in their choices. This shift has become more visible and been catalyzed by the advent of digital computers and the internet and today, when trying to define "New Media" two words seem impossible to avoid: *interactivity* and *ubiquity*. New media promotes interactivity by allowing people to communicate and participate bi-directionally as opposed to traditional media such as newspapers, radio or TV. The flexible, mutable and recombinant essence of new media allows a permanent hybridization and endless reproduction of media protocols and formats. After becoming participative, media has become customizable and is now ubiquitous, infiltrating all the capillaries of society. As Giorgio Agamben observes, even if certain devices date back to the time of homo sapiens', today they seem to model, contaminate and control every instant of our lives [8]. Anyone can have their own radio, TV channel or newspaper, expressing their thoughts and sharing their knowledge, lived and felt experience, skipping the traditional top-down system of most mass media. As Clay Shirky observes, "everyone is a media outlet." [9] From the already commonplace e-mail to *YouTube*, *Instagram*, personal blogs, online forums, online newspapers, podcasts, online radios, online social networks such as *Facebook*, *Twitter* or *Diaspora*, chat rooms as Messenger or *WhatsApp*, *Second Life* and Voip services such as *Skype*, media surround us and mediate us in the most intimate manifestations but also in our collective decisions. This empowerment of the individual has a direct impact on the way the collective comes together to identify, discuss and solve the problems of society. However, at the same time as these social tools have allowed for more participation, response, immediacy and sharing,

they have given rise to what Jean Baudrillard calls the *Ecstasy of Communication:*

"We no longer partake in the drama of alienation, but are in the ecstasy of communication. And this ecstasy is obscene. Obscene is not confined to sexuality, because today there is a pornography of information and communication, a pornography of circuits and networks, of functions and objects in their legibility, availability, regulation, forced signification, capacity to perform, connection, polyvalence, their free expression. Its no longer the obscenity of the hidden, the repressed, the obscure, but that of the visible, the all-too-visible, the more-visible-than-visible, it is the obscenity of that which no longer contains a secret and is entirely soluble in information and communication." [14]

In a time of pervasive media, technological devices and information saturation, one needs to understand the workings of these technical devices and the media we are engulfed by. More and more, media has become the nervous system of democracy and in light of this, artists, hackers and media activists have a central role in the discussion that takes place in the public sphere. If *culture jammers'* actions relied on reclaiming the public space through the production of counter-messages and in the subversion of public billboards, a new media/digital artist or activist should reclaim the public media space.
But why do we need artists to examine and short-circuit our technological devices and media spaces? How can their actions contribute to open discussions and bring consciousness about the public sphere we belong to?

Transparency and Code

The face-to-face meetings and discussions that usually took place in public physical space such as cafés, public squares and gardens have partly migrated to online digital spaces parallel to the world of atoms, becoming mediated by all kinds of technological devices. These immaterial places and devices where public opinion gathers and eventually evolves into political action have their own rules and laws, encrypted in the form of code. Code, software and other "hidden" internal processes of our devices have therefore become central issues that should not be discarded by those who gather, discuss and intervene in the affairs of the public sphere. The way in which *Google* or *Facebook* services deal with our personal data and the way they design their interfaces should be an issue of public concern. Artists and other actors have an expertise that brings awareness and critical distance to such issues. The same is true to all the software and electronic devices which transparently inhabit our routines.
The "all too visible" that Baudrillard associates with information pornography contrasts with the invisibility of the code and internal processes that our nano-devices hide under shiny plastic cases and liquid crystal screens. Lately, not only are the code and data obfuscated but the hardware and the mechanical components have also become black-boxed, making the core structures progressively more hidden and leaving only a simplified version of the device available to us. [15]
Interface design is essentially oriented towards a strategy of transparency and immersion and as Galloway observes, the challenge comes from maintaining the distinction between edge and center (medium/interface and content). [16][11]

"As technology, the more dioptric device erases the traces of its own functioning (in actually delivering the thing represented beyond), the more it succeeds in its functional mandate; yet this very achievement undercuts the ultimate goal: the more intuitive a device becomes, the more it risks falling out of media altogether, becoming as naturalized as air or as common as dirt." [11]

Transparency is often related to the clarity and visibility of a process or information transaction, for example in the context of politics or economics. However, in the field of HCI, transparency is instead associated with frictionless communication then mostly related to the concealment of information. [16] Rather than concentrating users on the functions and internal processes of the device, the transparent interface therefore wants them to focus on and become immersed in the contents. Then, the more they use the device, the more they become immersed and the interface "disappears", becoming invisible to their consciousness unless for any reason the "tool breaks", making the interface *present-at-hand*[2]. This process is obviously related to a consumer society interested in producing and acting faster, more effectively and without place for errors. However, down below the surface of our friendly and playful devices we find the "rules, conventions and relationships, which are basically changeable and negotiable, being translated into and fixed in software". [16] As Inke Arns maintains, the code not only affects the graphical interface but has a political effect on the virtual worlds we inhabit and as a performative text it is becoming law. [16]

In the age of the *electronic crowds* and networks, an effective action is one that happens at the same place where the crowd is and the networks flow. A pervasive and ubiquitous phenomenon needs pervasive and ubiquitous action in order to transform our personal and public technological devices into opaque, unworking vessels for detached reflection. Each device is a potential mirror waiting to be broken or subverted but also a potential vessel to be filled with different content. Art manifestations have left the gallery a while ago in order to find their public and in an attempt to merge with people's everyday life. This delocalization has been observed in Participatory and Relational art but also in movements such as Futurism, Dadaism, Situationism, Culture Jamming and among others, more recently in so-called *Flash Mobs*.

[2] According to Heideggerian terminology, when we use a hammer we use it without theorizing it, thus it is *ready-to-hand*, although if it breaks then it becomes visible or *present-at-hand*.

Moving away from the gallery

The dissolution of the artist's individuality, authorship and authority as well as the de-materialization of artwork characterized the avant-garde movements at the beginning of the 20th century. [7] The art object gave way to ephemeral public events that required the spectators' presence and very often their physical participation. According to Groys the Futurists and the scandalous actions created by Filippo Marinetti produced a kind of bridge between art and politics through a kind of "event design" that was used as a strategy to conquer the public space by means of provocation. [7] For Marinetti, "articles, poems and polemics were no longer adequate. It was necessary to change the methods completely, to go out into the street to launch assaults from theatres and to introduce the fisticuff into the artistic battle." [13] Then, as Claire Bishop asserts, "with Futurism, performance became the privileged paradigm for artistic and political operations in the public sphere." [13] This was also observed in Dadaist and Russian public experiments, although the latter had an ideological character whereas the former were anti-ideological and anarchists. [13] André Breton considered the public space away from the cabaret and the proscenium frame to be a privileged realm that could hold the attention of the public and create a bond between art and spectators' lives. [13] The *Excursion to Sain-Julien-le-Pauvre* and *The Maurice Barrès Trial* are two examples of public performances led by Dada in in 1921. [13]

Some decades later, like the Dadaists, the Situationist International (SI) headed by Guy Debord and Gil Wolman also reacted against commodifiable art in favor of art that should not be separated from life. The works produced by the Situationists were rarely visual, with the exception of films, and were often found in the form of text and in the construction of ephemeral situations, which were rarely documented. Two strategies were commonly used to construct situations: *dérive* and *détournement*. The first consisted in random ramblings around the city without a defined duration that could occur alone or in small groups of participants. [19] Such ramblings or drifts in the streets allowed the participants to observe, have encounters, confronting them with some "taken-for-granted" views of life and action. [10] The second strategy, *détournement*, was directly influenced by the techniques of collage, photomontage and the subversion of painting previously adopted by the Dadaists and Surrealists. This technique allowed the appropriation of cultural materials, undermining and subverting their original meaning. According to Debord, this was a true critical cultural practice that did not support the creation of new objects but instead acted over the existing means of expression. [13]

These public actions and performances outside the gallery spread throughout the fifties and sixties, influencing artists such as Allan Kaprow who staged the first *happening* in 1958, John Cage, Lygia Clark, Valie Export, Joseph Beuys and in between others Gordon Matta-Clark.

Some decades later, during the eighties, Culture Jamming rediscovered the Situationist tactic of *détournement* to reclaim the urban public spaces. This tactic has been commonly used by artists or activists which appropriate and take over the existing images of advertising billboards and subvert their original meaning, eventually exposing the "underlying truth of a corporation's strategy". [20] Jan Lloyd observes: "the public sphere has only ever been a site of communication and "free speech" for those that hold political, cultural, and economic power." This kind of "citizen art" as Rodrigues de Gerada calls it, therefore regards the public sphere as a place of cultural meaning-making and reclaims the right to public discourse, as opposed to the one-way flow of communication that characterizes the omnipresent corporate advertising mechanisms. [20]

The actions and culture jams normally use billboards and other advertising material in public spaces, although culture jammers have been extending their actions to CCTV systems (counter-surveillance) and have recently moved onto the internet. [10] With the development of new media technologies, artists have begun to explore the possibilities and the limits of public space, through the creation of temporary events, performances, happenings or installations using multimedia. Krzysztof Wodiczko, Rafael Lozano-Hemmer, or Kit Galloway and Sherrie Rabinowitz have been using public spaces and monuments as canvasses for very precise video and light interventions that play with local social, economical and political contexts, mixing online and offline worlds, also exploring issues of space and time. However, the use of technology in some of these interventions has been criticized and highlighted as another form of cultural industry in disguise, a new kind of *"effect" effect*[3] working in favor of technological commodification. [1]

From another perspective, as a social tool the immediacy and connectivity brought by technology is at the origin of a very contemporary urban phenomenon, *Flash Mobs*. These actions, which normally occur in public spaces, gather hundreds of people who engage "in seemingly spontaneous but actually synchronized behavior." According to Clay Shirky they can be divided into "harmless but attention-getting fun" events and, on the other hand, political protests. [9]

In their movement towards the public space artists are not looking to create objects and "utopian realities" but rather to "engage with the existing reality", creating contexts for potential action. [12][18] By means of provocative, scandalous, polemic, humorous, playful, spectacular, uncanny, shocking or practical actions, artists have been calling and holding the attention of a wider audience outside the white cube and far away from the rigid structures of art institutions in an attempt to build a more inclusive public sphere. Nevertheless, even if the effects produced by such actions are small and their consequences difficult to track,

[3] Rafael Lozano-Hemmer describes the *"Effect" effect* as a situation in which the "special effects become themselves the object of the artwork." (Lozano-Hemmer, 1996) The effect for the effect's sake.

they temporarily change the dynamics of power thus producing anxiety in those with power. [18]
Today the public is split between offline and online spaces and, according to statistics delivered by Comscore, in 2011 European citizens were online for a monthly average of 27.5 hours per person. [29] Online presence has been increasing with access to less expensive technologies, portable devices that enable permanent online presence and free Wi-Fi connections, so it is normal that for a while artists have been turning their attention to this "new" space and planning their actions here.
The increasing online presence reinforces the shift from a disciplinary society to a society of control and surveillance where the smallest movement or action becomes traceable and tagged. [17] Yet, as noted in the first section, another shift is observable in media consumption. The "passive" *mass* media consumer is quickly giving way to a participant who uses media "tactically". [24] Building on Michel de Certeau's *The Practice of Every Day Life*, Geert Lovink and David Garcia classify the *rebellious user*[4] as the "happy negatives" who uses media in a critical way, "by which the weak becomes stronger than the oppressors by scattering, by becoming centreless, by moving fast across the physical or media and virtual landscapes." [24] The authors classify tactical media as a "form of qualified humanism" that acts as an antidote to the commodification of human life but also to "newly emerging forms of technocratic scientism which under the banner of post-humanism tend to restrict discussions of human use and social reception." [24] By "becoming the media[5]", through the creation of media *anti-environments* that break and undermine the normal functions of the media and its mechanisms from the inside, the rebellions highlight the structures of power and turn them opaque rather than transparent, temporarily allowing the "hunted to become the hunter". [24] By means of custom made software and hardware, the rebellion has been critically exploring and subverting the technological landscape, using some tactics and techniques that are identified in the following section, during the analysis of some recent artistic, activist and social experiments.

Turning media opaque: infiltration, decontextualisation, appropriation, and hoax

As we saw during the previous section, artists have been using very different tactics to reclaim the public space and to hold the attention of passers-by, and lately have been adapting them in order to examine and comment on our use of electronic media, disrupting the flow of use by means of subversive reverse-engineering.

The video superimpositions in public spaces and monuments of Krzysztof Wodiczko, the fake websites and conferences of the Yes Men, the *shop dropping* carried out by Barbie Liberation Organization (BLO) and the city scale laser projections by Hehe collective have been using tactics of infiltration, decontextualization, appropriation and hoax that aim to draw our attention to social, political, ethical, gender, economic and environmental issues. However, these actions are constructed to essentially focus the spectator's attention on the "content" rather than on the medium in use.

Lately a new kind of action that we might call *medium reflective* has been put forward by artists, hackers and media activists. Such actions might take place in the offline public space, in online spaces such as news or social network services or in the intersection of both. The artists normally create a temporary situation in which they can remain incognito or remote in the case of online actions, so their presence is normally not perceived and the intervention occurs without any kind of official authorization. The interventions are normally subtle and very surgical and they always depend on the use of a certain medium, so they demand specific actions from the users or, in these circumstances, the *involuntary spectators*. In order to clarify this idea, we'll describe and examine four different projects (*Image Fulgurator*, *default to public: tweakleak, Face to Facebook*, *Newstweek* and *2.4GHZ*) that follow this modus operandi.

The Image Fulgurator is a device created by the German artist Julius Von Bismarck that reverses the normal operation mode of a photographic camera so that instead of taking pictures, it projects pictures onto any surface. The device detects when the flash of another camera nearby goes off and at the same instant projects a predefined image onto a target surface. The artist has been using the apparatus in public spaces that are normally crowded with tourists or at events involving photojournalists. In Tiananmen Square in Beijing, Bismarck "fulgurated" a white dove (Magritte dove[6]) over the portrait of Mao Zedong on Tiananmen Gate. The tourists who took photos with their digital cameras could immediately access the manipulated photo, a superimposition of a dove over Mao Zedong's face. Another intervention took place in 2008 when Barack Obama visited Berlin and made a public speech in front of the Siegessäule. This time, Bismarck "fulgurated" a Christian cross onto Obama's lectern, diverting his political role and changing the meaning of the event itself. The tactics adopted by the artist includes infiltrating crowds and image superimposing images that produce *deceptive détournements*[7].

[4] De Certeau characterizes the consumer as a rebellious user that uses media tactically.

[5] "Don't hate the media, become the media" is a popular slogan by the activist and musician Jello Biafra.

[6] This superposition seems to make reference to René Magritte's *The man in the bowler hat,* depicting a white dove that hides the face of a man.

[7] Debord and Wolman identified deceptive détournements as the detouring of major political, artistic or philosophical signs and minor détournements as the detouring of ordinary elements to another context.

Fig. 1 – *Image Fulgurator performance* at Tiananmen Square in Beijing, China.

default to public: tweakleak by Jens Wunderling is a networked installation, that operates in public places. Inside a café in Berlin, a printer installed inside a monolith, printed Twitter messages on small sticker strips. Each time a tweet was sent in the vicinity of the café, a sticker containing the message was printed and the author was notified over Twitter by an alert message: "Your tweet has just been printed on a sticker." Later, if someone took the sticker from the printer, a message would be sent to the tweet's author: "Your tweet has been taken away." [21] With this apparatus, Wunderling connects two spheres that are normally separated and work very differently, first questioning the sense of online and offline privacy and then creating an awareness of self-exposure. [21] By leaving the online sphere, the tweet enters the physical world of matter and atoms that has different mechanisms for processing information and the author loses track of his or her message since anyone can take away the sticker. This loss of control seems to highlight the incongruities between both spheres, and instead of solving them the artist uses them as part of the work's statement. By decontextualizing and appropriating the user's information and by notifying him/her that the message has been set "free" into the physical space, the artist is producing a kind of *distancing effect*[8] allowing the user to reflect on the medium's mode of functioning and on his/her relationship with it.

Another case of data manipulation is *Face to Facebook*, a "global mass media hack performance" by Paolo Cirio and Alessandro Ludovico. The artists developed an algorithm that automatically appropriates and displaces the information available on personal profiles on Facebook, recontextualizing it on a new dating website, "lovely-faces.com". Beyond obtaining textual data, they were able to steal the user's profile photos which were then arranged according to their facial expressions on the new website. This provocative action resulted in "one thousand media coverage around the world, eleven lawsuit threats, five death threats, several letters from the lawyers of Facebook." [23] This action, as well as *Tweaktleak,* reminds us that all the information that we give to social networks is available and accessible to others. Even when profiles are private, companies such as *Facebook* keep our data on their servers so they can use it or sell it to other companies. Furthermore, as Cirio and Ludovico maintain, "any user can easily duplicate any personal picture on her hard disk and then upload it somewhere else and mix it with different data. The final step is to be aware that almost everything posted online can have a different life if simply recontextualized." [23] This temporal displacement is then a symbolic action and representation of a commodification movement that is already occurring in our networks, however it is mostly invisible. With the emergence of online social networks we have witnessed the obsolescence of *telescreens*[9] and the architectural metaphor for modern power named *Panopticon*. Today, on Facebook alone more than 1 billion active users knowingly feed the network every day with the most refined information that telescreens or panopticons could never obtain. Coupled with a ubiquitous and effective CCTV surveillance system integrating face detection algorithms, social networks have become an essential, powerful source of information, and as a consequence, resistance to such networks has become a potential threat to society, seen as suspicious behavior[10]. In this context, Benjamin Gaulon's work *2.4GHZ* creates a disruption in the omnipresent CCTV network by infiltrating it with small counter-devices near the CCTV cameras in the public space. These devices are essentially small LCD monitors coupled with a 2.4GHZ video wireless receiver that display the image captured by the closest CCTV camera and make it accessible to the passer-by.

Newstweek, a project by Julian Oliver and Danja Vasiliev, employs a similar tactic of infiltration, using a custom-made counter-device that allows remote hackers/writers to edit and manipulate the news displayed on some main online newspapers. [22] A hijacked wall plug containing a mini-router is plugged into a power outlet in public cafés or any other places with open Internet access points, becoming part of the customary environment. The open wireless network in the surroundings of the counter-device partly comes under its control, generating a modified network that allows the hacker to edit the online news by using a graphical interface. The artists have carried out at least one intervention, infiltrating a Starbucks café in Paris, and they also made available the instructions to build the

[8] Bertold Brecht used direct audience-address techniques to prevent the spectator from having a passive emotional reception, avoiding an exclusive moment of amusement and entertainment. These techniques revealed the illusory and manipulative construction of the piece, keeping the spectator intellectually distanced from it. [4]

[9] In George Orwell's famous novel 1984, telescreens are devices of mass surveillance, featuring televisions and video camera. They are use by the "Thought Police" from the Inner Party.

[10] In an article retrieved from the Daily Mail in October 2012: http://www.dailymail.co.uk/news/article-2184658/Is-joining-Facebook-sign-youre-psychopath-Some-employers-psychologists-say-suspicious.html

device on their website Newstweek.com. More than just creating content, this project proposes a counter-device, which explores the nature and the typical top-down flow of mass media by using a tactic of hoax or "facts-fixing". As the authors maintain, *Newstweek* highlights the vulnerability of a reality which is increasingly dependent on media but also displays the complexity and ignorance fomented by the workings of networks and devices. [22]

Fig. 2 – *Newstweek* network map example

These *medium reflective* interventions have as a common goal the undermining of our online and offline routines, making visible what is normally transparent or, to be more accurate, invisible. Instead of creating new alternative media, the artists and media activists infiltrate, appropriate and decontextualize the dominant media, opening temporary fissures that call for a detached and critical reflection. By operating through shock and estrangement, these interventions create an understanding of a certain situation and call for a "specialist" gaze normally found in museum contemplation. [28] Jacques Rancière maintains that "being a spectator is not something that "we should turn into activity" but instead is "our normal situation."" [26]

In our everyday lives we are constantly making sense of events and situations and, according to a pragmatist approach in aesthetics, outside the museum, in the streets, at home or online, aesthetic experiences can potentially occur. A *medium reflective* object is therefore by no means anti-aesthetical.
When Bismarck or Gaulon focus our attention on the experience of digital cameras and CCTV cameras, it is not the same kind of attention one pays to work of art when simply looking at the technique or at the medium used by the artist. It is the subversion of that medium that produces the aesthetic experience. It is when the medium is no longer transparent that we finally understand the way in which we are bounded by the "invisible" laws of code, software and hardware. Another aspect of these medium reflective interventions is their "nomadic" and ephemeral nature. Unlike some types of public art (e.g. sculpture) and monuments which progressively become part of the cultural and urban landscape, such interventions appear and move fast, adapting to the media and infoscapes in constant metamorphose.

In this regard, these kinds of interventions and actions seem to expand the frontiers of interactive arts by redirecting and interrupting the media user's flow of activity for the sake of new meaningful and critical interactions. Despite the evident changes to the reception mode, the user is still an active participant, which is crucial in order to trigger the aesthetic experience. One might ask if the distracted user is able to contemplate such surgical and ephemeral interventions, but these emergent proposals foreshadow a promising future for art and design merging with everyday life routines.

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Statuevision: A participatory, collaborative, cross-generational, urban intervention with public monuments as primary content

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Abstract

This paper presents the project *Statuevision*, an interactive public performance based on historical statues in Washington DC in October 2014. The project also served as a study of strategies for engaging communities in shared cross-generational learning experiences in both a playful and meaningful way. *Statuevision* explored community engagement and empowerment with an urban projection intervention into Dupont Circle in Washington DC. Several seven and eight-year-old local students led the audience in a guerilla world history learning campaign, augmented with 3D video projections on the trees and ground. The public performance deployed a fleet of customized projection carts into Dupont circle at night; each cart projected animated renderings of local statues and provided a stage for the evening's young MC's. The students from Capitol Hill Montessori spoke with passersby about the history and importance of the monuments with the assistance of customized teaching material that was created for the primary school students prior to the event. *Statuevision* aimed to engage a community by decontextualizing familiar statues and monuments and reexamining the history behind each figure through the eyes of children. Passersby became audience members as they rallied behind the young student's learning efforts, and eagerly contributed to the narrative of each figure.

Keywords

Art, Technology, Education, Modeling, Projection, Intervention, Public Space, Montessori

Introduction

Washington, DC has over 100 large outdoor statues that depict notable historical figures. [10] Embedded in each statue is a piece of Washington, DC's history, deemed important enough to be commemorated with a public monument.The *Statuevision* project came out of a desire to leverage the wealth of public art and the unique historical narrative present in Washington, DC's public statue collection, as content for an outdoor public projection event and as a learning tool.

Statuevision was part of the 5x5 project, a Washington DC program of contemporary, and temporary public art, installed in DC over the fall of 2014. The DC Commission on the Arts and Humanities commissioned five curators to select five artists, and develop a publicly accessible work of art with each. Artist Ali Momeni proposed *Statuevision,* a celebration of monuments from around the Washington DC area in a public and participatory projection performance. The performance was developed collaboratively with school teachers, students, and parents at Capitol Hill Montessori, a local school. As an educational project, it encouraged community members to examine American history through the characters embodied in statues found throughout the district.

The one-night public performance started at dusk in DuPont Circle Park surrounding Chester French's statue. The event assembled approximately 300 DC citizens and visitors to experience live, real-time interactive projections based on 3-dimensional models of District statues. Utility carts on wheels allowed performers to move about and project on trees from small battery powered projectors. The project brought local history teachers and historians, students from Capitol Hill Montessori and Carnegie Mellon University, as well as everyday Washington DC history buffs, together in the narration of the lives and achievements of historical figures commemorated with the statues.

Statuevision explored learning through creative engagement with public history. By working with the community, *Statuevision* was able to bring together a cross-generational audience for the creative retelling of Washington DC's history through the eyes of school children, as mediated by animated projections. Not only was *Statuevision* a public performance, it also evolved to become a learning platform on three levels:

1) The *Statuevision* team worked with teachers at Capitol Hill Montessori to fabricate materials that were used for teaching students about the history of Washington DC through the figures represented as statues and monuments that the children see every day. 2) On the night of the performance, the school children taught passersby about the statues they had studied, and in turn, continued learning through a of dialogue and knowledge sharing with engaged members of the audience. 3) Trading cards and individual Facebook pages were created for each statute, containing all media content and historical information collected by *Statuevision.* This collateral material became publicly available online for any students interested in learning

Figure 1. Using 123D catch, this statue of George Washington is photographed from all possible angles, and made into a three-dimensional model, available to download.

about the monuments, or teachers hoping to share *Statuevision* resources with their classes.

Background

Statuevision was influenced by the rich history of social sculpture, contextual practice, guerrilla theater, and developments in situated learning methods. By synthesizing the history of public performative art of all kinds and alternative learning methods for young students, *Statuevision* was able to draw inspiration from each of these movements. For that reason, the technology used in the performance was an open process that invited public participation and inquiry. The same technology was also used as a method of engaging the young students in an alternative learning process. This use of public space and a collaborative process to encourage community participation and learning is a recurring theme in both art and education.

Looking at the history of Fine Art, public understanding of the function of art in society has been highly influenced by Joseph Beuys and his concept of the "Social Sculpture." Beuys argued that through the placement of art within a society, a society can be transformed. Such transformative power is accessible to anyone who chooses to exercise it, thus making anyone capable of being an artist. [8]

This concept is extended to, the more contemporary, contextual practice, often referred to as "social practice". Reminiscent of Dewey's writings on art as the experience of a work, rather than the object itself, contextual practice situates art projects within a community, creating an experience for the community, rather than an object, as the final product. [3] Artists like Ernesto Pujol and Rick Lowe of Project Row Houses can be referred to as social practice artists, and similarly approach art as a social endeavor. Pujol views himself as a social choreographer, who creates projects that utilize everyday locations as performative spaces and sources of material, through the help of local communities. His work *Memory of Surfaces* resulted a social archive of the history of Providence, Rhode Island. He worked with local communities that had sprung from institutions like the local public library and the Rhode Island School of Design to build an installation of borrowed things meant to be returned at the project's completion. [4] French art critic Nicolas Bourriaud goes on to define the artistic practice of "relational aesthetics," in which a work exits through its social context and relationship to humanity, not by its placement in a museum. [1]

Similarly, in the history of theater, Guerrilla Theater, and its associated Invisible Theater represent movements within performance that reexamine the location, theme, and players in a production. In Ronald G Davis's manifesto on Guerrilla Theater, he calls for the theater to become a catalyst for social change through the voice of a community. [5] Augusto Boal goes on to explain that what he calls "Invisible Theater" must take place in highly trafficked public areas, so those who witness the performance are in attendance by chance. [2] Places like the Cornerstone Theater, located in Los Angeles, work with communities to create performances around issues that affect that community. Another model for community engagement in a public forum is The Living Theater. Located in New York, the theater brings together a community of individuals through radical public performance that draws in its own audience through spectacle. [11]

The recurring themes in the artistic approach to engaging a community also appear in literature about alternative learning processes. The students become the community, and the success of an approach is judged based on the student's level of engagement with the material. Situated learning as a movement was first established by Jean Lave and Etienne Wenger; it explores the advantages of learning as a social process, situated in a specific context and physical environment. Much like art's departure from the gallery, in contextual practice and relational aesthetics, Situated Learning advocates for learning that is not confined to the classroom. Instead, knowledge is co-constructed within a community of practice. [6] A study performed by Alaa Sadik, professor of educational technology, on the benefits of learning through digital storytelling found that student understanding of curricular content increases with the use of technology, and that teachers were therefore willing to make the necessary adjustments within the curriculum to allow for such digital content. [9]

Figure 2. Meshlab is used to edit and clean up the models.

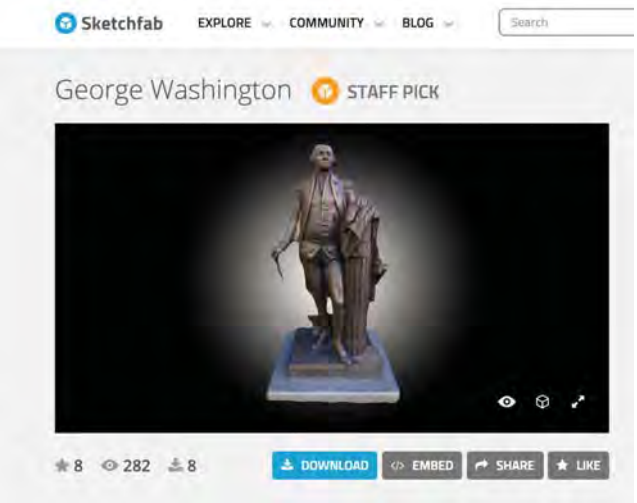

Figure 3. All models are available for download on Sketchfab.com/Statuevision

Like many of its influences, *Statuevision* was set up to be publicly accessible and collaborative. The desired outcome of the project was both to engage a community in the celebration and exploration of history though local monuments, but also to create an educational dialogue around the content. The performative and educational influences can be seen in the way technology was used for the project. All content generated through the use of technology became publicly available as an educational or artistic resource, and the exposed use of technology during the performance became a performative process, as well as a platform for collaboration.

Implementation

Statuevision was realized in several stages over the course of six months, and in collaboration with a public arts organization, a Montessori school, and undergraduate and graduate students from a school of art at a research institution. The sections below describe the process of realizing the work from conceptualization to the debut public performance on October 17, 2014.

Planning and Site

After receiving the invitation to participate in the 5x5 project, lead artist Ali Momeni made a number of site visits to the nation's capital in order to match suitable urban sites with engaging project ideas that would utilize urban projection--one of Momeni's areas of expertise--to activate a public space through a playful, collaborative, cross-generational performance that engaged the city's history. Curator Stephanie Sherman's deep understanding of the art in public spaces and advisor Don Russel's extensive wisdom about arts in the district were instrumental in shaping the project.

These collective investigations led to the selection of DuPont Circle as an ideal site for this performance for the following reasons: 1) This site is well known, easy to find, accessible to a wide range of people, (from tourists, to residents, to professionals working in the area, and other community members from a wide range of socioeconomic backgrounds). [10] 2) DuPont circle is built around a major monument: a fountain--commissioned by the DuPont family in 1917 and realized by Daniel Chester French--a tri-faucetted statue representing the stars, the sea, and the wind. 3) DuPont circle has a history of engaging citizens through public gatherings, embodied in events like the DuPont Festival and organizations like the DuPont Circle Citizens Association. [9]

Roles and Partnerships

The project was realized through collaboration among several institutions and individuals: Ali Momeni, lead artist and faculty at Carnegie Mellon's School of Art, conceptualized *Statuevision*, designed and implemented the necessary hardware and software for realizing the work, and formed a team of research assistants from Carnegie Mellon to assist in the creation and performance of the work. The participating research assistants contributed to the following components of the work:

Performers:

- Priya Ganadas
- Claire Hentschker
- Miles Peyton
- Daniel Pills
- Kaitlin Schaer
- Lauren Valley

3D Modeling:

- Rob Hacket (external to Carnegie Mellon)
- Claire Hentschker
- Lauren Valley

Social and Learning Media Design

Figure 4. Front and back of a Statuevision Trading Card. Each deck has 50 cards.

- Claire Hentschker

Figure 5. Multi-media Facebook pages for each statue.

Using existing and freely available technologies, the *Statuevision* team created accurate 3D models of approximately fifty of the Dupont Circle statues. The 3D models were made using the free and online 123D Catch tool by AutoDesk1, which allows users to generate a 3D model of an object with just a few dozen still images taken from various angles around the object, (illustrated in Figure 1.) These models were then further refined using MeshLab, another freely available and open source tool2. During the performance, custom software, (seen in Figure 2,) allowed the school children to animate and move video projections of the statues in ways akin to manipulations familiar in puppetry. The process of creating *Statuevision* generated a number of archives that are now freely available to artists, educators or researchers. The full set of 3D models are now shared through SketchFab3, a freely accessible online resource that allows social sharing and downloading of 3D models, (seen in Figure 3.)

School Children as Masters of Ceremony

A creative collaboration with Capitol Hill Montessori led to the involvement of young students in the performance, and the creation of situated learning platforms for educators and students to use in teaching the history of icons represented in DC's monuments, through *Statuevision's* archived material. The *Statuevision* team traveled to DC prior to the performance and organized a one-day workshop with the students and faculty at Capital Hill Montessori. During the workshop, the young students were able to ask questions about the project and their involvement, gain a familiarity with the technology being used, and begin to think in new ways about their relationship to the monuments they encounter on a daily basis. The workshop was organized in part to strengthen the relationship between those involved at both Carnegie Mellon University and Capitol Hill Montessori. Additionally, the workshop helped the *Statuevision* team craft teaching materials suitable for the classroom and the students involved in the project, from first hand experience.

The format for the teaching materials went through several iterations, with the help of the faculty at Capital Hill Montessori, in an effort to find the most effective method for engaging the students. In the end, each student received a pack of *Statuevision* trading cards: fifty 2 x 3 inch colorful cards with an image of the statue on the front, and "stats" about the statue on the back. (Figure 4 shows the front and back for George Washington's card.) Each card includes a section for the students to bubble in their assessment of the historical figure's fame, compassion, and legacy. Each card also poses a question to the students about potential contemporary counterparts to the figure represented; this section serves to encourage further learning by prompting the students to ask questions and research the proposed contemporary figures. Students were able to play with these cards together with their classmates, choose their favorite monuments, trade with friends, and learn at the same time. A digital version of the cards was sent to parents, so they could also become a part of the learning process. Finally, the *Statuevision* trading cards were used to help prepare the students for the performance.

During the performance, each student spoke about the figures that interested them most, and shared what they learned about the subjects. Through the trading cards, the audience was able to engage with the material and the students. Participants asked questions, shared their own knowledge and facts, and passed around the cards. The communal learning experience encouraged students and audience members to share not only what they had learned about the statutes, but also their personal relationships to the monuments as geographical landmarks.

Statuevision served as an experiment in playful and engaged learning. It facilitated direct interaction between students, public, and subject, and ensured that all project material remained publically accessible. The trading cards are available online4 and can be viewed in the browser, or downloaded and printed out. The information on the cards was designed for eight-year-old students, the same age as the *Statuevision* student-performers. For older students, more in-depth information about the statues and their respective 3D models can be found on Facebook pages5 that were created by the *Statuevision* team. As seen in Figure 5, the Facebook format provided an accessible and preexisting public platform for organizing and presenting historical information. The pages also include the 3D models for each statue, and location of the statue within Washington DC.

Instrumented Design: Software

Ali Momeni designed custom software, (seen in Figure 6,) for *Statuevision*, using Max, openFrameworks, OpenGL Shaders, and TouchOSC. There were several overarching goals in the software design:

Figure 6. *Statuevision* Software: Models are animated on the computer screen in real time, controlled by the custom mobile application.

1) To develop an intuitive and gesturally controlled system for creating animations from renderings of 3D models, 2) To help automate steps in the participant's use of the technology as a platform for animation and storytelling. The software scrolls through the archive of 3D statues, so one can be selected for wirelessly controlled placement and animation in space from a cell phone. 3) To employ platforms and technologies that could be embedded in future versions of the project, thereby removing the need for personal computers in this performance.

Instrument Design: Hardware

Statuevision was able to augment the experience of Dupont Circle with large-scale animated projections because all systems involved were designed to be portable. Six performers had their own carts, (seen in Figure 7 and Figure 8,) each equipped with:

- Top Lighting: 12V incandescent overhead lighting with hand-made lampshade,
- Projector: Dell HD700 3000 Lumin Projector,
- Laptop: Macbook or Macbook Pro,
- Statue Cards: Custom designed/printed "baseball card" format informational aids,
- Side Panels: Lasercut 0.006" polystyrene with Statuevision logo,
- Battery: LiFO4 100 Amp Hour,
- Inverter: 1000 Watt,
- Speaker: Mackie amplified 150 Watt public announcement system,
- Bottom Lighting: RGBWW remote-controllable strip lighting

An adjustable, incandescent lamp above each cart provided the student speakers with a spotlight as they spoke about the projections. The Projector remained firmly mounted to the cart with a Magic Arm and clamp. The lighting, projector, speaker and computer received power from a battery fastened to the inside of the cart that remained hidden by white paneling, bearing the branded *Statuevision* name and logo. The bottom of each cart glowed with white light as the students spoke, and red light when the students transitioned from one cart to another, because of RGBWW controllable strip lighting lining the base. These carts were designed and assembled specially for the *Stautevision* project.

Performance

The public performance:

6:00pm: A team of six undergraduate and graduate performers from Carnegie Mellon University wheeled six *Statuevision* carts into Dupont Circle. The carts were turned on and tested, musical accompaniment for the performance started, and the team familiarized themselves with the walkie-talkie communication protocol.

6:30pm: About ten school children from Capitol Hill Montessori, marked with glow in the dark bracelets for visibility, arrived with their friends, teachers and parents. Each student was assigned to a cart operated by one of the performers from Carnegie Mellon. The cart operators introduced the technology to the young students and assisted them in a brief hands-on run-through with the gestural interface for controlling the animation, as well as the public interaction.

7:00pm: Official start of performance. The carts were dispersed around Dupont Circle, and the school children took turns walking from cart to cart, teaching the crowd about

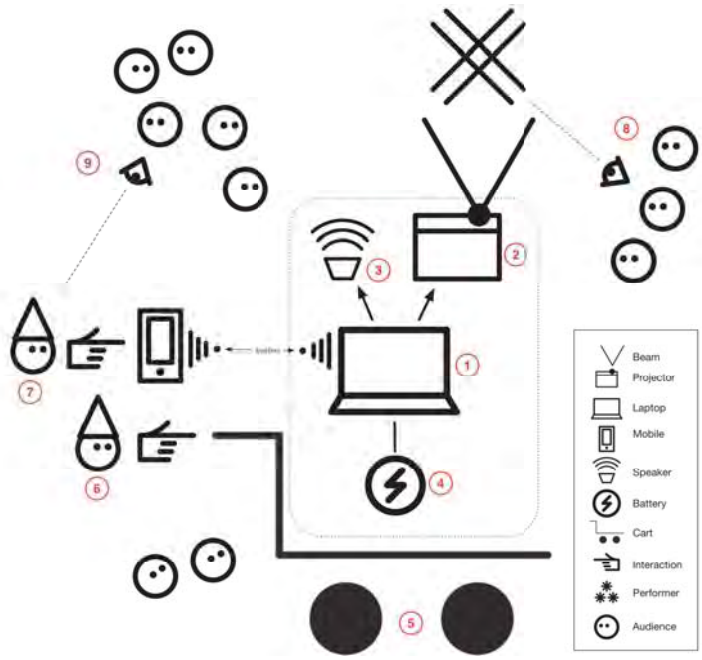

Figure 7. 1) Computer with custom real-time video animation software, 2) video projector, 3) loud-speaker, 4) battery and inverter, 5) mobile utility cart, 6) cart operator (university students) 7) student performer working with mobile phone as gestural controller for animation, 8) audience sees projection on ground and trees, 9) audience sees and listens to students animating projected statues and speaking

the historical figures they had studied. The performance flow at each cart was as follows:

When a student arrived at a cart, they would choose a statue to talk about from the deck of trading cards.

- That statue was then selected through the software and projected onto the environment.
- The young students talked to the audience about the statue and its history, taking questions and comments.
- Students, cart operators, and audience members collaboratively animated the projected statues, making them bend, rotate, spin, and dance while listening to short lectures delivered by the young students about the lives and accomplishments of each historical figure.
- Every 10-15 minutes, the students rotated carts and addressed a different audience in their new location.
- The above sequence was repeated for 2-3 hours until each cart battery, or each student, was exhausted.

The Take Away

As an art project, *Statuevision* transformed the familiar, often unheeded, presence of historic monuments into effective catalysts for public engagement. Learning about the heroic and referential legacies of statues allowed Washington DC's youngest citizens to engage with their local community and global history. The performance highlighted DuPont Circle's legacy as a site for congregation, social diversity, and public exchange. *Statuevision* created an uncanny environment for a single night, and populated public imagination through a visual and historical illumination of the city's statues and monuments.

As an educational platform, *Statuevision* brought an alternative learning process into the classroom and combined Situated Learning methods with an age-appropriate reinterpretation of pre-existing formats for content sharing amongst younger students. The student performances, the Facebook pages, and customized trading cards combined to encourage a successful internalization and critical reinterpretation of presented information. The project forged a community learning experience and shared appreciation for Washington DC; the monuments and the people who walk amongst them. DC's past

Video Documentation can be found at:
https://vimeo.com/117190296

Figure 8. An action shot (left to right): A Carnegie Mellon student performer, a Capitol Hill Montessori student performer, the Statuevision mobile projection cart, and audience members.

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Authors Biographies

Ali Momeni is into dynamic systems and moving targets; he works with kinetics, electronics, software, sound, light, people, plants and animals. His creative output ranges from sculptures and installations, to urban interventions and music theater performance. Momeni currently teaches in the School of Art at Carnegie Mellon University and oversees CMU ArtFab.

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Additional documentation of Statuevision

[Session 42]

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Dramaturgy as an enquiry on how interweave space, body and technology in performative interactive installations

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Abstract

This paper explores some of the important steps in the evolution of my doctoral research, which aims to relocate the notion of dramaturgy from the performing arts into interactive installation art. It briefly contextualises dramaturgy in the 21st century, and analyses the dramaturgical transformations caused by the impact of technology. It uncovers the still open process of the composition of a performative interactive installation, which supports the development of *space dramaturgy* concept. Developing the concept of space dramaturgy presupposes the analysis of other compositional elements vital for the elaboration of the concept: space, body and technology.

The first aspect to be analysed is the philosophical scope related with both individual and collective experience of space. This draws on Bachelard, Merleau-Ponty and Lefebvre's spatial theories. The theoretical underpinning is followed by a review of the process behind practice-based research, reflecting on the possibilities of adapting that to a dramaturgical questioning. Finally, the paper enquires into the interweaving of spatial bodily experience, participation, technology, the importance of time, and memory as a mean of finding performativity in interactive art installation, taking as a specific example the doctoral practice research.

Keywords

Dramaturgy, performance, spatial theory, interactivity, installation

Dramaturgy's contemporary panorama.

Dramaturgy is a discipline that envisions the creation of performative artworks. Experts Cathy Turner and Synne Behrndt state that "Dramaturgy tends to imply an observation of a play in production, the entire context of the performance event, the structuring of the artwork in all its elements" [1]. Turner and Behrndt reflect on dramaturgy as a comprehensive and complex practice and describe dramaturgy's main attributes: analysis, structure and composition.

Theatre and dance are fields with a complex practice, frequently involving people from different areas. Dramaturgy can offer support in the management of complexity through the analysis of the performance elements, how to structure and organise them into one composition.

The dramaturgical practice of analysis, structure and composition is historically linked to theatre, being theorised, for instance, by Aristotle [2] or the 18th century philosopher G. E. Lessing [3], who reflected about the composition of drama, function and effect. A dramaturgist, a theatre director or a playwright can either carry out the dramaturgical work, but throughout its evolution, dramaturgy built a close connection with text and literature. As the 20th century brought cultural and artistic transformations, the relationship between dramaturgy and text changed and detach from each other. Nevertheless, text and literature were not completely put aside; they are just not the most highlighted elements for the performing arts in general. In contemporary practice, dramaturgy can focus on spectatorship, defended by De Marinis in *The Dramaturgy of the Spectator* [4], the body, sound or image.

Historically, the deviation of dramaturgy from text was also a result of the technological development, one of the greatest transformations of the 20th century. Looking back, the artistic movements of the past century explored the dynamics of various technological innovations: industrial technology seeding into artistic expression related to *machine aesthetics*, which defined the work of Oskar Schlemmer and Meyerhold; cinema impacted scenography, resulting in projects like Svoboda's *Lanterna Magika*; or computer and digital aesthetics in the work of Merce Cunningham, for example.

Technology shaped performance into other formats beyond the traditional theatre and dance territory, and the transformation of performance can be observed from two perspectives; one is how technology stimulated the growth of interdisciplinarity in performing arts, opening way for the development of hybrid genres that intersected theatre with film, dance or installation art. As Hans Thies-Lehman notes in his seminal book *Postdramatic Theatre* [5], the incorporation of technology also impacted contemporary dramaturgy and the literary text lost its prominence. He asserts this could be as important as any other element such as sound, image or movement. For this research, dramaturgy is concerned with the interweaving of all the performance elements and to transform them into one single artwork. The crossover between art and technology, not only allows to take a closer look at where disciplinary boundaries meet, but also to see the potential expansion territories for dramaturgy. As Adrian Heathfield [6] explains:

> Dramaturgy no longer belongs to the theatre, nor dance-theatre, it is a practice spanning diverse disciplines and cultural sites. Wherever there is a performance taking shape there is a set of dramaturgical questions being asked and dramaturgical principles being tested.

Secondly, the public became more emancipated, as advanced by Rancière [7], and is also more capable of perceiving simultaneously different types of communication. The transformations happened at two different levels, the artistic production and reception, and both represent the two sides of the same coin and are an important reflection of the cultural and social dynamics. Therefore, the 21st century dramaturgy no longer needs to be bonded with text and literature, and deals with a much wider variety of elements as well as with new types of audience, that perceived and consume art at a much faster rhythm, are more informed and more keen to take part in art.

Performing arts assimilated a great variety of computer and interactive technologies. However, the performative potential of interactive technologies was always notorious throughout its history, and works like Myron Krueger's *Videoplace*, David Rokeby's *Very Nervous System* or Rafael Lozano-Hemmer's *Body Movies*, amongst others, are examples of pioneering artistic exploration into interdisciplinary art. They explored the performativity of technology together with the physicality of the body through theatrical settings, dance and music. The work of artists like Rokeby or Lozano-Hemmer, that focused on the creation of interactive installations and aimed to challenge the public to take an active and performative participation, set a fertile terrain for, what Heathfield mentioned, dramaturgical questions and testing of dramaturgical principles.

The compositional elements.

This investigation is situated within the context of a non-textual dramaturgy, aiming to apply this concept common to theatre and dance to interactive installation art. Dramaturgy became the main research vehicle to explore the performativity of this type of artworks. However, in order to proceed with a dramaturgical questioning, it is necessary to define the elements that are going to constitute the base for an artwork. These elements are: space, body and technology.

Space and Body

The research is focused on the development of a *space dramaturgy*, which means that space is the chosen core element. To choose the core dramaturgical element is to choose an artistic language. The research pursues a spatial language based on both individual and collective experience. Spatial theory undermines as well a conceptualisation of the body. The study began with a search for a sentient psychology framework grounded in the phenomenological perspective of Merleau-Ponty [8] and Bachelard [9].

Merleau-Ponty offers a notion of perception that unifies the sensory experiences with the human intellect. Space is intrinsically connected to perception: the apprehension of space is only possible because bodies are capable to spatialised themselves through the reasoning of sensory experience, for instance the understanding of depth thanks to visual information. Spatiality is inseparable from the sensory experience. The conscious processes of that experience is what allows spatial orientation.

The approach on the subjectivity of space was deepened by recovering some of the ideas developed in Bachelard's classic book *The Poetics of space*. Bachelard emphasises the association of memory and imagination as fundamental in the experience of architectural space, and defines personal psychological dimensions as the guiding thread in spatial experience. There is an encounter between the real space, that exists outside of oneself, and the inner or intimate space, constitute by the imagination, which makes particular spaces meaningful.

The philosophical scope of the research expands to LeFebvre's theories to explore the collective notions of space. Bodies are also part of social and collective synergies. These synergies produce data, memories, and impact the spatial environment. In the *The Production of Space*, Lefebvre dedicates a chapter to *Spatial Architectonics* [10] where he analyses the importance of the body in the understanding of the social space. Space is produced in the realm of its relationship with the body, which characterised symmetry and duality (right-left, up-down, front-back) and the released of energy. This type of *spatial body* according to Lefebvre, is determinate by the physiological rhythm and of social, political and economical dynamics.

Spatial theory undermines as well a conceptualisation of the body where the tangible and intangible meet. The idea of space becomes disassociated with the body. The first can only be conceived through the action of the second, involving the physicality of the body's sensory experience as well as its memory, imagination, intellect and awareness. Being in space is not to perceive its attributes, is to assimilate them and become aware of being present in it.

Technology

The technological component does not focus on software development, engineering, or any specific I.T. technologies. Technology is a source of knowledge and reflection about how to enhance the relationship between body and space. The theoretical investigation explored the intimate and psychological experience as a result of the contact with physical spaces. For this research, technology became a means to augment the sensory experience and

explore haptic and tangible interaction. The practical investigation turned to a combination of several technical resources: physical computing technologies involving capacitive sensors, arduino, actuators, digital fabrication and manufactured mechanisms. Altogether, the practice-based research gradually started to bundle body and space within the realm of the *machine aesthetics* where the presence of mechanisms provide these two elements with rhythms, movements and timely dynamics.

The Inquisitive Path Towards a Space Dramaturgy

Within this research, the structuring and analysis of dramaturgical process is also a result of a constant exercise of questioning. Posing questions is what allows to transform the previous theoretical postulations and to interweave the main compositional elements. The questions can be as simple as asking what? How? Why or what for? In essence, asking what?, is to find the initial idea for an artwork. How?, relates to means and techniques for the realisation of the artwork. Lastly, why? or what for?, is the desired effect of the artwork on the public.

The research established a theoretical framework around a subjective, intimate experience of space. This led to the idea of building an interactive maze, which emerged from this framework as it can potentiate the creation of an immersive and intimate environment, and stimulate people's imagination. Hence, the idea of an interactive maze responds to the question what?

Mazes are structures that resemble labyrinths and provide a recognisable visual narrative that is often associated to mythology and religion. On that account, these type of structures appeal to shared narrative with a possibility of becoming a shared spaces. Mazes do not need to look like labyrinths and they can be considered a different type of structure. Unlike labyrinths that possess one singular path with a beginning and an end, mazes have multi and fragmented paths. Nevertheless, these structures are also rich in plays of contradiction and simultaneity that are worth to investigate: visible and invisible, individual and collective experience.

The multipath structure, the symbology and familiarity of mazes favour the relationship of space and body in its subjective, individual and psychological dimension. The introduction of the technology enhances the body and space relationship, and brings the technical solutions or means of achievement. Therefore, the technological elements are connected to the question how? With the help of technology, the research explores a type of haptic interaction and a space that is pliable and mutable as oppose of static and rigid. Consequently, the chosen technical means relate with physical computing. The outcome of this exploration is an installation that consists in modules built with wood and fabric. These modules can be combined in different ways and number, and can be place either in smaller of bigger spaces. The fabric covers the back and front of each module and forms the physical interface, which has capacitive sensors that activate the mechanical inner structure. When touched, the textile interface should move accordingly with the touch intensity.

Finally, the last aspect of the dramaturgical enquiry relates with the question Why?, involving the attempt to predict public's reactions and the overall significance of the artwork. The maze is a space that can inhabit another space or architecture. It has an intervention quality as a fragmented space that can interrupt the linearity of everyday spaces, stimulating adaptation and reconfiguration. In order to pursue this purpose, the maze was envisioned to be set up in a passage type of space: a space that establishes a straight connection between two different places. When this type of spaces are disrupted, people are required to adapt or reconfigure the way they circulate and use that space.

Another element underlies the other three: *time*. For this research, time is not approached as an independent element. It has qualities of duration, speed, movement and rhythm that relate with the mechanical functioning of technology. Time is felt through displacement within space, and time is also a quality of bodies, it belongs to memories and to daydreaming. This last notion of time is also found in Bachelard's phenomenology of space. The ability of the human mind to travel in time, both past and future, is determinant is spatial experience and what allows to give meaning to spaces.

Time is an inclusive notion that entwines all other three elements, and is sensed both externally and internally. Externally, time can be identified through movements and rhythms, which the research explores through technology and interactivity. Internally, through memory and associations that might emerge while interacting with a space that disrupts the previous spatial logic. The intersection between these two dimensions of space, internal and external, should play a role in the engagement of people with the installation. Mieke Bal also corroborates the value of time in the achievement of performativity: "Memory as the mediator between performance and performativity operates on a mixture of temporalities."[11]

In sum, time brings the *here and now* by making the experience of an artwork unique and unrepeatable; hence, performative.

Conclusion

The research is still an ongoing process and the doors of exploration are not closed yet. Nevertheless, it is possible to draw some conclusions of the dramaturgical process.

Dramaturgy establishes a feedback relationship between theory and practice. Whilst theory allows expansion of ideas and concepts, practice allows decision-making, the narrowing down of objective and goals, and bridging the gaps between the connection points of technology, space

and the body within a performative structure. The aim is to seed the research with necessary questions and information for the completion of a performative composition.

Interweaving aesthetics elements for a performative artwork is a complex task. It requires an almost incessant inquisitive search towards a mixture of predictable and unpredictable outcomes. Engaging in a creative process of building an interactive installation alongside with the repurposing of dramaturgy is rather like opening a Pandora's box of paradoxical situations and contradictions.

Dramaturgy does not naturally belong to the realm of installation art, and even within performing arts it is often marginal. As a result, the application of dramaturgical principles to interactive media art tends to be rather technical than intuitive. It is a constant exercise of questioning, back and forth from theory to practice. However, it builds a duality during its creative processes. From on the one hand, artistic creation: researching, sketching or prototype, and achieving a final result to, on the other hand, the exercise of putting yourself in the place of the public and trying to imagine how the artwork will be perceived. It almost becomes an exercise in foreseeing what the installation will become.

The benefits of a dramaturgical enquiry reside on the skill of managing the complexity inherent to performative artworks. For example, performativity in interactive installations raises questions about levels of *control* and *spontaneity* in the public's participation. Interactive installations are programmed to produce planned behaviours and to induce desirable reactions in the public. However, should the public's participation be completely under control? And, to what extent is possible to predict and control emotional responses? Dramaturgy could help to harmonise contradictions like these and define what *control* and *spontaneity* will be focus on, for instance: *control,* as the incitement to a mechanical behaviour or physical reaction of the public, and *spontaneity* as the emotional reaction and the pleasure in aesthetic experience, which could influence the time that people interact with the artwork.

Overall, the research aims to highlight the creative process and, through dramaturgical enquiry, developed a reflective practice, where the sphere of *doing* meets the *thinking* with equal importance.

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Biography

Carla is a Portuguese artist currently doing her PhD at Central Saint Martins with a scholarship from the Science and Tecnology Fundation in Lisbon. She holds a degree in Theatre Studies and a Master in Art and New Technology. Previously, she developed and collaborated in several interactive art projects in institutions like La Casa Veazquez or Medialab Prado in Madrid.

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The Felt Sense Project: Towards a Methodological Framework for Designing and Crafting From the Inner Self

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Abstract

This paper offers the beginnings of a methodological framework for the design of body-centric artifacts, understood as those that use embodied self-awareness as a tool for bodily self-knowledge and wellbeing. We present a case study on the design of artifacts to be applied in the self-practice of the psychotherapeutic technique *Focusing*. The autobiographical journey of the researcher is documented in the use of different methods to be integrated into design research, such as crafting devices through autoethnographic phenomenological annotations, the application of second-person methods such as facilitated interaction for novices, and the use of a design kit to be tested by previously trained users. Even though wellbeing is a core concern of this project, the application of autoethnographic exploration through Focusing has an important creative potential, particularly in the generation of self-reporting narratives informed by somatic exploration. These rich descriptions can be utilised as a core construction material in the creation of art and design pieces for bodily understanding.

Keywords

HCI; Design Methodology; Phenomenology; Body-centred technology; Embodied self-awareness; Focusing; Wearable technology; Probes.

Introduction

This paper offers the beginnings of a methodological framework for the design of body-centric artifacts, understood as those that use embodied self-awareness as a tool for bodily self-knowledge and wellbeing. We present a case study on the design of artifacts to be applied in the self-practice of the psychotherapeutic technique Focusing. The autobiographical journey of the researcher is documented in the use of different methods to be integrated into design research. At the end of the self-reported process, the exploration of the inner world of the researcher is translated into a piece of technology that speaks the language of the audience. As a part of this journey of creating devices for healing, we ask: Which are the necessary conditions for designers to integrate their own autobiographical perspective into the making process? How can we validate the researcher's perspective as subjective, but also as an object of empathic understanding? In this project, the researcher subjects herself into psychotherapeutic self-observance in order to generate narratives emerging from her deeper layers of experience. By putting herself into different passages of her own psychosomatic subjectivity, the researcher uses her manuscripts to craft a piece of technology, which acts as a metaphor of her bodily experiencing. Since this technological exploration is deeply rooted in subjective inquiry, this framework aims to inspire designers and artists to use autobiographic accounts validated through participatory approaches as the first step of understanding users and audiences.

Even though wellbeing is a core concern of this project, the application of autoethnographic exploration through Focusing has an important creative potential, particularly in the generation of self-reporting narratives informed by somatic exploration. These rich descriptions can be utilised as a core construction material in the creation of art and design pieces for bodily understanding.

After setting the theoretical foundations of this project, including a description of the psychotherapeutic technique *Focusing* and its relevance, this paper presents a set of different methods to be integrated into design research such as crafting devices through autoethnographic phenomenological annotations, the application of second-person methods such as facilitated interaction for novices to the Focusing practice, and the use of a design kit to be tested by Focusing practitioners.

The use of the proposed methods has an important component of disruption, particularly since they defy the fabric of our everyday mode of awareness and self-understanding. When we become accustomed, aspects of life are taken for granted and remain mostly unchangeable. In order to stimulate reflection and change, it is important to revisit familiarity by making it strange [29]. This disruption in our mode of consciousness is one of the basic premises of the phenomenological set of methods applied in this research.

Designing from the soma

This section offers a brief theoretical ground to contextualise the application of the set of methods discussed in this paper. Particularly, we refer to the core importance of embodiment as a source of knowledge and reflection. In this particular case, *knowledge* refers to the tacit and im-

plicitly sensed dimension of experience [15], which cannot be easily described through language. As part of this project's contribution, we offer the application of a technique that bridges the tacit dimension to the explicit domain in order to be used as a source for inspiration and inquiry in art and design. In this respect, this project is situated within the domain of applied phenomenology and psychotherapy, with particular emphasis on the production of narratives emerging from the bodily dimension.

In our research philosophy, we celebrate the focus on the lived body as an active source of learning and inspiration. In this respect, the theoretical bases of our work are strongly influenced by Shusterman's project on *somaesthetics* and his emphasis on self-care and attentive exploration of the lived body or *soma*. Shusterman [25] draws clear distinctions between what is traditionally defined as *body* and his concept of *soma*, as a way to overcome the dualist understanding of the body as objective and separated from the mind. In his usage of the word *soma*, the body becomes object and subject of consciousness and unconsciousness. As a result, the soma is mindful, sentient, and purposeful; the body becomes active at different dimensions of life such as mental, social and cultural. The introduction of *Focusing* as a part of our research methodology inquires directly about the use of the soma, and how bodily exploration becomes a source of memories and insights for design and artistic creation.

There are some examples from electronic arts that focus on the subjective and lived body or *soma*. In such cases the crafting of body experience and the cultivation of self-awareness play an important role in the experiential goals supported by technology. *The Breath Temple* [36] is an example of an art installation where the participant is guided through a bodily experience of their breathing. A breath sensor is worn around the chest as part of a robe and the breath data is sonified as part of a compositional soundscape. The guide facilitates the direction of attention towards the participant's internal body-state and possible state transformations through imagery and scaling of body-world boundaries. *Whisper* [24] is an art installation where participants engage in social transactions of networked personal body-data. Garments are embedded with sensors, actuators and data transmission hardware, enabling the participants to control the selection of their own body-data for sharing with others. Awareness shifts between self and others, and is incorporated into the design of the tools comprising the system. In order to share this bodily information with others, paying attention towards one's own self acts as a precondition for interaction. *Stitchies* [28] is an interactive system consisting of two bodysuits that communicate remotely through haptic patterns. One of the open-ended inquiries of our research that shares concerns with [28] is to determine whether haptic communication can facilitate the emergence of a language with its own meaning.

As well as these previous examples, there are many others in the context of art and design that could fit within the idea of body as soma proposed by Shusterman. We believe that the applications of methods presented in this paper are relevant to the projects that share this philosophical spirit. Paying attention towards the self can be amplified through the use of somatic techniques, facilitating access to the body as creator of meaning. The introduction of such techniques can influence the creative process, by connecting the researcher with the exploration of his or her amplified bodily imagination. As we will see, in the case of *The Felt Sense Project* described in this paper, the attunement of the researcher with her own *felt sense* or *tacit dimension* was translated into annotations that later inspired the creation of artifacts for self-exploration. These artifacts embodied technical characteristics and features as metaphors of the resulting narratives emerging from autoethnography. In reference to the aforementioned *tacit knowledge* [15] contained in the soma, in the next section we introduce the theoretical foundations of our methodology that approaches the body as an implicit source of knowledge. We import the *Focusing* technique from psychotherapy as the methodological ground to obtain access to participant's subjectivity.

The Focusing technique

Focusing is a psychotherapeutic technique that merges emotional aspects of the self with its bodily manifestations [6]. Created by Eugene Gendlin, who was originally trained as a philosopher, this concept derived from his particular interest in finding the point of emergence, where creative thinking finds conscious awareness [16]. The emergence of such encounter occurs through what Gendlin refers to as the *implicit,* which represents a kind of knowing that surpasses language, and that is felt rather than rational [7]. Gendlin considers that environment and organism enact an active relationship, with the main focus on the body as the governing principle. In this sense, he considers the body to be an environmental process itself [8].

Since the body *is* environment, feeling oneself into the implicit domain of being cannot be separated from what we encounter in the world [16]. In that sense, we know much more about our surrounding phenomena than we can actually explain [15]. Therefore, the Cartesian insistence to split body and mind into different categories does not make much sense when trying to bridge the conscious and the unconscious. In this respect, Focusing was conceived as a technique to acknowledge the reunion of both aspects of being.

As a psychotherapeutic practice, Focusing aims to assist practitioners to find coherence between our thoughts and what is felt through the body, developing assertiveness and improved connection with our real needs. In a Focusing session, participants use their self-awareness of the body to identify what is called the 'felt sense'. By encountering various sensations without making a distinction between mind and body, the felt sense is perceived as a bodily feeling that emerges generally from the upper torso. The felt sense can be perceived as subtle as well as taking over the body, however definitions fall short to describe it [6]. As a

consequence, it is common that participants describe their experiences with their felt sense as metaphors, as sensations that move within the body, or subtle alterations in bodily perception. Such descriptions tend to be strange, as well as revealing and touching.

This technique offers some interesting advantages to be creatively integrated into different fields of knowledge. Firstly, it does not require the presence of a certified therapist in order to access the benefits to the body as it can be applied as a self-practice [6]. Moreover, since Focusing is grounded in the Philosophy of the Implicit [7] that presupposes the existence of a tacit bodily knowledge, the acquisition of the technique itself depends on participants' disposition to listen to their bodily changes as well as bracket rational judgment. Nevertheless, due to our cultural predisposition to reject what is outside of the domain of rational thinking [26], such connection is not always straightforward and requires practice and commitment.

Design Aims

The main objective of this study is to assist in the therapeutic exploration of our embodied self-awareness through body-centric wearable devices. We borrow principles of Focusing as main source of inspiration and philosophy. As part of the contribution of this project, it aims to disseminate the knowledge of this philosophy to the general population. Moreover, the design aims behind the creation of these artifacts can be summarized in the following set of principles:

- The creation of wearable/portable technology to enhance embodied self-awareness as a tool for wellbeing.
- Considering the impact of the constant sociocultural neglect of the body in our relation towards our embodied self-awareness [3], the resulting devices would act as prosthetics, assisting users to recover their connection with their human implicit nature.
- Since human's attentional focus is limited, an aspect that is particularly noticeable when the focus is directed towards bodily self-awareness [14], it is proposed that outcomes of these perception-amplifiers should be immediately perceived through our senses.

In addition to designing artifacts for well being and self-awareness, another aim of this project is to introduce Focusing as a tool for ideation as well as a technique that facilitates the access to embodied human experience. By means of Focusing-induced somatic exploration, we aim to access deeper layers of experience that are normally inaccessible through traditional research modes of inquiry. This modality has been tested and explored by us in the format of workshops, where participants were asked to recreate different situations by following the instructions of guided experiences. Our preliminary findings suggest that bodily exploration through Focusing can assist as:

- A source of ideation and inspiration: By accessing to our relationship with objects and situations from a bodily perspective, participants can unravel the relations between human-object.
- A form of vivid recall: Focusing vividly facilitates and amplifies the access to memories from the past. Focusing-driven narrations evidence moments of re-enacting the past as it were experienced in the present moment.
- An interview method: By accessing to deeper states of bodily awareness.

The objective of this paper is not to address such features in detail, but rather to describe the researcher's autobiographical as well as human-centred process. In the next section we will introduce in which way the practice of Focusing informed the creation of wearable devices in compliance with our design aims.

Methodological Framework

In terms of contextualizing this experiential approach towards the subjective dimension, this proposal is situated within the domain of first and second person methodologies. Particularly, it proposes the exploration of autoethnography as exploration in the context of electronic arts [27], design probes for inspiring designers through first-person perspectives [5, 12, 31] as well as explorations on somatics and technology [10, 11, 20, 21, 22, 23, 24, 27, 28].

Approach to data collection and analysis: Applied Phenomenology

Since the Focusing technique is grounded in the application of phenomenological principles, the qualitative approach to data collection and analysis is based on applied phenomenology. In this respect, the application of Focusing facilitates the emergence of memories and bodily responses towards everyday experiences and objects. As any other phenomenological-based approach to data collection, this research is nurtured by careful, comprehensive descriptions of experiences rather than measurements valued in quantitative studies [13, p.104]. Consequently, one of the most important reasons why we were inclined to choose phenomenological methodology relied on the main research question, which is open-ended, exploratory and concerned with the how. Through this research, we aim to answer the questions of "how body-centred wearable technology can assist in the enhancement of bodily awareness and, by extension, self-discovery" as well as "how Focusing –as a facilitator of embodied self awareness- can be applied as a tool for art and design inspiration". Concepts such as self-awareness and self-discovery are subjective and require a proper set of tools to be analysed. Furthermore, considering the novelty of integrating psychotherapy into the design of body-centric artifacts for self-awareness, it opens up opportunities for the design of devices and

techniques that still have not been created. The use of phenomenology as the core ground for methods such as cultural probes in design and autoethnography offers valuable guidance. For instance, probes have been previously utilised to deeply understand the user's subjective world as well as obtain inspirations for the new generations of devices [5, 31].

Since becoming aware is one of the main purposes of phenomenological research [1], the success of this technique depends on the ability of participants to become aware of themselves as well as reaching deeper layers of consciousness. Those techniques are usefully applied in interviews as well as in written reports. Some of these guidelines rely on the provision of a clear set of instructions, exercises prior to the experience in order to be focused on the task and the constant recalling of the lived experience. A core part of this methodology is the suspension of rational judgment by replacing it with an active acknowledgement of the present moment through sensing the body [18]. In Focusing workshops or therapeutic settings, participants are asked to describe their experience immediately as it is perceived as well as invite them to take notes of their bodily outcomes. In this account, aspects from phenomenological instructions such as encouraged concentration and focus are already implicit in the practice.

This research aims to unravel the process of participant's perceptual phenomena rather than to verify an existing hypothesis. This means it has to understand the lived experience of the subject in order to discover the meaning of it [2]. Therefore, the expected responses are neither rational nor grounded in pre-conceived judgment, which requires certain skills in order to be obtained. By utilising this set of techniques, the objective of this set of methods is to explore into new layers of reality by making the quotidian strange.

Due to the nature of autoethnographic research and design probes, which mostly relies in autobiographic notes and diaries, most data collection will be obtained in a written form. The expected documents would reflect the richness of subjective experiences. In order to ensure this condition as well as aspects such as validity, we will describe some of the characteristics of phenomenological annotations.

Three Methods for Exploring Subjectivity

The focus of interest in this research is mainly located in the exploration of subjective experiencing. Now we present three approaches towards participation that highlight subjectivity as their main source of inquiry: autoethnographic exploration, facilitated interaction and design probes.

1. Autoethnographic Exploration

Design is a discipline with a strong focus in practice. From this perspective, one of the researchers of this study took part in the world of Focusing practitioners by immersing herself in this technique, assisted by a certified professional. Divided into a series of eight workshops attended by approximately ten people per session, these courses had as an objective to offer the foundations of Focusing to the general public. At the end of the eight workshops, participants were ready to apply the technique to themselves and others. From the first session, participants were introduced into practical exercises and encouraged to practice immediately. In order to understand as a first person the nature of the metaphors and reactions emerging from this practice, part of the researcher's task was to annotate her sessions in a descriptive manner. The documentation process follows similar rules to Husserl's transcendental phenomenological reduction or suspension of judgement [19], however, introducing a core variation, such as the emphasis in bodily exploration rather than in the descriptions through the stream of consciousness. In this Focusing-oriented approach, evaluative language emerging from rational analysis is avoided, as bodily descriptions are encouraged. As an example of this method, this is one of the resulting extracts from a descriptive session across a year of documentation:

Suddenly, my body reacted; I never expected to experience such a strong and unknown feeling. It felt like all my concerns were concentrated in a single point in the middle of my universe. Particularly, my chest was burning. I became my chest and everything else disappeared from my awareness. I could feel something that can be described as little leprechauns rhythmically playing drums with my heart, taking over my body. I felt physically uncomfortable when the vibration started resonating very strongly on my back. But I was okay with it. I was actually expectant and ready for more, out of curiosity. But it wasn't a sort of rational curiosity, but a bodily one. (Documented on 8th of March, 2014)

The use of this phenomenological approach to description has an interesting advantage when documenting an autoethnographic report. Since constantly evaluating experiences from the standpoint of our own socio-cultural ethos is part of our daily manner of living, these unprejudiced descriptions seem somehow written in an unfamiliar genre. This unfamiliarity is desirable in the production of phenomenological reports, since it reflects the process of reflection and imagination experienced by the participant. Phenomenological research brings up some interesting perspectives regarding unfamiliar scenarios as a resource to stimulate participants' imagination. Especially in transcendental phenomenology, the emphasis on intuition, imagination and how speech is structured, are fundamental to understand how the dynamics of experience are constructed [13]. This imaginative state facilitates the deep understanding of the situation, by the dynamic interplay between what is considered "normal" and "abnormal". Where everything can be considered as "normal" and therefore familiar, there is no real need for understanding [29]

The practice of this technique and the analysis of the authoethnographic texts inspired the creation of wearable devices. The first prototype was a glove that included haptic stimulation to anchor the felt sense and coloured LEDs,

representing metaphors of mood. This last feature was added to experiment with the effect of colour in the emergence of the felt sense, and was not necessarily inspired by the phenomenological annotations, but through the idea that colours could add to the repertoire of possible ways of expression. Subsequently, a set of three gloves was pilot-tested to assess aspects of wearability, affordances as well as their quality as facilitators of bodily self-awareness. Participants involved in pilot testing sessions did not have previous experience in the application of Focusing. This leads to the next stage of the study: facilitated interaction.

2. Facilitated Interaction

Even though this proposal seeks to contribute with enriched metaphors to participants that already practice Focusing, the potential main user of these artifacts is the general public. This project's goal is to transmit the simplicity of this knowledge to everyone who is open to learning about it. Facilitated interaction is the appropriate method for those participants that have no knowledge about techniques imported from different disciplines [23]. The purpose of this approach to technology is to generate impact in participants through the emergence of unique experiences and memorable messages mediated through the interaction with devices and scenarios for reflection. Facilitated interactions and guided experiences fall into the category of second-person methodologies. Second-person methodologies can be defined as *"an exchange between situated individuals focusing on a specific experiential content developed from a first person position."* [1] The first-person position refers to the standpoint of the subjective experiencing of the individual. In this case, the researcher or designer facilitates the exploration of the participant's subjectivity in order to diminish unwanted bias. This technique also reduces distractions that can compromise the completion of the task as well as facilitates a deeper immersion in the experience. Some examples of this approach in interactive art and HCI, where the audience experience is facilitated by the artists/researchers, include Whisper [23, 24], the Heart Library [9], and Speechless [10].

In the context of second-person methodologies, Schiphorst [23] describes the importance of somatic facilitation in enriching the design in a multidisciplinary context by bridging somatic connoisseurship with HCI. By means of facilitating the interactive experience, the designer is also connecting his or her experiences with others. In that sense, somatic facilitation requires the ability to engage in empathic mediation and interpret subtle aspects of participants' shared experiences.

The use of facilitated interaction is currently proposed to test devices and scenarios with users that have no experience in Focusing practice. These guided sessions provide non-expert participants access to the felt sense as well as allowing the researcher to obtain their insights regarding aspects such as wearability and comfort. In order to ensure the correct functioning of the prototypes before sending them to Focusing practitioners, a pilot study was conducted in the Design Lab at the University of Sydney. Students from the third year of Interaction Design were introduced through a guided script inspired by Focusing and imagery techniques. The script contained passages that induced participants to the acknowledgement of bodily sensations. In order to do so, they were invited to close their eyes and sit in a comfortable position.

This guided experience had as an objective to introduce the concept of felt sense from a practical perspective as well as assisting participants in the connection with their embodied self-awareness. This first stage of the experience of guided interaction was also envisioned to generate a shift from the general attention to the deliberate attention on the body, as required in the practice of Focusing [18]. After the guided exercise, they received a shorter version of the script to be explored in teams of three or four. In each group, one participant delivered the script, another wore the glove and explored the emergence of the felt sense in his/her body, while the third and fourth participants documented their observations in the shape of annotations and photographs. Twelve students assessed the wearability of the Felt Sense Glove, also practicing the use of evaluation methods for design research.

As a result of the pilot testing, it was observed that the use of colours as a metaphor of mood was distracting rather than helpful to access the felt sense (Figure 1). However, haptic stimulation obtained positive assessment in heightening the felt sense, as well as it made sense through the script. This simple finding suggests how relevant is the immersion in the experience in order to design devices to make sense in the practice of any technique. Since haptic stimulation was inspired by the phenomenological annotations, its use flowed through the practice of the technique. Different was the case of the use of colour, which emerged as an idea grounded in logical thinking. In this respect, the preparation for the next stage included improvements of the device in terms of wearability as well as simplification in their functioning (Figure 2).

Figure 1: First version of the Felt Sense Glove. It included a vibration motor on the palm and coloured LEDs in the back. Pushbuttons were located over each finger and in the tip of the thumb. The latter controlled the vibration to be applied on the body.

Figure 2: After the pilot testing session, the LEDs were removed and the device simplified to haptic stimulation. The pushbutton to control the stimulus was relocated between the thumb and the low portion of the index finger.

3. Design Probes

At the current stage of this research, participants have been selected in terms of their affinity and sensibility towards the application of Focusing. During the next steps of this project, they will receive a parcel containing a design kit with instructions and prototypes to be tested. Participants will be asked to live and interact with *The Felt Sense Kit* (Figure 3) within a month, documenting their experiences in a phenomenological diary. The objective of this exploration is to determine if the output representation of the devices resonates with their felt sense. Moreover, this research seeks to determine at which stage devices can be integrated as complementary elements for expression. It is important to note that previous integration of approaches that externalise the felt sense such as Focusing-oriented Art Therapy (FOAT) [17] and sense of touch in Focusing therapy [4], suggest that the presence of technology-driven metaphors could enrich the existing set of our bodily expressive and perceptual channels as well as facilitate the access to our implicit knowledge in novel ways.

Understanding the nature of Focusing as private, bodily and highly subjective, it is necessary to reduce possible biases by allowing Focusing experts to interact with the devices in their own territory. This focus on the subjective is grounded in first-person methodologies [30] and particularly in phenomenology [13, 29] (and others). However, it is also necessary to complement the documentation of subjective experiences with other qualitative/quantitative data in order to ensure validity [30, 21]. In this respect, questionnaires are also included in the design kit, in order to understand basic aspects about the devices' wearability and affordances.

Design Probes are grounded in human-centred design methods and compatible with the objectives of phenomenology that pursue the understanding of human subjectivity. These are tools for design and understanding, in which objects contain a message and intriguing ways to consider a question [31]. In this approach, users live and interact with prototypes in their own environment in order to understand human phenomena as well as to explore design opportunities [12]. Design Probes have some characteristics that make this method particularly suitable for research with a body-centric focus. Firstly, the probes approach to data collection is based on self-documentation, allowing interaction without external interference in the participant's practice. This aspect facilitates the emergence of subjective expression in the safety of participant's private space, while defying their everydayness through the inclusion of unfamiliar artifacts. In this respect, the safe private space (familiar) and the inclusion of strange artifacts (unfamiliar) might sound contradictory, however, this dissonance is necessary to reach the phenomenological attitude that brackets preconceptions [29] and recommended in the practice of Focusing [6, p.55]. The use of unfamiliarity as a resource implies revisiting familiarity in a slightly different way in order to foster understanding of our surrounding world [29]. Considering our everyday life as mostly production-oriented, even by introducing small changes in participants' routine – allowing them to talk from the inner dimension of their experiencing - might represent a worthy and reflective disruption in their everydayness.

In some approaches to probes, they tend to stimulate co-creation between the designer and the participant [31]. The cooperative quality of the probes, in this case is not granted by the co-creation of an artifact in a direct manner (for example, by including prototypes to be manipulated somehow by the participant in order to come up with a meaningful artifact), but through the use of a diary to documment their access to the felt sense through the use of prototypes. The access to the participant's subjectivity will inspire the next stage of development, that includes new metaphors and representations of what is felt through the body in the shape of more personalised devices.

Figure 3: The Felt Sense Kit. The main devices were composed of a glove with haptic stimulation to anchor the felt sense, a cushion with a pulse sensor that generates vibration as it were a externalisation of the user's heartbeat and a stole painted with thermochromic ink that dissappears in contact with human touch.

Conclusion

This work provided a description of how different methodologies for the design of body-centric artifacts are integrated into practice, using Focusing as a case study. In this account, the research exploration started with the immer-

sion in the Focusing community and documentation through autoethnographic notes inspired by phenomenological annotations. From the analysis of the texts, devices were created and tested by participants that received an induction in the technique. In the next stage of the research, a design kit will be sent to selected participants in order to obtain their perspectives regarding how the use of these artifacts fit in their practice, and in which ways these assist – or not - in the emergence of the felt sense. It is important to note that, through the responses obtained from the pilot testing session it was observed that some of the features of the device had mostly a positive impact in the emergence of embodied self-awareness in non-practitioners. On the other hand, Focusing practitioners might have a different approach to the artifacts due to their experienced contact with the felt-sense without mediating assistance. However, evidence from other studies indicates that the use of art, touch and other physical interventions has a positive impact in the acknowledgement of the felt sense, particularly working with clients in psychotherapeutic settings [17, 4].

The use of autoethnographic accounts as proposed in this paper aims to up new sources of inspiration for art and design. By utilising somatic techniques such as Focusing to make the familiar strange, the researcher can take a step aside from his or her rational understanding for a moment, allowing the emergence of a different level of bodily experience, which is generally elusive through pure reflection. Not only the immersion in the technique appears beneficial to the researcher since it offers a personal as well as professional gain. The application of facilitated interaction is furthermore valuable for both the participant and researcher. From the standpoint of the participant, the experience is delivered pedagogically as new knowledge imported from a different discipline. From the perspective of the researcher, it is a way of obtaining informed insights from laypersons, an aspect that is particularly important when designing for communities where participation is hard to obtain due to different reasons. In this case study in particular, even though Focusing is a well-established technique with demonstrated benefits, it is not a mainstream practice. This research is contributing to: 1) the use of body centric technology for enhancing bodily perception; 2) the dissemination of Focusing as an accessible practice, either in psychotherapeutic settings as well as in the privacy of self-practice; and 3) the use of Focusing and other somatic practices as a sources of self-reporting narratives for art and design inspiration.

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Authors Biographies

Claudia Núñez-Pacheco is a designer and a PhD candidate from the Design Lab at the University of Sydney. Her research investigates how bodily self-awareness can be used as a tool for human self-discovery as well as a crafting material for design, art and technology. In her research journey, she has engaged in a multidisciplinary exploration that merges wearable technology and the novel inclusion of Focusing as design method and philosophy.

Dr Lian Loke is an interaction design researcher and performance artist, who places the lived body at the core of inquiry into contemporary issues and emerging technologies. Her research and creative practice is interdisciplinary and spans the arts, design and human-computer interaction. She has an established research program of working with somatic practitioners and dancers to inform the design and human experience of body-focused interactive systems. She is a Senior Lecturer in the Design Lab, Faculty of Architecture, Design and Planning, University of Sydney.

Demonstrations and Poster Presentations

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a.k.a. Profile Glitch

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Figure 1. Johanna arrives at Harmony Village.
http://www.akaprofileglitch.org/story/index.html#Introduction

Abstract

a.k.a. Profile Glitch (http://www.akaprofileglitch.org/story/index.html) is an interactive online narrative about three characters, Marty, Maeve and Johanna, who meet at Harmony Village, an intentional community located outside of Ithaca, New York. (Figure 1) The unique emotional and physical dynamics of communal life, with its own constructed social norms and rules of conduct, creates an intense interpersonal experience. Marty, Maeve, and Johanna develop a deep, unlikely friendship that is possible because of the unique social context of the commune. After several months, Marty, Maeve, and Johanna each decide to return home and the dynamics of their relationship is altered. Marty begins blogging about her experiences at Harmony Village and in the process reveals information about Johanna and Maeve that they are not comfortable with. Maeve and Johanna confront Marty through a series of online conversations. The conflict between the characters highlights issues of self-identity and self-representation in different social contexts and how new technologies of the networked public disrupt the way people perform their identity online.

Keywords

networked, publics, collapsed, context, performance, identity, glitch

Performance of the Self in the Networked Era

a.k.a. Profile Glitch looks at how digital technologies impact the performance of the self on-line and how the networked construction of persona is complicated because of the increased probability of "collapsed contexts," or the collision of multiple social contexts. [1] The moment a persons' self-presentation is threatened by the introduction of conflicting information, an interpersonal glitch occurs. Networked publics, featuring user-generated content, transgress boundaries between digital and physical space, representation and performance, and private and public interactions.

Figure 2. Marty's profile photo on her blog.
http://www.akaprofileglitch.org/story/index.html#Marty_s_Blog

The profile image is a good example of how social network users create an on-line identity with digital artifacts. The profile picture is the most noticeable component of one's digital identity and the regular updating of a profile picture can be considered a performative act. (Figure 2) Online profiles do not just depict the individual it belongs

to, but help shape the representation of others connected to the individual on the social networked site. The online profile is not a static representation of self, but is a "communicative body in conversation with other represented bodies." [2] As more people enter the conversation and add information to the digital represented body, the greater the probability that an interpersonal glitch will occur.

a.k.a. Profile Glitch illustrates the implications the networked public has on the performance of identity by tracing the interrelations between three characters as their friendships move from a close, intimate, physical experience of the commune to the networked realm of online communications. Johanna is confronted with the fact that Marty's blog could reveal to her family the truth about how she spent her summer living at a commune, having sex with a hippy. Maeve's feelings are hurt by the way Marty portrays their relationship in her blog and tries to confront her about what actually happened, only to be met with the cold shoulder. (Figure 3) Marty's self-representation online is much more polished, professional, and stuffy compared to how she behaves in person; a charade only Maeve and Johanna seem to be able to see through. The conflict and the anxiety felt by Johanna and Maeve are exaccerbated by the increased likelihood of context collapse created by the new networked public.

Figure 3. Maeve tries to contact Marty. http://www.akaprofileglitch.org/story/index.html#Web_chat_between_Maeve_and_Marty

Fragments of Content

The online interface of *a.k.a. Profile Glitch* is designed to mimic the experience of navigating online content through multiple windows and platforms. The landing page offers seven different entry points into the story. (Figure 4) Each entry point leads to a scene of the characters interacting after they have moved home from Harmony Village. The visual backdrop reflects one of the characters' personal space and provides visual information about the person. On the left of each screen, a second menu appears with descriptive labels such as, "Talking Stick," "Fire Pit," and "Goodbye Marty". These links go to scenes at Harmony Village, and serve as backstory for the conflict that transpires online.

Figure 4. Landing page of *a.k.a. Profile Glitch.* http://www.aka-profileglitch.org/story/index.html#Home

The overall design of the graphical user interface is intended to create a fragmented view of the characters. Just as users of social media platforms piece together fragments of content to construct an identity of the people they interact with, [3] viewers of *a.k.a. Profile Glitch* are given bits of information about Marty, Maeve, and Johanna. Through cognitive and visual associations, the viewer constructs a totality of the narrative.

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Colorigins: Disrupting Color Theory Pedagogy with a Tactile Color Mixing and Matching Game

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Abstract

This paper briefly introduces *Colorigins*, a tactile color mixing and matching game designed and developed for the Sifteo Cubes platform. *Colorigins* presents a softly gamified approach to learning elements of subtractive color theory. The game objective is to accurately match a randomly generated target color by mixing it from a set of source (conventional primary and secondary) colors. Throughout the process of color mixing, players can gain experience with concepts such as value, saturation, tints, shades, tones, complements, chromatic neutrals, and the relative visual strengths of particular colors.

Keywords

Colorigins, color theory, color mixing algorithms, gamification, pedagogy, interaction design, interface design, design process, Sifteo Cubes, physical / tangible computing

Overview

Colorigins is the first in a series of speculative art and design learning experiences (designed and developed by the Experimental Interface Lab) that leverage emerging and novel digital technologies. These experiences take the form of manipulatives / tools intended to supplement—and disrupt—conventional approaches to foundational art and design pedagogy. *Colorigins* specifically focuses on the pedagogy of subtractive color theory by softly gamifying the process of color mixing. Throughout this process, players can gain experience with concepts such as value, saturation, tints, shades, tones, complements, chromatic neutrals, and the relative visual strengths of particular colors.

The term *manipulative* implies physicality and tangibility. Yet, these are not often characteristics that are immediately associated with digital media. Leveraging the Sifteo Cubes platform to develop *Colorigins* provides an opportunity to amalgamate both the physical and the digital, and simultaneously maximize the affordances of each. The distinctively physical experience of mixing color (like paint on a palette) is maintained, although it is transformed by the responsiveness and accuracy / objectivity of the digital medium.

The (now defunct) Sifteo Cubes tangible computing platform forms the basis for *Colorigins*, and has carefully informed the design of the *Colorigins* interface. The Sifteo base stores and runs software built for the platform, connecting wirelessly to up to twelve 1.7-inch square cubes. The cubes each feature a touch sensitive LCD, an accelerometer, and proximity sensors so that the cubes know when and where they are in contact with one another.

Playing *Colorigins*

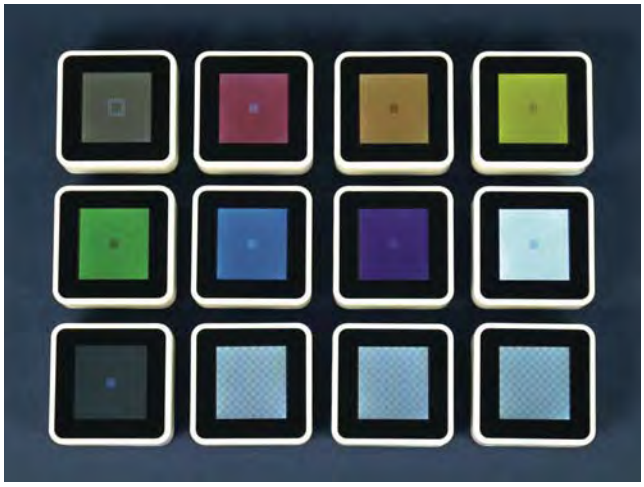

Figure 1. *Colorigins* runs on a set of 12 Sifteo Cubes. A video demonstration is available at https://vimeo.com/97997307.

Cube Types

Upon running *Colorigins*, the player is presented with several different cube types that perform various functions of the game:

- The target cube (shown in the top left of Figure 1) displays the color that a player needs to match through color mixing. This color is generated randomly using *Colorigins*' color mixing algorithm.
- The empty mix cubes (shown in the bottom right of Figure 1) are workspaces in which a player can create color mixtures. Once filled with a color, these cubes become filled mix cubes. Mix cubes are analogous to the wells of a paint palette.
- Source cubes (the remaining cubes not identified in Figure 1) hold conventional primary and secondary colors to be combined into new color mixtures. These cubes are analogous to tubes of paint.

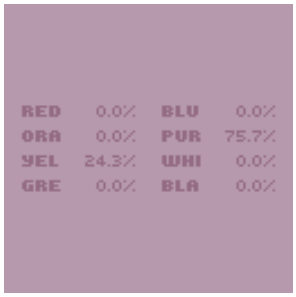

Figure 2a. (left) The percentage analysis of a filled mix cube.
Figure 2b. (right) Filled mix cubes display a set of arrows to indicate the direction of color flow.


Figure 2c. (left) A progress bar shown during color mixing, visually displaying the current proportion of mixture.
Figure 2d. (right) The match accuracy score display.

Cube Actions

A player physically manipulates *Colorigins*' set of cubes to control the game. There are three moves that a player can perform, and they each result in different outcomes depending on the type(s) of cubes involved.

Shake The shake action involves agitating a cube:

- Shaking a target cube will randomly generate a new target color for the player to match. This action is most useful when a player feels a color is presenting too much of a challenge to mix.
- Shaking a filled mix cube will clear the color currently stored, causing the cube to revert to being an empty mix cube.

Tap The tap action involves touching the display surface of a cube:

- Tapping a filled mix cube allows the player to reference a percentage analysis of the components of the cube's color mixture (see Figure 2a).
- Upon winning a round of the game, tapping the target cube will initiate another round with a new color to match.

Neighbor The neighbor action involves touching the side of one cube to the side of another:

- Neighboring a source or filled mix cube to an empty mix cube will fill the empty mix cube entirely with the source or filled mix color.
- Neighboring a source or filled mix cube to another filled mix cube will fill the second filled mix cube with a mix of the source / first filled mix cube and the second filled mix cube. A set of arrows displayed on filled mix cubes indicates the direction of color flow; the color from a filled mix cube placed to the left of another filled mix cube will flow to the right, mixing in and with the right filled mix cube (see Figure 2b). The components of the new color mixture will be proportional to the amount of time the two cubes are neighbored with each other; this is represented visually with a progress bar (see Figure 2c). A color mix is calculated by a custom mixing algorithm that uses spectral reflectance values of Munsell Color System colors to create a perceptually accurate subtractive color mixing experience.
- Neighboring the target cube to a filled mix cube will display a score representing how accurately the color stored in the filled mix cube matches the target color. A player needs to achieve 97% accuracy to win a round of the game (see Figure 2d).

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Author Biography

Brad Tober, an Assistant Professor of Graphic Design at the University of Illinois at Urbana-Champaign, is a designer, educator, and researcher whose work explores the potential of emerging code-based and interactive visual communication technologies, with the objective of developing applications of them to design practice and pedagogy. His practice-led research entity, the Experimental Interface Lab, is characterized by a speculative approach to design (a manifestation of pure research) that recognizes that forms of and methodologies for contemporary practice that spans design and technology are best developed through fundamentally flexible and exploratory processes. Brad holds an MDes from York University (Toronto, Canada), a BFA in graphic design from the Savannah College of Art and Design, and a BA in mathematics from the University at Buffalo.

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Designing Nano-Media Across Disciplines: Circular Genealogies and Collaborative Methodologies at the Optical Frontier

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Abstract

This paper draws on a collaboration between scientists, an artist, and a media researcher to produce 'nano-media,' a media surface designed at the nanoscale, to examine the interdisciplinary methodologies and circular genealogies of emerging media. Based on nano-optical structures and optical variable devices, the scientifically innovative technology uses many analog techniques to construct a new kind of material that can produce striking iridescent images and simultaneously store covert information. The first goal of this research was to use these novel optical nanostructures to create a cover for the periodical *PUBLIC*. This paper details the project as it moved from conceptual exploration to the prototype and manufacturing stages, considering the specific hurdles of translation between fields, the production challenges, and the points of intersection that brought the team together. By situating nano-media in 'retro' techniques of image production – including analog cinema and photography – the paper also provides a point of entry for artists and humanists to engage and participate in the imagination and innovation of media built at the nanoscale. Finally, through the lens of nano research, the paper challenges the 'art-sci' moniker to reflect a more fluid and multiple cross-pollination of fields as we design the media of the future.

Keywords

nano-optics, research-creation, art-science, interdisciplinarity, emerging media, nano-media, iridescence, biomimicry, media history, materiality

Introduction

After a full day of meetings discussing nano-media with various curators at Vancouver art galleries, I was crossing the street when a car I had not noticed zipped by me. I jumped back as a man turned my way and said with a chuckle, "What we can't see can't hurt us!" An innocuous statement to be sure, but after spending the week immersed in the world of nano-optics, my mind was attuned to questions of sight and visibility, not to mention the overarching ethical labyrinths of working in the realm of nanotechnology, and I could not help but pause to consider his words. Technologies of the nano, after all, are built at scales invisible to the unassisted human eye, and indeed it remains to be seen if being able to access matter at this scale is boom or bust for humanity. [1] The reason I was in town was an interdisciplinary collaboration in which as a media researcher, I brought together a team of engineers from the Ciber Lab at Simon Fraser University under the helm of Professor Bozena Kaminska,[1] together with the artist Christine Davis,[2] to develop a new kind of media surface and visual experience that combined the optical properties of materials at the nanoscale, the distinct methodology of nano-fabrication, and classical analog photography/cinematic techniques. We called it 'nano-media.'

In the world of nanotechnology, material structures and functional systems are built at the scale of nanometers, or billionths of a meter. Operating at this scale, nanotechnology "dreams of engineering every aspect of our material reality, precisely fashioned and designed at the limits of fabrication, one atom at a time." [2] Specifically, "the radical innovation" of nanotechnology (and nanoscience) is the ability to examine the properties of matter at the nanoscale, where "surface phenomena rather than mass properties govern the chemical and biological behavior of objects," meaning that, once we reach the nanoscale, materials have different properties – chemical, electric, magnetic, mechanical, and optical – than those of bulk materials. [3]

Colin Milburn has described the visualization of the molecular landscape as "nanovision," which is made possible through powerful scanning probe instruments like the scanning tunneling microscope (STM), scanning electron microscope (SEM), or atomic force microscope (AFM), that sense, feel, and map the atoms of the surface to create topographical images based on the data gathered through the "haptic encounter" of the scanning process. [4] Much of what has been called nano-art so far has been engaged with the nanosurface through these kinds of images, renderings, or (re)presentations, which provide ways to understand the invisible dimensions and scales of the nanoworld by using the sense of touch to explore the joined concepts of scale and surface. [5] This 'vision,' made possible through touch and tactility, is an example of nanotechnology research as "fundamentally an aesthetic endeavor in that it depends upon the production of new sensory experienc-

[1] The scientific team included postdoctoral fellow Dr. Hao Jiang, graduate students Reza Qarehbaghi and Mohamad Rezaei, and undergraduate student Mohammad Naghshineh.
[2] http://www.christinedavis.com

es" in which "the appearance of new kinds of vision and visual metaphors was key." [6][3]

While the STEM disciplines have taken to nano by storm, every day yielding new discoveries with the potential for radical change, there has so far been little access for those outside of the sciences to respond and engage with these developments in sustained and informed ways.[4] The aesthetic of the surface is in many ways an entry point for humanists and artists into nanotechnology, as it renders the nano visible and thus accessible. So far, however, there has been limited attention paid in the arts to the particular optical experiences that can be created using nanomaterials,[5] and the building of the surface, the making of materials that use the knowledge of nanovision, has been largely restricted to scientists, with some notable exceptions, such as Frederik de Wilde's *Hostage* (2010), Julian Melchiorri's *Cocoon* (2014), or Kimsooja's *Needle Woman: Galaxy was a Memory, Earth is a Souvenir* (2014). Indeed, artists and media scholarship – a field that should be most intrigued by the creation of new kinds of surfaces – have so far engaged rather tentatively with these new matters and their distinctive properties as materials and media. It is with this in mind that I formed an interdisciplinary team to creatively explore nano research and innovation of surfaces, specifically in the realm of nano-optics. The goal of our collaboration was not to access the surfaces of nature, to touch or image existing materials, but to in fact build a surface, one that would use the properties of materials and light as they interact at the nanoscale. We imagined a new kind of interface, a medium that would harness our ability to manipulate and design matter at the nanoscale to create novel visual experiences.

Driving the collaboration was an inquiry into the emerging possibilities of nano-optics that combined new scientific discoveries, experimental research and practical considerations, and the methodologies, questions, and particular knowledge (historical, material, aesthetic) of the artist and media researcher. As a first step in the partnership we decided to produce a cover for the fiftieth issue of the Canadian periodical *PUBLIC Art/Culture/Ideas*,[6] which was to launch on November 26, 2014 at the Art Gallery of Ontario in Toronto. The deadline for the project was therefore firm. What follows is an account of this first project, including scientific breakthroughs, practical challenges, and exploratory reflections on the methodologies and genealogies that emerged in the collaborative making of nanomedia.

Morpho Butterflies and Nano-Optics

The technology of nano-optics, or the field that is concerned with the properties of materials and light at the nanoscale, has so far been predominantly applied in the domains of security and authentication. One oft-referenced inspiration in this field is the blue morpho butterfly, whose wings appear blue to the human eye even though they contain no pigment and are transparent. This effect is due to the way the light diffracts from billions of nano-sized structures that constitute the wing. [7] (Fig. 1a) A number of natural organisms, from butterflies to beetles and minerals, have such iridescent properties, and scientists have been working to emulate them through the design of optical nanostructures, called optical variable devices (OVDs). These do not use color inks or dyes but, like the morpho butterfly, generate structural color through the light defraction from nano-sized slits or holes in a given material, such as a polymer or metal. (Fig. 1b) These can be very specifically designed to produce particular ultra-high resolution iridescent visual effects. [8] B. Kaminska and the Ciber Lab had been developing groundbreaking OVDs for a number of years already, including creating OVD nano-images embedded and reproduced in a variety of polymers, for use in banknotes, for example. [9] (Fig. 2a) This technology was commercialized, and the lab was moving forward with new ideas to further improve their designs as well as their fabrication and manufacturing methods. They were also looking for new applications outside of the realm of security.

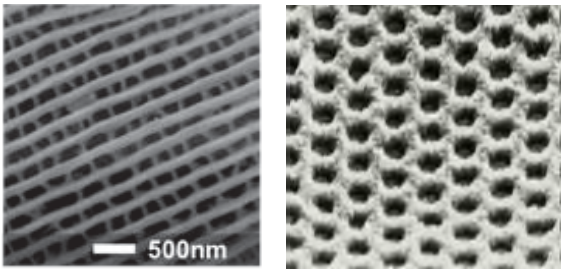

Figure 1a (left). Scanning electron microscope (SEM) image of morpho butterfly wing; Figure 1b (right). SEM image of nano-OVD produced by the Ciber Lab, also 500nm.

Independently of this, Davis too had been inspired by the properties of the morpho butterfly's wings. In her project *Who's Afraid of Red, Yellow, and Blue* (2008), she projected filtered light onto its wings to display not the familiar iridescent blue, but distinct color patterns. (Fig. 2b) The wings became a projection screen, a display of Davis' longstanding attention to the material properties of the projection process, experimenting with the materiality

[3] Victoria Vesna and James Gimzewski's *Blue Morph* (2007–), for example, is one such pioneering work that used the AFM and SEM to record sounds and images of an organic surface (wings of the morpho butterfly) to produce new aesthetic and sensory encounters with the nanoscale. http://artsci.ucla.edu/BlueMorph/

[4] This can be in part be attributed to the complexity of the technology, the speed at which it is developing, as well as the difficulty in gaining access to the newest developments. Experts in nano-optics (and particularly OVDs), for example, which are currently predominantly used for security applications, are reluctant to make their knowledge open to the public.

[5] For examples see Paul Thomas, Chapter 4, "Matter, Measurement and Light" in *Nano Art*, pp. 87–104.

[6] Christine Davis is the co-founder of *PUBLIC* and I am the current Managing Editor. See: http://www.publicjournal.ca/

Figure 2a (left). Nanostructures (OVDs) by the Ciber Lab; Figure 2b (right). Davis' *Who's Afraid of Red, Yellow, and Blue*.

and haptic nature of the screen, and developing interactions between projected light and organic surfaces to produce modulated images. In *Who's Afraid*, the slide projected is a close up of a Wonder Bread package, echoing a relationship between biomimicry and evolution.

The scientists' primary goal was to create new nanostructures with increasingly better colors and manufacturing processes. They strived to produce larger and customizable images, to reduce cost in the production methods, and to improve resolution and storage capabilities. Davis meanwhile was intrigued by the ultra-precise manipulability of light and the way colors were generated, by the brightly iridescent properties of the OVDs, and the possibility of integrating pixels of OVDs in a variety of materials and art contexts. Though coming from entirely different disciplines, the common interest in playing with light and color through the manipulation of materials rooted the project in a shared curiosity and placed the emphasis on process and research. Together we wondered how media innovation would take shape in the context of such interdisciplinary inquiry.

The Science of Nano-Media

Nano-media is the next step in nano-OVD innovation produced by the scientists in our team. [10] It is built by combining a pixelated pre-fabricated nanosubstrate with an image. The image is located in the intensity control layer (ICL), which can be produced either through photochemical exposure, laser writing, or as a black-and-white photomask that is then precisely aligned with, or imprinted on, the substrate. The nanosubstrate and ICL together produce a colored image. (Fig. 3) The scientists early on compared this superimposition of two layers to the early twentieth century process of Dufay color film, which used color filters based on a regular mesh of red, blue, and green lines on the film base, along with black-and-white photographic emulsion, to produce color images. In nano-media the film becomes a nanosubstrate, but the principle remains the same. One can say that nano-media brings together biomimicry (through the 'imitation' of the morpho butterfly) and 'retro' – analog, material – techniques of image production (such as those of Dufay color film).

The substrate is made up of nano-sized holes (nano-hole arrays, or NHAs) or slits/graves, that create pixels, with approximately one billion holes in a square centi-

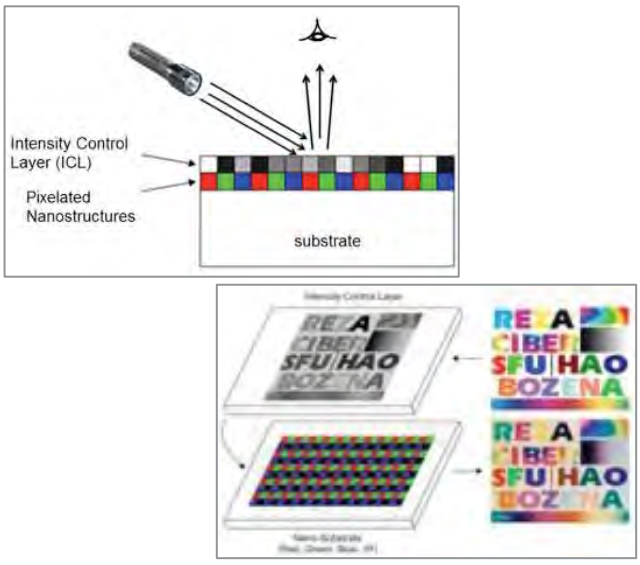

Figure 3. Diagrams of ICL creation and alignment on nano-substrate to create a nano-media.

meter of nanosubstrate. Each pixel is made of four sub-pixels: R (red), G (green), B (blue), and IR (infrared), with the dimensions of each pixel changing depending on the production method, and thus producing different color resolutions. (Fig. 4a) Depending on the pixel size, nano-media can produce images ranging from 1,270 pixels-per-inch (PPI) to 12,700 PPI. This is equivalent to a range between 36,830 dots-per-inch (DPI) to 368,300 DPI. The smaller the sub-pixels the higher the resolution. [11]

The substrate material fabricated with pixels is built using nano-fabrication tools like focused ion beam lithography (FIB) and e-beam lithography (EBL). It can be made with a variety of materials, including metals, polymers, paper, tissue/fabric, or glass. Nano-holes with a thin layer of metal (ex. gold, silver) in particular produce an extraordinary optical transmission (EOT) and display intense visual colors across the visible spectrum. [12] These are referred to as plasmonics, and are used in OVDs, sensing, and other areas.

The RGB pixels can be tuned to produce any color with the ICL, while the IR pixel is used for non-visible information (storage). There are a number of techniques to produce the ICL, which can offer different resolutions

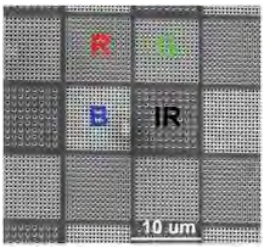

Figure 4a (left). SEM image of the fabricated nanosubstrate showing the structure of the sub-pixels; Figure 4b (right). The first prototype of an ultra-high resolution color image stored on nanosubstrate, with 36,830 DPI (2 x 1.5cm).

when combined with the appropriate pre-fabricated substrate. The final resolution of nano-media therefore depends on both the sub-pixel size and the ICL. High resolution can be achieved through a photochemical method, while lower resolution can be achieved using a photomask. In the photochemical process, a silver halide emulsion is exposed, or the ICL is written, for example using a laser. Using a photomask, a 'negative' of the image is produced and then aligned with, or imprinted on, the nanosubstrate. In both cases the technology functions much like photography, and the team initially described the technology as nano-photography, or nanography. Ongoing comparisons to analog versus digital methods became increasingly apparent and useful in the collaboration (more on this below), and the scientific team continues to explore new ways that analog methods can be adopted for the development of nano-optical materials and surfaces.

For a long time there have been limitations with using nano-optical structures, such as the need to generate a costly stamp for each (very small) image (a stamp is a 'form' made of nanostructures embedded with an image that is used for high volume reproduction), and this is reflected in the kinds of applications that use them, such as banknotes. [9][10] Indeed, while the visual quality of nano-images is continuously improved, [13] there had not yet been a solution for fabricating images without the use of stamps, limiting the expansion of the technology.

With the *PUBLIC* project in mind, the scientific team developed the techniques of nano-media, producing image prototypes of around 2 x 2cm. (Fig. 4b) The elimination of the stamp meant that larger images could be made more easily: rather than building each image from nanostructures to make a stamp, the image was now located on the ICL and 'transferred' to the pre-fabricated nanosubstrate. Moreover, the development of the substrate to include the IR sub-pixel meant that these nano-optical structures could concurrently store a variety of information into the visible image on the various layers of the infrared spectrum (digital binary information, a bar code, a 2D QR code, a grey-scale image, etc.). The result, nano-media, was an extremely thin 'film' that could both display and store a variety of information, and could be produced incomparably faster to the stamp-only methods. [11] The question to be resolved was how to transfer the process used for the prototype to the production of 1,000 issues in a period of roughly eight months.

Collaboration and the Evolution of an Idea

Davis and I, both based in Toronto, travelled to Vancouver in April and August 2014. We did preparatory research on nano-optics and on the work produced by the lab, which was sent to us in advance. A few things quickly became apparent:

1. The Analog, the Material

In considering the production of nano-media, we pinpointed early on numerous analogies to analog processes: Dufay color film's two-layered process, photography's use of emulsions, exposures, and negatives, as well as physical methods of printing like lithography and mezzotinting. This ongoing return to analog techniques was a way for us, the non-scientists, to access the innovations of nano-optics and nano-media. Moreover, Davis' background as an analog photographer, her knowledge of emulsions, and of photographic processes in general, proved helpful to the engineering team, who was unaccustomed with working in this increasingly obsolete 'mode.' This, alongside her experience working across media, armed her with much more practical and material understanding than the scientists expected, which laid the foundation for a fruitful collaboration. While the scientists were searching the world for emulsions, Davis' familiarity with, for example, DIY methods, showed the scientists a new way of approaching the problem, not as scientists, but as an artist searching for, if not making, her materials.

Understanding nano-media in a set of development and fabrication processes allows us to contextualize it as material and therefore to situate it within a larger media history. First, the physicality of the holes in the substrate is not unlike that of early computing technologies, where punched cards or microforms, for instance, carried data through a system of holes.[7] The difference, broadly, is in the size of the holes and material used. Then there is the nano-media itself, a foil-like material that, when produced in large quantities through a roll-to-roll manufacturing industrial process, has a materiality akin to film. Giuliana Bruno describes film as a kind of surface, "a thin skin, a membrane," and, writing about Tacita Dean's film *Kodak* (2006), makes an observation, about the making of celluloid film, that resonates equally with 'nano-film,' as "intimately dependent on being touched and transformed by light, in time, and taking time." [14]. The concept of the surface as a way of thinking across media becomes increasingly useful with nano materials. As Silvia Casini notes, when "we discuss visibility and invisibility…we cannot avoid talking about the surface." [15]

Turning to analog practices provided more than useful analogies, as nano-media itself can be understood as a digital-analog hybrid technology. While it is digital in the design of the substrate structures and ICL, the analog techniques, such as that of exposure, the ability to 'transfer' or 'imprint' any analog image directly into a substrate (i.e., without converting it to a digital file), as well as the physical material of the foil, open the door to interesting connections that cast a light on the circular genealogies of visual media and information technologies. This ability to draw on the history of materials and processes is helpful not only for humanists entering the realm of nano research, but for finding commonality across disciplines.

[7] I presented a paper on this topic, "Nanotechnology, Media Studies, and the Punched Card," at the Canadian Communication Association conference at Brock University in 2014.

2. Innovation and the Disruptive Experience

Nano-media has the unique capacity to store covert information in the IR layer. Though it is one of its defining features, we quickly discovered the challenges of applying it in the *PUBLIC* project. While some were practical (we had a short timeframe and were already working with so much that was new), there was also a conceptual difficulty surrounding the user experience. How do we show the ability to store data in nano-media in a way that the viewer could *experience* as something different, unfamiliar, and novel? We eventually decided against the idea of using a reader (e.g., smartphone) to scan the information since, without being given any explanation, a user would not engage with this technology any differently than scanning a QR code or using an AR application. In other words, as soon as the reader was introduced and the data had to be read, decoded, and viewed on a separate screen, the very fact that the information was stored in the material (hardware) and not the software would be difficult to convey, and probably lost. Moreover, we decided that convincing *PUBLIC*'s readers to download a new application would be difficult, not to mention the additional work of producing the software (work for which we would have to find a specialist outside of the current team). Some ideas we had to resolve this issue included: using filters that would show the data stored in the IR layer; encoding the data only in certain sections of the cover; encoding different data on different sets of covers; integrating the data with pressure or biomedical sensors; storing sound which could be played though the cover. While these challenges could be solved in an installation or exhibition setting – for example with special lighting conditions that used filters that would allow access to the IR – they were unrealistic in the *PUBLIC* project. We could not, with our time and budgets constraints, find an appropriate design and manufacturing solution that would create a disruption of user experience. After weeks of deliberation, we decided that though it was a feature that should be showcased, we would proceed for the cover without IR data storage. This was a very unexpected outcome for the scientific team, an example of the aesthetic and media experience taking precedence over the 'scientific method.'[8]

3. "In my world"; Optics Across Fields

Interdisciplinary collaborations, especially across the arts, humanities, and sciences, have long been described as a meeting of, and translation between, cultures. [16] Currents in transdisciplinary collaborations mostly focus on the coming together of arts and sciences, but technologies, argued Cornelius Borck, act as the "communicating vessels," an idea that shifts the notion of fields from distinct to overlapping. Indeed, the binary moniker 'art-sci' proves all the more insufficient as collaborations work towards new kinds of technologies and emerging materials, surfaces, and media. It is a false dichotomy that produces an illusion of clarity that neatly, if only in terminology, joins two 'worlds' when worlds are messy and many. In the diverse context of nano research, which itself blurs the lines between science and technology by bringing together, among others, biologists, chemists, physicists, and engineers, [17] it is not enough to speak only of a meeting between 'art' and 'science.' While Borck locates technology as "the communicator, the missing link and material linkage between art and science," [18] Robert Root-Bernstein also adds media as one such often overlooked communicator. In his integral tetrahedron model – what he describes as the "universe of innovation" – he brings together sciences, technologies, media, and aesthetics, to describe the "pathways between arts and sciences" as "two-way streets mediated by media and aesthetics." [19] He does not here articulate how he differentiates between science and technology, and technology and media, which are particularly muddled categories in the field of nano research. However, his point about the influence of media and aesthetics back onto science and technology is significant: new technologies that explicitly work to converge our materialities, the matter of the world, into information and into media [20] generate new aesthetics, but, conversely, new aesthetic approaches must also influence the materials (media, technologies) produced. For this, the spaces of scientific and technological innovation need a sustained rapport with the knowledge and methodologies of the arts and humanities, allowing 'art-sci' to better reflect the fluid and varied cross-pollination of fields possible in transdisciplinary research.

In this particular project, searching for points of contact between our fields resulted in exploratory conversations that often began with, "In my world…." In the earliest stages, the very scale of the nano at which the scientists were working seemed "incomprehensible" [21] to Davis and I, a feeling that, as Victoria Vesna and James Gimzewski have put it, "our minds short circuit" when confronting the scale of nanotechnology. [22] To get a better sense of working at this scale, we toured the sterile environment of the clean room where the scientists worked. The meticulously regulated process of suiting up was like a confirmation into another, usually inaccessible to us, 'world,' and the affective experience gave us an entirely different outlook on the physically demanding labor of working at this scale.

There were a few unexpected hurdles of translation, some larger than others. For example, the realization that while the artist was using DPI as a measurement for resolution, the scientists were using PPI. While these were the standards in their fields, calculating the conversion and understanding their relationship, though relatively straightforward, was a crucial step in making sure everyone was visualizing the same level of resolution. Another such example arose with color. While Davis would be giving the scientists an image file produced through Ado-

[8] See Robert Root-Bernstein's argument that scientists must "abandon our reliance on a 'scientific method'" to embrace the kinds of knowledge that come from the artist. In "Aesthetics, Media, Sciences, and Technologies," 276.

be Illustrator, the scientists would convert this using an in-house software to produce the ICL. But how does color translate from the Adobe software to nano-media? Put differently, how does the structural color produced through nano-media, translate into that of a software like Illustrator? Here the scientists had to familiarize themselves with the artist's tools, while she had to make sense of the software they were using. While color systems like RGB, CMYK (cyan-magenta-yellow-black), and HSL (hue, saturation, lightness) have been established for pigment-based color printing, "color systems have not been established for plasmonic-based color." [23] Slowly we understood how to produce the best colors through the different stages of production, allowing Davis to better imagine the final nano-media result of her Adobe file.

From Craft to Automation

Over the course of the summer, the scientists faced one seemingly insurmountable hurdle after another, each step of the process to scale up the fabrication a challenge. In effect, they were scaling up a technology extremely rapidly, moving from the prototype stage to the production of 1,000+ copies, along with their integration into the publishing process, in just a few months. All the while they continued to develop new ideas, working to find solutions and alternative approaches to unforeseen problems. For example, if using an alignment method, the substrate and ICL had to be juxtaposed with an accuracy of 5 microns but current available machines could only do it at 100 microns. A misalignment of that scale, because we are dealing with nano-sized structures, would ruin the entire visual effect. So, while the scientists proved this could be done by hand, producing very high-resolution images (Fig. 5), the labor-intensive nature of the work made it impossible to do for so many copies.

As for any scaling-up endeavor, the challenge was in how to transfer the innovations of a manual process to one that was automated, in moving something akin to craft, to an industrial set-up using sheet-to-sheet or roll-to-roll fabrication. The biggest challenges were the production of the ICL and deciding how the image would be produced: through photochemical exposure, laser writing, or the alignment or imprinting of a photomask, each of which has particular advantages and restrictions.

Figure 5. Nano-media image (3 x 5cm) produced by manual alignment.

At the start of the project, guided by the 'scientific method,' we had been aiming to achieve the highest possible resolution, and thus strived to develop the ICL using the photochemical process. The scientific team went on an international search for the right materials, emulsions and lasers. Concurrently, to be on the safe side, they kept refining the photomask approach with different resolutions, using different polymers, coatings, bonding layers, and alignment methods. Finally, by September, with just over two months remaining, it was decided we had to use the relatively reliable photomask imprinting technique, as the time and labor involved for the other more innovative processes were above-and-beyond our capacities for this project, and also too risky.

For Davis this was not a significant change of plan, as the resolution using the photomask was still incredibly high. Whereas for her the 'less advanced' method was perfectly suitable for the purposes of the *PUBLIC* project, the scientists' were not used to thinking of their technologies in this way, where a 'less optimal' solution was perhaps better and sufficient. For this project, where the goal was not just a technological showcase but also an aesthetic exploration, we could work with 'less.'

Once this decision was made, we proceeded with as much testing as possible before ordering the final roll of nano-media foil (the combined nanosubstrate and ICL) from ITW Covid.[9] In one such test, when a metalized polymer on a sample *PUBLIC* cover produced problematic results, the decision was quickly made to change to a transparent foil. Even if the visual effect would be diminished (since there would be no metal to enhance the color's brightness), it could be superimposed on top of a cover, and in those places where there was no image the foil would simply be see-through, rather than opaque due to the metal. Time was running out.

Designing the Cover

By early fall it was also time to make a final decision on the cover image. Alongside the ongoing scientific progress, Davis had continuously been looking for ways to play with the themes of (in)visibility, perception, nature, light, and color. With the assistance of fellow artist Scott Lyall,[10] and as the theme of this *PUBLIC* issue was *The Retreat* (based on a visual arts residency at the Banff Centre), they produced an image of a dark and shadowy forest. This would be the cover printed on paper with inks as per usual. Based on the decision to go with the mask method, Davis would superimpose this printed layer with sections of nano-media, an array of sparkling iridescent colors emanating from the cover. The light structures would flicker from the forest and also retreat, a reflection on the hidden depths of nature and the moments of illumination that shine from he darkness of invisibility or the unknown. (Fig. 6)

[9] A professional company that became an essential collaborator.
[10] As well as her assistants Polina Teif and Vlad Lunin.

Figure 6. Test of final design of the cover with nano-media manually superimposed.

Armed with a design plan, the scientific team proceeded to design the necessary nano-media components and sending them to ITW for roll-to-roll fabrication.

Troubles at the 11th Hour

From the start we followed the instruction from *PUBLIC's* printer, located in Québec, who indicated the kind of paper and lamination usually used. We had decided that it would be best to print the cover and assemble it with the nano-media layer in Vancouver, before shipping the ready-to-bind product to our Québec printer, who would print the interior of the issue as usual. Their soft deadline for receiving the cover was November 1. After receiving the nano-media foils from ITW, and with a bundle of printed test covers, the team set out to a lamination company in Vancouver. While some lamination tests had been done before this stage to ensure that covering the foil wouldn't dampen the effects too drastically, a last minute decision to coat the foil in an extra reflexive coating (to compensate for the switch from metal to transparent foil), was not tested, and the result, when everything was put together – cover, nano-media foil, lamination – fell flat. The light reflected too much from the entire surface, while the specific colors of the image were not easy to distinguish, dampened drastically by lamination. It was now November 3, 23 days before the *PUBLIC* launch.

The next few days were frenzied. We enlisted the help of *PUBLIC*'s designer and printer to help us find a solution and salvage the hundreds of meters of foil. After much deliberation, we opted to put the foil inside the journal as a rectangular insert with a round cut out where the foil could be placed. In a true spirit of teamwork, the entire Vancouver team set up a production assembly line to produce the inserts, which were delivered to Québec on November 20. (Fig. 7a) Davis and Lyall produced a revised cover that included the image of what the nano-media would have been. They printed a 'shadow' of the nano-media, with the solid ink functioning as a 'fixing' of the variable optical version within. A special shipment of

Figure 7a (top). Assembly of nano-media insert; Figure 7b (bottom). Final results in *PUBLIC*. [11]

the issue with nano-media insert included, arrived in Toronto on Nov. 24, two days before the to launch. (Fig. 7b)

Outcomes, Debrief, and Next Steps

The project did not turn out the way it was initially conceived, with difficulties in scaling up the nano-media prototype, with all of its features, and the last minute move from the cover to an insert. But, since artistic and scientific projects face similar challenges as they move from speculation to production, the team navigated the difficulties with flexibility and creativity. In hindsight, under the circumstances of the firm deadline, our goals were set too ambitiously. But the collaboration was still successful in developing interdisciplinary methodologies for technological exploration, research, and innovation. Moreover, the furious pace of the project lead to numerous innovations, which, though they could not be incorporated into *PUBLIC,* have already produced new patent applications [24] and partnerships, and are the foundations for new ideas and ongoing research.

Continuing their collaboration, the team is now working on an installation for Davis, exploring the possibilities of thread embedded with nano-media pixels, drawing on the histories of weaving and looms. The entirely different conditions of the installation allow for a process that can develop organically through singular objects, leaving time for technological and aesthetic exploration through trials, feedback, and observation. The possibilities for nano-media are vast, and if we give artists and humanists access to these technologies, we might start seeing things very differently.

[11] The final product in motion: https://vimeo.com/112849671

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Sensory Reload: Group Interaction with Touchable Sculpture

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Abstract

This paper discusses a collaborative practicum PhD thesis work in its final stages of production. The project inquires about the possibilities of the tactile sensation in art to reestablish human sensory relationship with the current technology. The series of interactive sculptures investigate tactile interaction as an aesthetic experience within the multimodal multisensory system. The silicone sculptures **Silicone Valley, Hemorrhage,** and **Disturbed System** aim to take visitor's experience with the artwork into unfamiliar sensory territory. Touch variations to the sculptural surfaces provide electronic feedback of embedded vibration and directional spatialized sound in an installation format. The artwork presents this sensory information in a form of unexpected assemblage of pulsing organic sculptural surfaces and emitting sound. It also places visitors in a shared interactive space, an aura of travelling sound warped by their touch to the sculpture. This shared interaction investigates relationships between nature, artifice, technology, human body and human social group behavior.

Keywords

Group interaction, touch, physical computing, haptic feedback, generative sound, consumer technology, spatialized sound, multisensory, immersive, information interfaces and presentation.

Introduction

This research project originates from the idea to metaphorically share artist's experience of touching sculptural material with the visitors. It exposes artist's perception in production process to transform the conception of the presented artwork into a creative active experience for the visitors [13,14]. Unlike visitors' experiences in exhibitions, artists experience their work at a physical level during the fabrication process. Artists sense the scent of oil paint, the texture of modeling clay, and the varying resistance of carved stone. The connection between the artist and artwork happens through a full body experience, as explained by Brodsky [4] and Vallega-Neu [5] through Merleau-Ponty's and Dewey's theories about perception and embodiment [6, 15]. This connection is evident in Richard Serra's film Hand Catching Lead (1968) and Matthew Barney's relationship with prosthetic grade plastics and petroleum jelly in Cremaster Cycle (1994-2002).

Figure 1. **The Silicone Valley**, at Art Gallery of Grande Prairie [1] in 2014. Visitor encounters a flesh-like 27" breast with the internal tissue exposed. Black plastic 3D printed sensors in form of small mutating vaginas and nipples activate haptic feedback. In response to these sensors, the breast periodically buzzes an electronic pulse, subtly inviting visitors for closer interaction. The slowly pulsing buzzing subtly references breathing and heartbeat. The pulsing intensifies when several visitors touch multiple areas.

Figure 2. **The Silicone Valley**. The black hard plastic elements protruding from the breast tissue concentrate the vibration feedback and host the conductive copper wire of capacitive sensors.

Our project also shares the artists' social understanding of the medium used in assembling the sculptures. The silicone material evokes questions of its associations with the body augmentation. Embedded technology continues the theme of augmentation and comments on a comparison between physical computing and artificial life forms. Three sculptural installations recruit haptic technology [7, 16] and popular modes of interaction to explore variations of approaches to representation such artist's perspective. These approaches include presentations in a traditional art gallery, in a science centre, embedding under the surface and exposing sensors and actuators, investigating vibrational feedback, addition

of sonic data, experimenting with generated speech and music, and variations on social contexts of the works.

Tactile Aesthetics

Our research investigates the value of touch in perceiving art in a digital age, which initiates new challenges identified by Alan irby 10 . Among these challenges, invention of new materials, wearable technologies and hand-held electronics proves the traditional strictly visual experience of art unable to capture viewers' attention for extended period of time. The installations attempt to stimulate one's awareness of others, the environment and experienced sensations.

Scientific research in haptic psychology 11, 12 , in combination with Saddik's survey of haptics [16 provide an understanding of how one perceives touch. Touch differs from other senses: it is distributed over the entire surface of a human body, promotes active exploration of physical environment, and conducts a bidirectional exchange between body and environment 11, 16 . Inclusion of the tactile sense, which cognitively is processed slower than vision, provides an artist the opportunity to extend visitors' engagement in an exhibition 8, 17 . The process of exploration involves a variety of motions on the surface of the sculpture. This includes skin contact, pressure, following surface contours and holding individual parts of the sculptural body. Temperature, body balance, and hand manipulation augment the comprehension of sculptural shapes.

The inclusion of tactile and sonic feedback into live interaction with sculptural objects establishes a temporal, sensory and experiential communication between the artist and the audience. This type of communication differs from observing visuals or the interaction with the screen in the way it creates a state of awareness of physical surroundings. We stimulate awareness of visitor's physicality by disrupting the familiar patterns of interaction 9, 12 with the generated feedback and incorporating timing into the experience. Preprogrammed timing allows to transform the experience with the work into a narrative structure.

Figure 3. Disturbed System (2015). The soft silicone material disguises 8 built-in speakers that emit directional sound along with 4 external spatialized speakers. The embedded sensors react to squeezing and pulling on the surface.

Sharing Touch and Its Social Context

A silicone sculpture of an enlarged breast, **The Silicone Valley** (refer to fig. 1 and 2), reacts to human touch by pulsing vibrations within the surface. Visitors get to touch the inside raw tissue of the breast embedded with 3D printed hard plastic sensors. The piece speaks about the issues of naturalness and artifice in the context of augmenting human bodies with technology and foreign material. It presents the viewer with one of the most touched female organs turned skin-side down and detached from the body. It also places the body part associated with intimacy into a context of group interaction in a public setting of the art gallery.

A second iteration on the theme of touching internal tissue evolves into a smaller piece **Hemmorhage** (fig. 4). The abstract shape of the sculptural piece references an internal body organ that pulses in a similar way to the previous work, however the sensors and actuators are completely inlayed within the sculptural 'tissue'. This presentation encourages motion in addition to placing their palm on the sensitive area. The search for sensor locations invites visitors to actively explore the surface of the sculture. Occlusion of the feedback mechanism speaks about the notion of art's mystifying of technology and romantisizing of it in science fiction. Touching **Hemorrhage** during the Calgary Maker Faire illustrates a contrast in visitors' relationship to art in a gallery to the science centre 18 .

The current work, **Disturbed System** continues exploring human tactile interaction with silicone and technology. In this iteration the installation places visitors within a virtual immersive sonic environment within the physical exhibition space. Visitors are invited to touch an object that references disasembled body tissue. This object emits a synthetic, distorted voice speaking gibberish, which structurally reselmbles English. The voice changes over to playing notes once the visitors overcome their discomfort of the presented object and engage in touching the sculpture. The sensors

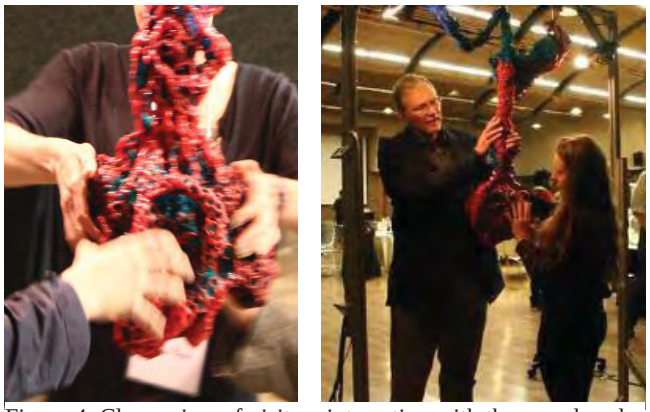

Figure 4. Closer view of visitors interacting with the sound sculpture.

within the surface allow recording the sequence of touched areas, each playing a separate synthesized note. The sculpture becomes a music instrument. Emitted sound travels to the outside speakers corresponding to the locations visitors' touches in relationship to the exhibition space. This spacialization effect allows simulating of a space aura which distorts based on the number of visitor's interacting with the piece. **Disturbed System** (Figure 3) evokes a feeling of dicomfort while presenting visitors with familiar technology disguised within an unfamiliar object. Combination of the tactile and sonic feedback draws visitors' attention to the familiar daily experiences of touching technology, authenticity of feedback, physical sensations, natural and artifice.

Conclusions

Our collaborative project allows creating a multi-sensory art environment for group interaction. We explore themes of physicality in visual and sonic arts by recreating a state of awareness inspired by artist's interaction with sculptural materials. The piece **Disturbed System** manifests our concluding explorations on the topic of shared interaction with touchable art however, comparing other variations allows researching of the structure of interaction and its meaning in the different contexts.

Figure 5. **Hemorrhage** (2015) resembles an internal organ and evokes references to medicine, science fiction in a performative manner. Artist-performer invites the audience to touch it in artist's arms or when set laying on a table surface.

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Electromagnetic Landscape – In-between Signal, Noise and Environment

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Abstract

Electromagnetic Landscape demonstrates in direct, tangible and immediate ways effects of the disruption of the familiar. An ubiquitous technological medium, FM radio, is turned into an alien and unfamiliar one. Audience participation, the environment, radio signals and noise create a site-specific, ragged sonic landscape. The work exhibits intrinsic, non-trivial, emerging behaviour, cyclic or wave-like, which converges and ebbs. It varies its sonic and visual display through a dynamic interaction of light sources, fog and light sensors. The system maintains a fluxing state of ambivalence between proximity and distance, engagement and rejection, curiosity and annoyance; it slips in and out of participants' control.

Keywords

Radio, environment, noise, participation, disruption, alienation, installation

Description

The *Electromagnetic Landscape* installation consists of five shiny, hard and alien-looking thin resin/fibreglass black blobs which sit in different places on the floor in a dark indoor room (Figures 1–2). The irregular shaped blobs look semi-volcanic. Each blob is 20–70cm high and 20–50cm across and has a crater on top. The craters are taken up by large diameter loudspeakers with central, strong, upward-pointing light-sources. The blobs are equipped with FM radios (hidden under the speakers), light sensors (in the crater rims) and small fog machines.

Participants control the radios by (un-) covering the light sensors. Light from the blobs is reflected by e.g. people's hands, arms and pieces of clothing, by the fog emitted from the blobs and the ceiling of the room. The more light the sensors detect, the louder the radios play, the higher their FM frequency, and the brighter the lights (it uses a similar technical basis as the authors' previous *EL-O* installation (Figures 3–4)[1]). Fog machine(s) are used periodically (for approximately one minute every 20 minutes) and independent of participant action to maintain an alien atmosphere and provide cyclically changing lighting conditions.

Figures 1 and 2. Sketches of the installation

The landscape is experienced as louder and more dense with information the more people are present in the installation and interact with it. Participants can enjoy or endure a collage of music, speech and noise or try to tune several blobs into the same radio station. But the system is quite unstable and hard to control. There are influences outside of the participants' control, e.g. the room's ambient brightness, outside brightness (if the room has windows or open/glass doors) and fog eruptions.

The installation's systemic behaviour is site-specific (i.e. lighting conditions, FM reception) and time-dependent (e.g. radio program schedule, fog). The *Electromagnetic Landscape* can only be experienced as a process, and only by people who are present and engaged in creating it. All system (re-) action is created in real time, during and through participant intervention. The system exhibits intrinsic, non-trivial, emerging behaviour, cyclic or wave-like (such as chain reactions and feedback loops), which converges and ebbs.

Rationale

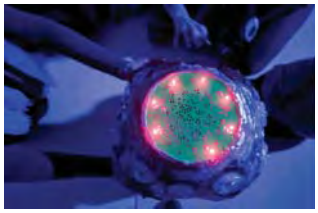
The work demonstrates in a participatory and immediate way effects of the disruption of the familiar. It makes an ubiquitous technological artifact appear unfamiliar – a way

[1] Shown at Wundergrund Festival, Copenhagen, Oct 24–Nov 1, 2014; Digital Interactive Art Space (DIAS), Copenhagen, Sep 25–Oct 26, 2014; Hitparaden 2 – International Festival for Performance Kunst, Copenhagen, September 18–21, 2014; for a video demonstrating the interaction see https://vimeo.com/118279549.

to make apparent as well as question modes of automated perception (Brecht 1964:192).

The installation plays off the participants' expectations, predictions, experience and actions. The system maintains an instable state of ambivalence between proximity and distance, engagement and reflection, comfort and disorientation, known and unknown, attraction and rejection, curiosity and annoyance; its systemic expression includes elements of dissonance as well as of convergence. The effect is oscillation, tuning out *and* in, into noise *and* signal.

The installation looks and feels like a strange place on a different planet. As a visual metaphor, the landscape rejects a mimetic display: The work is realized as an alien, foreign, formless and abstract landscape – a kind of non-landscape, or anti-landscape, which is out-of-tune with everyday experience.



Figures 3 and 4. *EL-O*, first version, Wundergrund performance and DIAS installation

Interaction and Experience

Brecht's *A-effect* turns 'the object of which one is to be made aware, to which one's attention is to be drawn, from something ordinary, familiar, immediately accessible, into something peculiar, striking and unexpected.' (Brecht 1964:143) *Electromagnetic Landscape* uses alienation as a tool to invite reflection, investigation and critique. The idea of alienation appears to run counter to mimetic fidelity: The medial display becomes grainy and intransparent when it acts as its noisy self, and interferes with the signal. The piece shows how elements of medium-specific noise (Fetveit 2013) can be used as an aesthetic translation of the alienation-effect. In the work, alienation is taken not as a position towards its originality or truth (which would be fake), but as a method towards audience engagement.

The work is intended to open spaces instead of closing them, and to confront participants with rather than comfort them with a technology in a surprising way. Participants 'get [...] irritated with the everyday, 'self-evident', universally accepted occurence' (Brecht 1964:140). The work playfully challenges the audience and plays with its expectations. Participants can respond to the challenge, play with and explore the system's behaviour.

The A-effect is extended: The interaction corresponds to the conceptual position of ambivalence; the audience is engaged in an oscilating performance. It is both, participating in forming the landscape and in observing it. Participants are continuously in control of some aspects of the system, but other parts slip in and out of their control or constantly lie outside of it.

Audience participation, the environment and radio signals and noise create an emerging, site-specific and ragged sonic landscape. The engagement with the medium relies on and is intersected by presence, movement and touch in the space. The participation creates what is experienced in terms of light and soundscape: Unique auditive and visual patterns emerge and dissappear, sometimes in unobstrusive, often in disruptive ways. The process is in-flux; wave-like oscillation, up and down, on and off. The participation of the audience on location carries and initiates the action. The interaction happens between participants, blobs, audio signals, space, light sources and fog.

Related Works

Electromagnetic Landscape questions communication media as a channel for only communication, information and signal. The project is concerned with what the audio-visual expressions people experience in the piece have to offer in terms of noise or non-communication.

In 'Signal-Rausch-Abstand' from 1988 (signal-to-noise ratio) German media historian, Friedrich Kittler writes about the materiality of communication systems. He focuses on how materiality is linked to the phenomena of noise and shows how noise is a fundamental element in understanding communication technologies – or systems of information as Melle Jan Kromhout writes in his introduction to the text (2012:5). Kittler scrutinizes the statistical formalization of communication by mathematician Claude Shannon who argues that communication is in the presence of noise; that noise is alongside the information/signal.

Kittler discusses Shannon's argument that sets out to show that the maximum communication of information turns into a statistical improbability, because the information becomes very hard to separate from noise. Kittler tests Shannon's theory and makes a statistical experiment using letters in random order: 'XFCML RXKHRJFFJUJ [...]' (Kittler 1988:346) – but due to the choice and placement of the letters according to their probable occurrence, Kittler's experiment generates English-ish words that in his eyes resemble the words in James Joyce's *Finnigans Wake*: 'IN NO IST LAT WHEY CRACTICT [...]' (ibid.).

Kittler states that this experiment is an attack on writers by noise ('Diese frontale Attacke auf englische Schrifsteller oder auch Teufel führt selbstredend das Rauschen […]' (Kittler 1988:347)) – that shows noise is part of the signal. Communication channels emit noise, and signals mimic (where possible) disturbances ('Signale üben tunlichst Mimikry an Störungen' (Kittler 1988:344–345)). Statistically, signals emit noise (Kromhout 2012:4). Engineers might equate information with signal, but Kittler includes noise in his notion of information and proposes an inseparable crosslinking of signal and noise, and of noise and matter. Kittler (1988:345) calls it 'thermal noise' and explains it as the noise that all matter (or materiality) emits

when heated. As Kromhout (2012:5) clarifies, '[o]ne could say it is noise which ties information to its materiality'.

Works such as *Radio Dada* (2008) by Rosa Menkman and Extraboy and *Electromagnetic Landscape* can be said to connect to Kittler's statement that noise is always also part of signal or information in communication media. For example, *Radio Dada* exhibits the glitch and noise of media as part of Menkman's and Extraboy's investigation of the aesthetic possibilities of the materiality of those specific media, radio and computer. *Radio Dada* articulates visual noise as a pixilation of the images due to feedback loops and format conversions in different programs. Menkman (2011:17) explicitly refers to Kittler in her Glitch Manifesto: 'The only resolution to the problem of non-communication was to incorporate it within the system'.

The noise aesthetics and visual formlessness in *Electromagnetic Landscape* also relate to Kittler's theory of signal and noise; and the project also aims to explore how noise is a fundamental element in understanding communication technologies. Specifically, *Electromagnetic Landscape* explores radio as a communication technology and as an aesthetic technology. The (non-) landscape with blobs in different sizes and shapes creates a visual frame that supports the experience of the noise. The real-time audiovisual experience of patterns of light and shadow, signal and noise, creates a site-specific environment, and an estranged experience of the potential of place, that is oscillating in-between noise and signal, shape and form. The sound of interference and evanescence vibrate and hold a tension until the next signal comes through from a radio station somewhere in the aerial landscape.

The interest in aesthetic possibilities in noise as something that is always also part of signal or information in communication media, can be found in avant-garde experiments in the Dadaist movement in the time of World War I. In Dadaism the investigation of media – not only as devices/channels for communication, but also of non-communication and aesthetic experience – can be seen in Kurt Schwitter's poetry and collages, in Raoul Hausmann's photomontages as well as in Anna Höch's collages. The interest in noise as an aesthetic experience also connects to Italian futurist Luigi Russolo's manifesto *The Art of Noises* (L'arte dei Rumori) from 1913, where noise from the urban environment and technology is seen as something with specific aesthetic qualities.

Sound and media theorist Douglas Kahn builds on Kittler's work and argues that one should not explore the communication system in itself, but focus at the relationship between media and the environment. 'Modern telecommunications began with message devices that resonated with and received signals from the larger energetic environment. It was with these devices and within these environments that the aesthetic trade in the Aelectrosonic began [...].' (Kahn 2013:22)

Electromagnetic Landscape investigates the aelectrosonic as defined by Kahn. The project also draws on artistic investigations of electromagnetic environments as can be found in works such as *Electrical Walks* (started in 2004) by Christina Kubisch, *Trilogy for Night and Radio: Radiotelegraph/Night Fall/Relay* (2014) by Anna Friz and Konrad Korabiewski and *Simple Forces* (2013) by Joyce Hinterding. In Simon Penny's *Lo Yo Yo* (1988) the electromagnetic information that permeates the installation space is made audible – the installation displays the received signals from the energetic environment – showing how the space, that is, the air in the space, is full of electromagnetic signals. Works such as *Imaginary Landscape no. 4* (1951) by John Cage, or Nam June Paik's *Random Access Music* (1957/78) also experiment with the relationship between randomness, signal and noise as an interactive and site-specific audiovisual aesthetic.

Kahn (2013:6) proposes that media should not be understood 'under a sign of technology and as a procession of the historical development of technological/instrumental devices' but as something aelectrosonic – as media that have 'a footing in nature'. This indicates that noise is not only an expression of media, but also an expression of the environment – as one might be able to hear in *Lo Yo Yo*, *Night Fall* and *Electromagnetic Landscape*. The question of the relationship between signal and noise is reformatted and extended to investigate the role aesthetics play in people's engagement with and understanding of communication media as signal, noise and environment.

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MAKING DATA FELT: UNTITLED BOMBARDMENT VISUALIZATION

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Abstract

Untitled Bombardment Visualization is an experiment in translating statistical information on aerial bombardments into an affective, visceral, emphatic experience that captures some of the faceless data's disruptive violence. The artwork mines data regarding the time/place/duration/intensity of aerial bombardments, which is visualized using a custom-made laser engraver that burns the data points into the surface of a topographical map of the region. The visualization piece thus "performs" a tangible and emotionally charged reenactment of the destruction engendered by the data, aiming to lend a body, shape, and smell to the otherwise anonymous and faceless statistical data of aerial bombardments.

Keywords

Data Visualization, DIY, laser cutting, affect theory, statistics.

Project Description

MAKING DATA FELT is an installation-based research-creation project of experimental data visualization, designed to explore the affective dimensions of statistical information. The project appropriates low-cost DIY 'maker tools' such as laser engravers, 3D printers, CNC milling devices, and thermal printers for the creation of relatable, open-access data visualization solutions that allow me to 'make data felt' by highlighting the social, political, and ethical stakes that we often overlook in statistical information.

The visualization experiments are designed to yield critical and aesthetic artifacts based on statistical data that is otherwise presumed to be disembodied, alienating, and impersonal. How, I ask, can we translate impenetrable statistical information back into meaningful affective experiences and artifacts? MAKING DATA FELT foregrounds the critical, cultural, and social stakes encoded in such data, and seeks to reverse the obfuscatory, dehumanizing effects of numerically encoded statistics.

The first iteration, "Untitled Bombardment Visualization," mines publicly available data regarding the time/place/duration/intensity of the 2014 aerial bombardments of the Gaza Strip, and converts this information into a durational 2D vector file that is used by a custom-made laser engraver to burn/etch the data points into custom-printed paper maps of the region, partially destroying the maps in the process. The installation thus 'performs' a tangible and emotionally charged reenactment of the destruction encoded in the statistical information, and lends a body, shape, du-ration, and smell to the otherwise faceless data. My visualization tool yields 3 types of experiential artifacts, each emphasizing affective dimensions of the visualized data:

1) A live 'performance' in which the laser engraver burns/etches information of the bombardment events onto custom-printed paper maps. The performance is accurately scaled to represent duration and intensity of the bombardment events.

2) Scorched maps inscribed with 'statistical data points' that are translated into visible, touchable, smelly burn marks, to be framed/exhibited.

3) HD video documentation of the engraving/burning performances, designed to magnify the details of the paper maps and to further bridge the gap between data and experience.

Process/Methodology

Statistical data on the bombardment to be visualized in Phase 1 is made freely available by the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA), and consists of geographical coordinates, dates/times, and an 'intensity scale' derived from UN-owned satellite imagery and statistical information gathered by UN ground staff. The information is provided in a disembodied numerical shape that alienates us from the human suffering of the victims and from the scale and socio-cultural impact of the events. MAKING DATA FELT retranslates this information into meaningful, relatable, affective experiences.

The first project stage is an experimental visualization device (described above) that can be applied to an open-ended variety of different visualization scenarios. The installation consists of a custom-built laser engraver attached to a laptop and a macro HD video recording device. In a 3-step process, statistical numerical information is converted (using a custom-written Processing sketch) first into CVS (comma-separated value) files and then into standard g-code vector files that can be plotted using the laser engraver. All required software tools (Pure Data, Arduino, Grbl, and Inkscape) are open source and freely available, and my original scripts will be shared upon completion, with the

hope that they will be useful for other 'affective mapping' and experimental visualization projects.

Rationale

MAKING DATA FELT is inspired by the observation that statistical information often alienates us from the cultural, social, and political contexts of the events to which the data refers. "Untitled Bombardment Visualization" aims to explore ways of retranslating disembodied geographies of anonymous numbers into an affective geography of destroyed residences, collapsed schools, and ruined public infrastructure.

Overall, this experimental visualization tool functions as a kind of 'instrument' – not unlike the torture machine in F. Kafka's novella "In the Penal Colony" – which can be used to document, reenact, and narrate traumatic events recuperated from the invisibility of the statistical record. This kind of visualization is highly visceral – smelly, blinding, messy – just like the events to which it refers.

Beyond Phase 1 of the project, my long-term goal is to collaborate with others in building additional visualization devices that use other accessible crafting tools (such as CNC mills, thermal printers, and 3D printers), which will be deployed for appropriate, medium-specific visualization projects (focusing, for example, on ecological disasters, on urban development, or on crime statistics). Part of the theoretical dimension of the project will be to explore how the tangibility and immediacy of craft-based visualization methods impacts our emphatic/affective responses to statistical data. How, in other words, can we make such tools useful for translating disembodied, 'sterile' data into affective experiences? I am particularly interested in applying a growing body of scholarship from media theory and affect theory to the exploration of tensions between the statistical (data) and the material (artifact), and to consider the power of the digital (code) to conjoin these phenomenologically distinct arenas. The project thus hopes to overturn perceived incompatibilities between the materiality of making/crafting/working and the immateriality of information.

Author Biography

Martin Zeilinger holds a PhD in Comparative Literature (Univ. of Toronto) and teaches at the Ontario College of Art & Design and at the University of Toronto. He is the co-director of the Toronto-based *Vector Game Art & New Media Festival*. His film and video work has been shown in Canada, the US, and Europe, and he appears as a live coding performer under the pseudonym *st01c*.

http://marjz.net/

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PERFORMING THE BODY AND SPACE WITH SOMATIC SOUND

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Abstract

The paper explores embodied experiences through moving, interactive and somatic sound. Somatic sounds presents a new approach as to how the body of the user can become a dynamic material to shape embodied, corporal sensations. The project represents both an incremental improvement to full-sphere, immersive spatial audio sound experiences and a new take on embodied sound letting users touch sound and feel space.

Keywords

Somatic Sound, Somaesthetics, sound cloud, holophonic, interactive sound, electronic skin, haptics, touch interface.

Introduction

The paper explores how sound can be used to perform both bodily and spatial perceptions through a user-controlled, touch based system. It presents a novel approach as how to interactively involve the body of the user as a dynamic input in shaping embodied, corporal sensations through sound. Somatic sound can be defined as the live, embodied and multidimensional experience of sound as a corporal phenomenon.

The Somatic Sound project represents an iterative development in the area and history of immersive sound experiences. From a technological viewpoint somatic sound is an installation where the user can corporally and intuitively control, shape and experience a three-dimensional audio space. The project is built upon a touch-based system that composes real time, interactive user experiences inside a 3-dimensional full-sphere sound field. A spherical montage of 25+ speakers frame the space, effectively wrapping a live sound cloud around the user. This set-up allows physically precise directions and volumes of the sound. The full-sphere sound encompasses all users present as a physical and spatial experience.

The user can precisely move and compose the aural and spatial experience of the installation space by direct or indirect touch of a proximity sensitive, near-field sphere. This centrepiece of the installation is a sphere covered in pure gold. It functions as a touch sensitive, electronic skin.

Immersive spatial soundscapes

The somatic sound approach is related to a long track of developments in full sphere, immersive and interactive sound systems. One of the most known is the Philips pavilion from 1958, constructed by Le Corbusier with a 300+ loudspeaker setup configured by Varese and Xenakis. [1] Another is the Erotogod project, using interactive real time composition controlled by a bodysuit. [2] A contemporary research facility investigating many of the issues related to somatic sound, is the multi-channel loudspeaker setup of the Surrey Sound Sphere. [3] One novel addition in the Somatic Sound setup is the innovative use of the body-centred, golden sphere controller that allows users to effortlessly steer the flow of music through space in relation to their own bodies and actions.

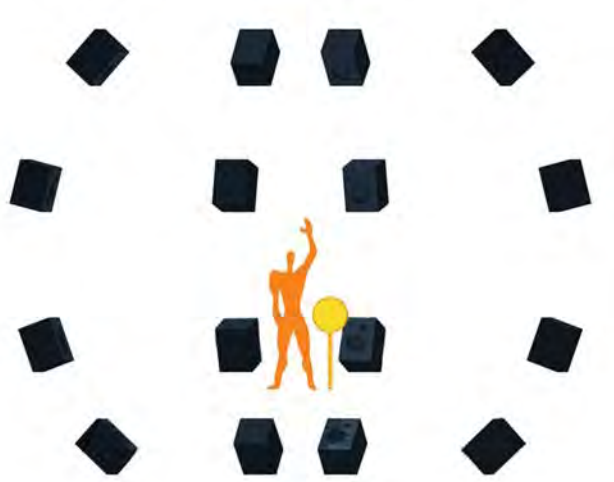

Figure 1. Somatic Sound Immersive Audio Set Up. ©Stenslie.

Technology

The somatic sound system is built around a touch sensitive golden sphere divided into 48 zones. Each zone is made touch sensitive through capacitive induction and controlled

through a custom built patch to Max/MSP. Each of the zones of the golden sphere is coupled to a separate loudspeaker/sound channel. In the experimental setups the top and bottom channels/zones were combined, rendering 34 up to 34 active output channels.

Artistic Experience

The somatic sound system has been performed on several occasions and with various sound contents (Dramatikkens Hus in Oslo 2012, Oslo School of Architecture 2013, Ichihara Biennial in Japan 2014). In the latest version of the system, named Dead Voices (2014), (performed at ANX, Oslo, Norway 2014) the user is immersed inside a 3D sound cloud made out of – or inhabited by- 77 different, distant voices. The tittle is directly related to the content as each voice is scripted as a story told by a dead person. Users of the installation affect and influence the invisible ghost sounds by touching the golden sphere. The voices portrait lost souls, hovering in limbo, themselves not knowing neither life nor death. During a two week exhibit at the users reported experiencing the sound universe and content as partly disturbing, partly compassionate.

By touching, caressing the sphere, voices are caught, pulled down to float around the user. The golden sphere lets the user become both a composer and a necromancer, trolling the dead voices into reality. Each individual voice is talking, telling and struggling to communicate. Every one of the 77 voices is an anxious attempt to create a dialog with the one who touches the sphere.

Figure 2. Somatic interaction with the golden sphere, functioning as electronic skin. ©Stenslie.

The combination of a multichannel touch interface with a full-sphere, immersive spatial sound system turns sound into a material for direct, somatic and dynamic experiences. The project demonstrates how innovative combinations of digital technologies and use of sound can shape spatial experiences. The installation functions also a sound controller and instrument that both investigates and demonstrates how physical, interactive and three-dimensional sound systems affect our phenomenological perception of the world.

Artistic Methodology and Approach

Somatic Sound takes a practice-based approach to the investigation of how sound affects us. The project is built through an iteration of practice led explorations of how sound can i) be experienced in full-sphere, immersive spatial sound systems, and ii) how users haptically interact with arrays of proximity- and touch sensitive field sensors. [2]

The project is further inspired by the open, explorative question: how do we experience embodied, interactive sounds in an immersive, dynamic sound space? And how do sounds produced by haptic and kinaesthetic interaction affect the users experience? Departing from initial observations in beta versions of the system, the project investigates the open hypothesis that interactive experience of physically immersive, multichannel, holophonic soundscapes, is perceived by users as more affective and engaging compared to perceptually manipulative simulations of 3D surround sound such as stereo, 5:1, 7:1, THX and comparable systems. These simulations are highly effective in providing convincing experience of 3D sound.

So what is the addition of Somatic Sound? Sound is a physical phenomenon, produced through physically measurable waves. It exerts influence on our bodies, impacting us in several somatic ways. [4] In everyday situations we are actively tuned to our environments in an embodied way, listening to and reacting to sound sources from multiple sources and directions. Sound is so naturally perceived as being multidirectional. Yet traditional presentations of music -such as concerts, theatres and playback systems- mostly place users as passive listeners in front of a one-directional output. Users need to face one direction to perceive the sound output in the correspondingly 'correct' manner as conceived by the sound designer. Digital music systems have recently triggered an enormous production of music and systems for multichannel playback (THX, 5.1 etc), yet to get the most out of it, users need to face one main source. Preferably even sit still. This makes users consume and experience sound somatically passive. One reason for this is the difficulty and complexity involved in producing believably immersive experiences through 3D sound simulations. Interactive sound systems adds another dimension by allowing the user to enter the challenging role of being a real-time composer. This influenced the formulation of the open, explorative research question of what happens if we instead of simulating 3D sounds, creates a real spatial and immersive experience for sound?

Touching Sound, Touching Space

How can we describe what we have never experienced before? It is outside common, everyday experience to interact with a moving and immersive soundspace, that is, an actual physical space that changes its aural shape and expression according to users actions. Inspired by the philosophical framework of Somaesthetics, the Somatic Sound project presents as an incremental disruption in the way touch can be used to produce highly immersive and spatial sound experiences. [5] By touching the golden sphere, the user also reconfigures the spatial projection of sound, effectively influencing the architecture of the installation space. This gives the combined somatic effect of touching space and sound in an embodied manner. This can be described as *Embodied Sound*, produced with and through users active, haptic, living bodies.

Conclusion

Somatic Sound gives users the ability to perform, shape and experience space through the touch sensitive skin of the golden sphere. [6] In relation to ISEA 2015's theme of disruption, the project represents both an incremental improvement to holophonic experiences and a new take on embodied sound letting users touch sound and feel space.

The project adds several contributions to the field of immersive, spatial audio. The use of the golden sphere as a direct controller of sound in space allows new perceptions of sound. The new controller functions as an active, second skin that directly couples users actions to full sphere audio listening. This enables easy, intuitive navigation in multichannel audio environments. Sound configurations such as Somatic Sound greatly influence our spatial perceptions, allowing for new variations of relational, in-situ dependent listening.

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Author Biography

Prof. Dr. Ståle Stenslie is teaching and researching as a full professor in Art and Technology at Aalborg University, Denmark.

He is an artist, curator and researcher specializing in experimental media art, interactive experiences and disruptive technologies. His aesthetic focus is on art and artistic expressions that challenge ordinary ways of perceiving the world. Through his practice he asks the questions we tend to avoid or where the answers lie in the shadows of existence. Keywords of his practice are somaesthetics, unstable media, transgression and the numinous. The technological focus in his works is on the art of the recently possible - such as i) panhaptic communication on Smartphones, ii) somatic and holophonic soundspaces, and iii) open source design of functional and lethal art weapons for low cost 3D print.

He has been exhibiting and lecturing at major international events (ISEA, DEAF, Ars Electronica, SIGGRAPH).

His PhD is on Touch and Technologies, see virtual-touch.wordpress.com .

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Rhythm Zoo: Music Composition Modeled on Genetic Networks

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Abstract

Inspired by the cyclical patterns of gene expression found in developing organisms, and the resonance these patterns have with rhythmic and harmonic cycles in music, our ongoing creative work focuses on the use of hierarchical Random Boolean Networks (RBNs) for musical creation. RBN models are widely used in scientific research to study the genetic networks underlying biological systems. A hierarchical RBN consists of multiple, interconnected sub-networks that run at different time scales. As a result, the sub-networks disrupt and influence each other's cyclical behaviors. In biology, these patterns of interference, which manifest in genetic networks, are what define biological structure: for instance, which part of an organism will become a head versus a tail. Inspired by the way that disruption creates biological structure, we use hierarchical systems of musical RBNs to create musical form and compose "musical organisms."

Keywords

Music, Biology, Random Boolean Network (RBN), Generative Art, Genetic Networks

A Case for Biological Art

Life on earth is filled with beauty, diversity, complexity, and even absurdity—many of the qualities artists often strive to capture in creative work. We believe that artists can learn from the billions of years that life on earth has had for creative exploration by taking inspiration from the processes that develop these qualities in living organisms.

DNA acts as the code for biological development and has been a source of inspiration for the development of a wide range of artworks, including music. Susumu Ohno and Midori Ohno's 1986 paper "The all pervasive principle of repetitious recurrence governs not only coding sequence construction but also human endeavor in musical composition" compares repetitions found in DNA sequences with the repetitions found in music, and suggests the possibility for creating music based on DNA as well as DNA based on music [1]. Other composers, musicians, and musician-biologist collaboratives have developed a variety of approaches to creating music based on DNA sequences as well as music based on protein amino acid sequences [2, 3, 4, 5].

In our work inspired by biological development we have been interested in the *interactions* between specific DNA sequences (i.e. genes). These gene interactions form what is known as genetic networks (Figure 1). One of the incredible and inspiring aspects of biological development is the process of converting DNA sequence information into complex, hierarchical structure with repetition at different scales. An organism is composed of a variety of large-scale structures, some of which can be repeating structures like ribs and limbs. Each of these structures can be composed of a variety of tissues, which in turn can be composed of many cells of a particular cell type. Each cell, in turn, is composed of varied, but repeated, molecules. Similarly, a musical composition possesses complex, hierarchical structure with repetition at different scales. A musical work might follow a sonata form or a rondo form composed of repeating sections and phrases. Within each of these larger sections, different rhythmic patterns, harmonic cadences, and melodic motifs can recur.

Our work extends Susumu Ohno and Midori Ohno's comparison of "repetitious recurrence" in music and biology to include the "repetitious recurrence" found in the complex hierarchical structures of both music and biology. With "Rhythm Zoo" we create "musical organisms" with musical form that is at once familiar and novel. We achieve this by creating algorithmically generated music modeled on the gene network dynamics that generate structure in living organisms.

"Rhythm Zoo" evolves from a nine-year investigation of biological systems as models for music composition, and is influenced by our backgrounds in evolutionary developmental biology, digital signal processing, music synthesis, art-science performance, and music composition.

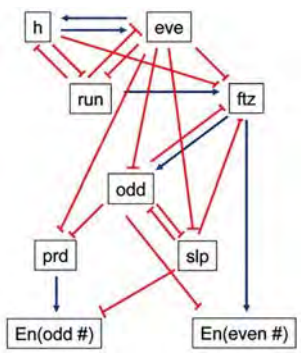

Figure 1. This is an example of a gene network [6]. Each node in the network represents a gene (e.g. 'ftz'). At any given time, a gene can be expressed (ON) or unexpressed (OFF). The expression of a gene is dependent on influences from other genes, represented by the interconnecting lines. A gene can inhibit (turn OFF) the expression of another gene (red lines) or promote (turn ON) the expression of another gene (blue arrows). The interconnectivity of the network results in complex patterns of gene expression that are critical to defining structure and pattern in developing organisms. This particular gene network is important in defining body segments in the beetle *Tribolium castaneum.*

Using Random Boolean Networks

Many breakthroughs in genomic sequencing have been made in the past half century, including the completion of the Human Genome Project in 2003. But even for species where the entire genome has been sequenced, much of the interconnectivity of the genome (i.e. the genetic network) remains unknown. Uncovering genetic networks is especially challenging for species like humans where experimental manipulation of genes is problematic.

Random Boolean Networks (RBNs) were first introduced by Stuart Kauffman in 1969 as simplified, computational representations of genetic networks [7]. RBNs have since been widely used in scientific research to simulate and study gene network dynamics in the absence of and in conjunction with wet lab experimental data.

An RBN is a randomly generated network containing a random number of nodes with random interconnections. The number of connections and the type of connections (promotion or inhibition) in the network are critical to the network demonstrating behaviors similar to those found in the gene networks of living organisms. Given an initial state, with certain genes expressed (ON) and others unexpressed (OFF), an RBN will pass through a number of expression states and then fall into a rhythmic pattern. Figure 2 shows the state space of a 13-gene RBN where 8,192 possible initial states fall into one of 15 rhythmic patterns.

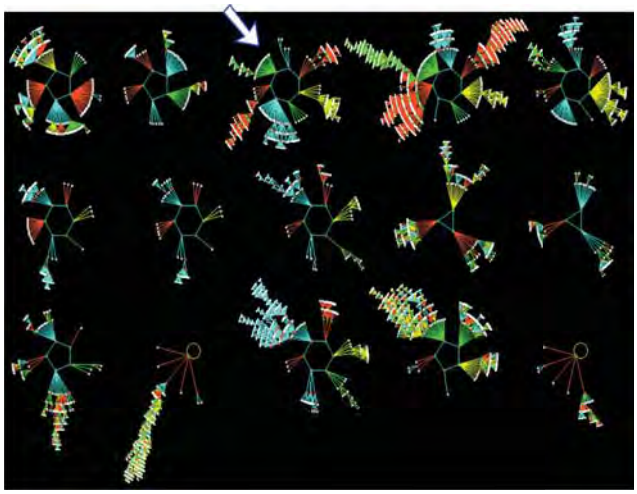

Figure 2. This figure diagramming a 13-node network is reproduced from a paper by Stefan Bornholdt [8] and adapted from an image by Andrew Wuensche [9]. The network has 2^{13} = 8,192 possible initial states. Each state flows into one of 15 attractor cycles (the polygons at the center of each of the clustered paths). The number of edges for each polygon corresponds to the number of "beats" for that attractor cycle. For example, the attractor cycle identified by the white arrow has 7 edges or "beats." This network can generate cycles with 1, 3, 5, 6, or 7 beats. From a network with only 13 nodes (genes or musical pitch states) springs the possibility for rhythmic and metric complexity.

In our "Rhythm Zoo," genes within an RBN are associated with musical tones (e.g. a piano note or a particular drum in a percussion ensemble) that are sounded when the genes are expressed. In biological networks, most expressed genes ultimately make proteins that give structure to a cell. However, some expressed genes, called transcription factors, serve purely as regulators of other genes. In our musical networks, some musical genes create musical structure (they produce sounds), while other musical genes act as musical transcription factors. These musical transcription factors are silent, but they act as regulators of other sound-producing genes.

The "Rhythm Zoo" has focused on hierarchical RBN systems with a number of RBN sub-networks and limited interconnections between sub-networks. This hierarchical approach is critical to creating complex "repetitious recurrence" at different structural scales. Key to this hierarchical approach is that each sub-network runs at a different timescale (e.g. one sub-network may be evaluated 100 times per second while another only once per second). This results in the disruption of one sub-network by another, creating abrupt shifts in musical texture and revealing large-scale musical structure. In one significant network configuration, one or more slow sub-networks, with silent regulatory musical genes, are connected to fast sub-networks with sound-producing genes.

Animals from the Rhythm Zoo

Our RBN system produces "musical organisms," some examples of which can be found online in our "Rhythm Zoo": http://www.askewmusic.com/RBNMusic.html. Our "musical organisms" are simulated in Matlab and sonified using a variety of music synthesis techniques.

"RBN Free Jazz," [10] one of the "musical organisms" featured online, was generated algorithmically using our RBN system and using sampled piano, bass, and drums without edits or post-production. At 18 seconds into the piece, a dense poly-rhythmic structure in the piano with an equally chaotic drum part gives way to a simple driving repeated pattern in the piano accompanied by a strong backbeat in the drums on 2 and 4. These changes occur without human intervention. This demonstrates the capacity of our multi-periodic RBN system to produce musical structure with dramatic shifts in texture and complexity.

Our RBN system was also used to create the score for *Beetle Bluffs* (2013) [11], an animated film by Anna Lindemann, developed in collaboration with the Harvard Museum of Comparative Zoology. The film illuminates the evolution of an adaptive color pattern found across nine Cuban beetle species. As a beetle's color pattern evolves in the film from 3m26s to 6m48s, the musical textures also evolve. The five incremental steps in the evolutionary process illustrated in the film were generated musically as a result of five instances of human modification to initial parameters defining a single musical RBN hierarchy. The music was realized using sampled synthesized sounds.

Conclusion

To our knowledge, our use of RBNs makes our project the first work of generative art modeled on the mutual interference of multiple genetic networks running at different time cycles. In biology, the patterns of interference that result from the disruption of one genetic sub-network by another are what define biological structure: for instance, which part of an organism will become a head versus a tail, or how many legs an organism will grow. Inspired by the way that disruption creates biological structure, we use hierarchical systems of musical RBNs to create musical form. This ability to generate macro-scale structure algorithmically is a novel and significant contribution to the world of generative art.

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Time Lens – Interactive Art Project

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Abstract

Time Lens is an interactive, multiplatform art project and a mobile App featuring a series of immersive panoramas documenting the rapid gentrification of an urban neighborhood in Philadelphia. Incorporated into these digital panoramas are the voices, stories, dreams and memories of members of the largely invisible homeless community.

A collaborative participation model is used to engage the community. We partnered with men from a homeless shelter to create photographs, videos and interviews of the neighborhood's past, present and future. At the core of the project is the idea of home and community and what these terms mean to people in the neighborhood. What are the cultural treasures and invisible markers that are wiped away to make way for the betterment of a neighborhood. What are the stories that are lost forever? What traces remain behind?

Users can download the App on their mobile devices and then follow along in the actual location and experience both the past and the present, the virtual and physical worlds all at the same time. The goal of *Time Lens* is to bring people to a specific location to participate in a transformative experience of that space, to infuse media art into the geographical landscape.

Keywords

mobile app, interactive art, interactive documentary, social practice, augmented reality, gentrification, homeless, landscape

Introduction

Time Lens is an interactive multiplatform documentary art project and mobile app featuring immersive panoramas documenting the rapid gentrification of an urban neighborhood in Philadelphia. Incorporated into these digital panoramas are voices, stories, dreams and memories of members of the largely invisible homeless community. Users can download the app on their mobile devices and then follow along in the actual location and experience the past and the present, the virtual and physical worlds all at the same time. The goal is to bring people to a specific location to participate in a transformative experience of that space, to infuse media art into the geographical landscape.

The story of Chinatown North and Pearl Street is representative of the stories of change that are affecting many urban neighborhoods in the United States. At the core of the project is the idea of home and community and what these terms mean to people in the neighborhood. What are the cultural treasures and invisible markers that are wiped away to make way for the betterment of a neighborhood. What are the stories that are lost forever? What traces remain behind?

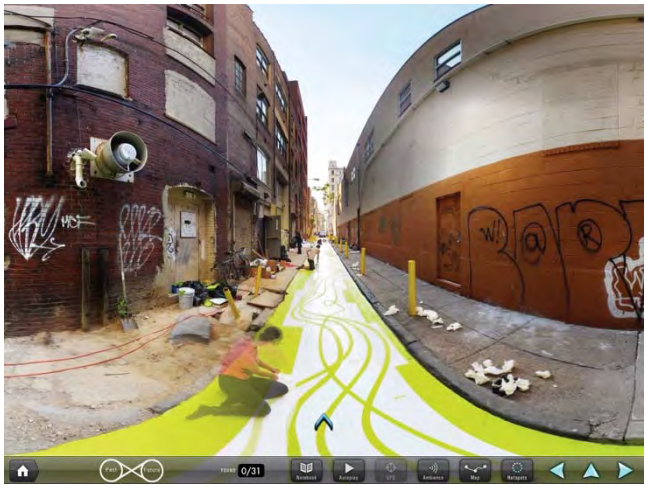

Figure 1. *Time Lens App – Panorama 1230 Pearl St view to west.*

Time Lens experiments with the concept of experiencing multiple dimensions of a place. This allows audiences to question their own role in ongoing transformation of a neighborhood. The project was developed as part of the Asian Arts Initiative's Social Practice Lab and funded by ArtPlace. The *Time Lens* mobile app is retrieved from https://itunes.apple.com/us/app/time-lens-pearl-street/id706525884?mt=8

Project Background

Our work is an evolving combination of interactive documentary and socially engaged participatory media. One of our early inspirations is the work of video artist Janet Cardiff whose Video Walk projects (San Francisco MOMA 2001) try to merge the "virtual' and "real" worlds. By "lining up" video content with the architectural space, her videos match the perspective of the audience. Layers of real and recorded sound overlap, creating a rich and ambiguous sense of space. In our location-based projects, we create works that explore urban spaces through multiple layers of time and community stories.

The questions we are interested in exploring as part of our process include:

- How do we explore the meaning of place and home in the context of change and the passage of time?
- How can we create explicitly place-based art that is deeply rooted in the communities and locations it documents.
- How can we facilitate, capture and organize community memories and histories so that we can create an entryway to learn about a place?
- How can new multimedia technologies like Apps, augmented reality(AR) and virtual reality (VR) be a platform for creative and community storytelling?

Implementation

We are interested in what Pablo Helguera, in his book *Education for Socially Engaged Art*, calls a "Collaborative Participation Model." As we engaged in the process of creating *Time Lens*, we had to gather information about what the community wanted and establish a relationship of openness and trust, while also striving to create a work that we felt expressed our own vision for the project.

The themes of place, home, identity, disadvantaged populations, and forgotten histories resonate in *Time Lens*. The gentrification of the Pearl Street neighborhood is leading to the displacement of many residents, including the homeless who live in its alleys and who are served by the homeless shelter, Sunday Breakfast, which occupies a prime location in the neighborhood. Many of the homeless men have long been deeply connected to their location and community. The broader community and neighborhood development committee are frustrated by the very existence of the homeless shelter, in fact, because it reduces property values. However, when it is the homeless who are operating the cameras and asking questions about the future of the neighborhood, it changes the conversation.

Figure 2. Bioscope mobile video installation.

We collaborated with men from the shelter to create photographs, videos, and interviews of neighborhood's past, present and future. The men received training in photography, video production and creative non-fiction. Then we developed the App to link the stories to the specific spatial locations.

To bridge the gap between the virtual and the physical worlds, and to find a way to share the project with the community, we drew inspiration from a travelling cinema device that is still used in remote villages in India today – the Bioscope. It is a wooden box, the interior of which has pictures that are viewed through four circular holes. We are excited by the symbolism of the bioscope as a dream-making machine of the past as well as the community-viewing interaction and experience it fosters. For the premiere of *Time Lens*, we created a solar-powered Bioscope video installation with four interactive iPad screens and viewing portals. This allowed for audience interaction and input with the project on the actual streets. It was incredibly moving to witness the special moments at the project launch – the homeless men experiencing and interacting with the final product of their creative efforts, as well as visitors and passers-by recognizing the men and talking to them about their stories.

Figure 3. *Collaborative Participation Community Workshops*

Film scholars Patricia Zimmermann and Helen De Michiel have coined the term "Open Space Documentary" to describe participatory media experiments that are proliferating across rapidly evolving distribution platforms. They reveal how mobile devices, apps, and social media are liberating artists to explore new ways to frame community activities as creative practice and to weave them into a larger social fabric of history and memory.

Technical Approach

Time Lens expands and builds upon our previous locative media work, *Explore Hawai'i Volcanoes* [Fire Work Media 2014] and *Walk Philly* [Termite TV Collective 2008-15]. [1, 2] By adding the dimension of time and community engagement, we maximize the participatory potential of augmented reality and location aware mobile media technologies. Using a combination of GPS and physical landmarks, time-lapse spherical panoramic sequences (32 images) are captured sequentially in each location by a robotic tripod over a period of 3 years. Tagged onto the panoramas are community generated historical and social markers in the form of videos, interviews and photographs.

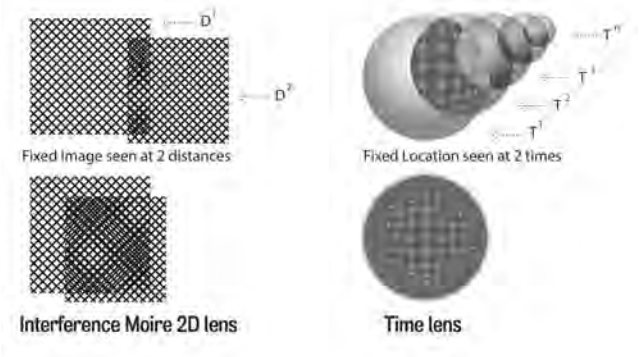

Figure 4. *Temporal Interferometry*

The project uses the dimension of time as way to experience a place. When panoramas of a specific location from different times are blended, it creates a lensing effect, a temporal interferometer, allowing insights into a location's multiple temporal incarnations. On each location of Pearl Street, viewers can look at and reflect on the past, present and future.

The Autoplay scripting function of the app creates an ability to script a path through documentation location to location along the street and also to the past or future of that location. Through the Autoplay function, a scripted narrative path can be woven into the space-time matrix of panoramas.

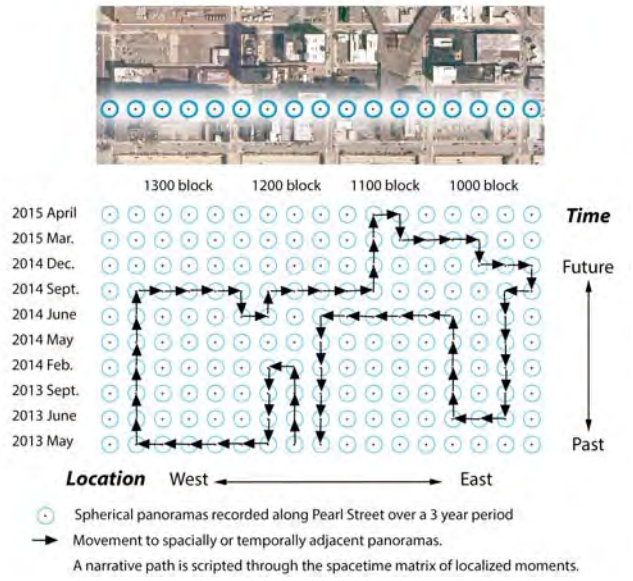

Figure 5. *Scripted Spacetime Path on Pearl Street Philadelphia*

Future Work

In our future work we will continue the longitudinal study of the Pearl Street neighborhood in Philadelphia, broaden community involvement, broaden the project's access and compatibility to include Google Android and build more interactive components. The *Time Lens* model will be further developed in additional locations to facilitate informed community engagement.

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Figure 6. Panoramas of 1219 Pearl Street, Philadelphia, USA - September 27, 2013 and February 11, 2014

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Anthropomorphic Things: Disrupting the Boundary Between Subject and Object

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Abstract

This poster presentation displays visual documentation of my practice-research investigations into the forms and materials that evoke the uncanny with the illusion of presence. I found that such uncanny experiences of presence are evoked by objects that are human in form and proportions, by objects that are placed within a narrative structure, by objects that move autonomously, and by objects whose motion is responsive to the viewer. I also argue that uncanny experiences are an important subset of aesthetic experiences because such experiences challenge us to face our fears and deep-rooted assumptions, thus forcing us to question our presumptions about what it means to be human. The question that informs my practice is: what elements push an object toward forming a seemingly sentient identity? This question is addressed through theoretical investigations, through experimentation within studio practice, and through observations of the artwork and its viewers. The culmination of this study is a series of human-sized uncanny objects (which I describe as sculptural puppets or minimal robots) that disrupt our perception of lifelikeness.

Keywords

Figurative Sculpture, Puppetry, Robotics, Uncanny, Lifelikeness, Presence, Human Condition

Introduction and Overview

This project integrates knowledge and methodologies from sculpture, puppetry, and robotics to create aesthetic experiences of 'presence'. The artistic outcomes are relatable freestanding humanoid creatures, with human dimensions, and some autonomous motion, that convey the illusion of a living presence, as well as personality and character. The intent is to instigate reflection on how we emotionally connect with lifelike objects within a cultural context in which robots (objects with presence) are starting to become commonplace across society. I describe my works as minimal robots, with just enough motion and response to create a momentary illusion of life. In my investigation into how to create the illusion of lifelikeness, I found that this sensation is evoked by objects of human scale with anatomically correct proportions, by objects with autonomous motion, and by objects that mechanically respond to the viewer. I also explored how to convey personality and character, and found that while maintaining neutral facial expressions, I can convey personality through materiality, costumes, and (minimally simple repetitive) behaviors. I position my artistic output somewhere between puppetry, an ancient art that has always relied on the illusion of a living presence as a means of expression, and figurative sculpture, which uses the visual language of the human body to create an experience of contemplation. In the process of creation, I review studies in robotics that reveal how to design lifelike creatures that communicate specific emotions, as well as studies that examine how humans interact with affective robots. My artistic output is further informed by documenting observations of the creation process and of viewer's interactions with the artworks. I found that I was able to create playful situations for those who encountered my creations.

Motivation

The desire for 'presence' is a fundamental human craving, as we are social animals, and uncanny experiences of 'presence' with objects can be pleasurable or thought provoking or playful. My artistic production intends to create these types of experiences, and to instigate reflection on the boundaries between subject and object within a contemporary cultural context in which objects (such as robots) are becoming increasingly personalized and personable. With advancing technology, there is an ever-increasing use for robots in applications that involve personal interaction with humans. [1] [2] [3]

This arts-based study intersects with the field of human-robot interactions, addressing the question of how an object can evoke a sense of presence and take on a personality. I also address the uncanny valley [4] [5] – the point at which the illusion of lifelikeness provokes feelings of discomfort; I examine how to avoid it as well as how to use it to instigate reflection about our presumptions of humanness. [6] The study of human-robot interaction is becoming very important as technology moves towards the use of robots for companionship, and this is a scientific field in which aesthetics will play an increasingly important role. [7] [8]

This work looks beyond human-robot interactions with a review of the history of puppetry and a survey of figurative sculpture, which reveals that uncanny objects with presence play an essential role in aesthetic social criticism. [9-19] The act of looking at and reflecting on images of our

selves, of our fellow humans, is the most fundamental way by which to contemplate the human condition.

Anthropomorphic Things

Suzana Jofre

Suzana Jofre, shown in Figure 1, is a 6-foot tall marionette with articulation at her head, shoulders, elbows, wrists, and knees. She has been in performances in which I am manipulating her strings, and performances in which her strings are drawn by motors (http://youtu.be/eI7njlHzLUA). A sensor triggers her head to turn towards the viewer when standing beside her.

Suzana's style of dress is inspired by the canon of Camp aesthetics, which includes women's clothes of the twenties, feather boas, and short bangs. [20] Susan Sontag's 1964 seminal essay "Notes on Camp" equates an appreciation of camp with an appreciation for the arts of the masses or 'folk art'. [20] My references to Camp and to puppetry (a folk art) point to the pragmatist view of aesthetics I hold.

I left the face artificially white, in part to reference the artificially heavy make-up of Camp glam, but also to allude to Suzana Jofre's own artificial nature (is it less uncanny if it doesn't try to 'fool' us?). I also used intentionally visible and decorative strings to directly state her marionette nature.

Figure 1: Suzana Jofre ©2014 Ana Jofre

Figure 2: Joana Jofre. ©2014 Ana Jofre

Joana Jofre

Joana Jofre, shown in Figure 2, is a 5-foot tall figure with articulation at her head, shoulders, elbows, wrists, hips, and knees. Her face and postures are intended to look naturalistic, so as to almost 'pass' as human, and when placed in a gallery setting, she gently taps her hand on a table (https://youtu.be/zXZvZ6wsRAw). This character was used for public interventions/performances, in which she was placed in public settings, such as bars, cafes and parks.

Figure 3: Joana makes friends at the park. ©2014 Ana Jofre

This poster documents interactions with the public during interventions. For example, figure 3 shows one of many episodes that occurred when taking her out to a public park. I found that people were quite eager to engage in playful acts upon encountering her, and that taking selfies was a particularly popular form of engagement.

Monster Jofre

Monster Jofre, shown in Figure 4, is a 5-foot tall minimal robot that exhibits a breathing motion (her chest rises and falls), and she turns her head towards the viewer when the viewer stands next to her. (The following two videos document her motion: https://youtu.be/kLqnFAuyzAE and https://youtu.be/LBNugZP7bds). Her arms are free to move at the shoulders, elbows, and wrists. Here I explore the notion of the uncanny by means other than creating a human double. I challenge preconceived notions of the feminine by covering her body in fur, while giving her a clearly female form. There is a playful ambiguity in her fur, since she is also wearing furry boots, and this implores the viewer to question whether she is a weird topless creature or a human wearing a furry costume.

The unexpected is also an important element of the uncanny, and so Monster Jofre has a third hand that appears on her left breast. I added this extra hand because I found that almost everyone who saw her wanted to touch her large furry breasts. So the hand is placed such that it appears to be holding her left breast, addressing the viewer's possibly repressed thought of wanting to touch it. [21]

Figure 4: Monster Jofre ©2015 Ana Jofre

Conclusions

I used a reflexive methodology to produce a series of objects in which I evoked the illusion of a living presence, and generated a site for uncanny experiences. I found that the illusion of presence was invoked by objects of human scale with anatomically correct proportions, by objects with autonomous motion, and by objects that mechanically respond to the viewer. Furthermore, my characters, despite all having a rigid neutral facial expression, each have a personality that was expressed through their materiality, through their costumes, through their limited actions, and through how I performed with them.

I was able to use my humanoid sculptures to create playful interactive experiences, experiences that hinge on the uncanny: engagement often started with a startled utterance that breaks into laughter. The uncanny here is provoked by the illusion of presence, and illusion is accepted and sustained through deliberate acts of play.

The contribution to sculpture offered by this work is an integration of puppetry and robotics into the discipline so as to introduce a new way of seeing sculptural objects, not just as forms that interact with space, but also as personalities that interact with people.

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Antikythera: Tactile audiovisual poetry app for tablets

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Abstract

Antikythera is a tactile, generative and interactive audiovisual poetry artwork for iPad and other tablet devices. It is based on the *Antikythera mechanism*, the ancient analog computer from c. 100 BC Greece, found in the Aegean Sea in 1900. It links together poetry, new technology, visual and sound art, and researches and explores new forms and possibilities of digital narratives from broken chronology and randomness to determined paths of reading/viewing and lines which change their meanings by the reader's touch.

Keywords

Generative art, Disruption, Tactile interfaces, Audiovisual poetry, Digital narrative, Tablet computers, European cultural history.

Extended abstract

Figure 1. *"When the dark wakes up, it is too late, a lamp is lit already."* When opened, the *Antikythera* app will choose a storyworld and daily verse based on the current moon and seasonal phase (according to the tablet's calendar). The reader may, of course, choose differently. ©Crucible Studio / Shakti Dash 2015.

Antikythera is a tactile, generative and game-like poetry application for iPad and other tablet devices. It is based on the *Antikythera mechanism*, the ancient analog computer from c. 100 BC Greece, found in the Aegean Sea in 1900.

Within the context of the artistic research of Storytelling in New Media,[1] the application is experimental and voluminous; it contains over 200 poems written for the mechanism. The artwork links together poetry, new technology, visual and sound art, and researches and explores new forms and possibilities of digital poetry: broken chronology, randomness and determined paths of reading, locked poems which open procedurally, games, visual and animated poems, temporality, disappearing and appearing poems, poems where verses change their places from one poem to another, words and lines which change their meanings and react to the reader's physical actions, her/his touch and movement of the tablet.

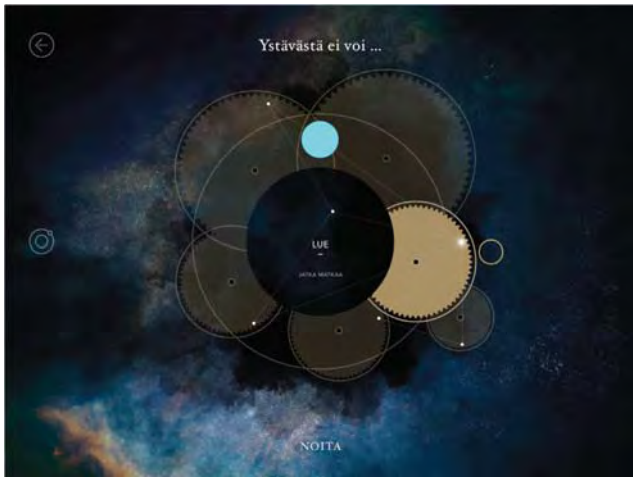

Figure 2. *"A friend cannot…"* Thematic connections between the six storyworld gears (*The Witch* portrayed) are displayed via constellations that enable reader to move between the worlds. ©Crucible Studio / Shakti Dash 2015.

The *Antikythera* collection of poems has six parts – or storyworlds, presented as the gears of the mechanism – each part containing 32 poems written for 32 different themes (e.g. love, transition, death etc.). ***Zeppelin Letters from***

[1] "Crucible Studio studies storytelling systems in the context of interactive and performative media environments, technologies, and cultures. In our view, narrative agents – author-directors, actor-performer-players, and audience-followers – enact *situated* and *sensuous storytelling* as their *embodied expression* of the *shared experience*." http://crucible.mlog.taik.fi/introduction/ [25 May 2015]

The Hindenburg *(Ilmalaivakirjeet Hindenburgilta)* is about young *Adele* and *LZ 129 Hindenburg's* last journey in 1937. ***Labrys***, the feminist and feminine version of the story of *Ariadne*, is set on the *Treblinka* extermination camp. ***The Witch*** *(Noita)* tells about the 17th century witch-hunt in *Finnmark, Vardo Island*, Norway. In ***The Empress*** *(Keisarinna), Elisabeth of Austria* monologues about restlessness, rage and lack of freedom. ***Images of Artists*** *(Taiteilijakuvia)* is situated in pre-war *Vienna* and discusses poverty, art, love, sex and artist's muses via two voices: *Oskar Kokoschka*'s doll of *Alma Mahler* and *Egon Schiele*'s lover *Valerie Neutzil*. ***Town Stories*** *(Kaupunkitarinoita)* imagines a medieval European town with a whole new set of little ghost and horror stories between poetry and prose – it's about poverty, evil and horror.

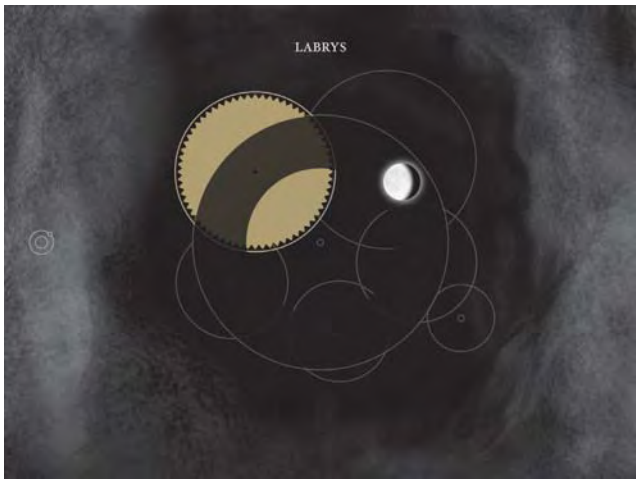

Figure 3. Section selection interface depicting the artwork of *Labrys* in background with the associated moon-phase. ©Crucible Studio / Shakti Dash 2015.

There is also an ***Oracle*** in *Antikythera*, divining mechanism based on the "free verses" of all the poems in the thematically organised database. The database also provides the reader with date, season and moon phase sensitive daily verses via the moon interface traveling in astronomical real-time unless interrupted: the cosmos goes on unless a reader pauses it.

Based on awarded poet **Saila Susiluoto**'s overall idea and concept, *Antikythera* presents her latest collection, co-dramatised for New Media by director **Mika 'Lumi' Tuomola**, visual art and interface design by **Shakti Dash**, sound art & design by **Antti Nykyri**, and system architecture by **Rasmus Vuori**. As part of the **Aalto University ARTS** Department of Media research group **Crucible Studio**'s artistic research, the app is being technically finalised for the Finnish Apple App Store during Spring-Summer 2015 by the **Taiste** production company. The public launch – together with Susiluoto's ***Ariadne*** book (published by **Otava**) that is a transmedial part of the storyworlds of *Antikythera* – will take place in **Media Centre Lume**, Helsinki, Finland, on Friday 21 August 2015. *Antikythera* will also be presented as an immersive installation piece, designed by architect & media artist **Jaakko Pesonen**, 20-30 Aug 2015 in the **Helsinki Observatory** gallery as a part of the Helsinki Festival (14-30 Aug) events Poetry Moon (Runokuu) and Media Facades.

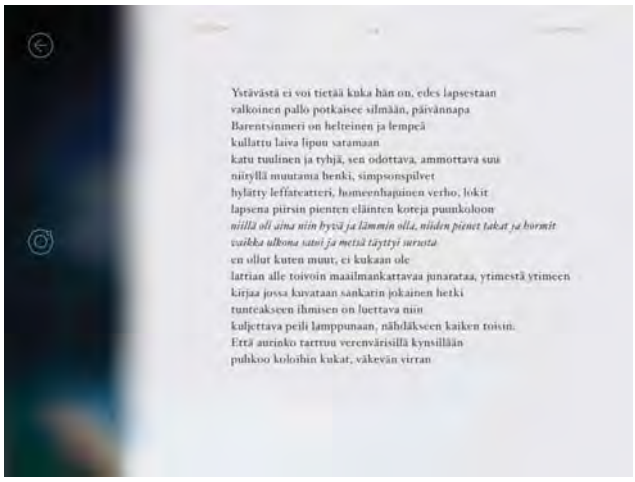

Figure 4. *"A friend cannot be known, not even one's own child…"* The tailored and physical movement responsive reading layer engages the storyworld traveller. The animated poems that may for instance slide on the screen, create new shapes and transform textually into variations of themselves according to the rules authored for the database. The read poems appear as new constellations on return to the gear mechanism. ©Crucible Studio / Shakti Dash 2015.

The requiring poetic translation of *Antikythera* into English is expected to take place early 2016. Meanwhile, for both the non-Finnish and Finnish speaking storyworld travellers alike, the app's tactile mechanism hopefully makes it a pleasurable instrument for playing sound and visual art.

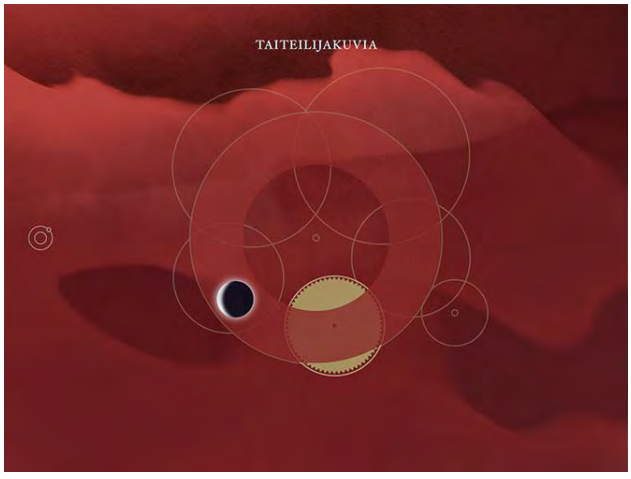

Figure 5. *Images of Artists.* The background art and soundscapes change according to the chosen storyworld gears, so that *Antikythera* may be played like an audiovisual instrument disc-jockeyed by the reader. ©Crucible Studio / Shakti Dash 2015.

Figure 6. The six storyworlds of *Antikythera* take the reader-traveller to a journey through the deep-blue cosmos of *The Witch* to the dark tunnels of *Labrys*. ©Crucible Studio / Shakti Dash 2015.

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Author biographies

Saila Susiluoto is Helsinki-based, awarded Finnish poet, who has investigated generative poetry since her *Huoneiden kirja* (*A Book of Rooms*, Otava 2003) collection. She's published eight collections of poems and nominated for the Nordic Council Literature Prize in 2012. Her poems have been translated in 14 languages.

Mika 'Lumi' Tuomola is internationally awarded writer, dramaturge and director for New Media since "Daisy's Amazing Discoveries" (Coronet Interactive 1996), one of the first interactive audiovisual narrative productions online, and the co-founder and director of Crucible Studio, the New Media Storytelling research group at Media Lab Helsinki in the Department of Media at Aalto University School of Arts, Design and Architecture, Finland. September 2015 he will start as professor of narrativity in Scuola del Design, Politecnico di Milano, Italy.

Shakti Dash is a multidisciplinary visual designer (UI-UX-typography) with specialist concentration on New Media Storytelling and experimental sound and music. Currently, he's lead designer at Tellyo Ltd and visual designer at Nordkapp Ltd.

Antti Nykyri, Helsinki-based Finnish artist, has worked with sounds and music in several contexts such as installation art, contemporary dance, sound art, application design, interface research, theatre, electronic music and artistic research. During 2015 his works will be on display at the Venice Biennale, Prague Quadrennial and Gwangju Design Biennale. Nykyri is preparing his doctoral work for University of the Arts Helsinki, Theatre Academy.

Rasmus Vuori is an internationally awarded systems architect and programmer for New Media productions that have included e.g. the Prix Möbius Nordica 2006 winner *Obsession* (dir. Pia Tikka). He's currently the head of studies (MA in New Media at Media Lab Helsinki) and lecturer at the Department of Media, Aalto University School of Arts, Design and Architecture, Finland.

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AVB – A New Protocol for Multi-Channel Multimedia

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Abstract

AVB (Audio/Video/Bridging) is a new open standard for distributing real-time multimedia signals over standard Ethernet infrastructure. Its goal is to replace ad-hoc computer interfaces with an easy to use, well-written, open, industry standard. We will demo a multi-channel sound installation running using Meyer speakers running AVB.

Keywords

Audio, Video, Multimedia, Open-Source, Protocol, Installation, Mult-Channel, Demo

Introduction

Currently it is very challenging for a sound artist to create multi-channel works using a computer. It is even more challenging to create multimedia art works that are "transferable", i.e. a technically challenging work that a physically distant museum could set up with without the artists' direct involvement. The goal of Audio/Video/Bridging (AVB) is to solve these problems with a well-written, open, industry standard. The standards body behind AVB is The Institute of Electrical and Electronics Engineers (IEEE), the same industry trade group responsible for the 802.11x wireless Ethernet standards. These thoughtful standards, with broad industry support, have revolutionized computing. It is possible to take a Mac, iOS, Linux, Android, or Windows device into any coffee shop and connect to a wireless Ethernet network. No proprietary drivers, special interfaces or dongles are needed. AVB should do the same for multimedia.

The Problem

Intermedia artist often struggle with technology to create multi-channel audio and video works using a computer. It is even more challenging to create works that are easy to install without the artist's physical presence. For example, if a sound artist has an interactive 8 channel audio composition, the setup might look something like this: A Mac Mini computer connected by USB to an interface (from a company such as MOTU, Focusrite, etc) would run audio software such as Pure Data (PD) which creates the audio and then send it to the interface. This interface might have 12 analog input channels, 4 output channels, and MIDI I/0.

The unit requires custom drivers from the manufacture to operate on the Mac Mini. For simplicity lets assume the whole piece is performed using the open source (and free) software package PD. And for the sake of the artist, let us assume the first performance goes well, is documented satisfactorily and garners interest from another venue.

How would the sound artist "sell" or loan this piece to a museum in another state? Even if the museum has a Mac Mini, most likely they have a different audio interface; for example, instead of a MOTU USB audio interface they own a Firewire Focusrite interface. While these two units are functionally equivalent (they both have 12 analog inputs, at least for analog outputs, MIDI I/O) each require a proprietary driver, and each maps inputs and outputs differently, and their interface to PD is different as well. So unless the museum in question has an interactive audio expert, there is very little chance that a suitable setup could be configured to perform the audio piece. Currently the only solution is to ship all the hardware (the artist's own computer, interface, loudspeakers, microphones, cables, etc) to the gallery, but even then the setup is arduous. Now, imagine that in addition to multichannel audio, the artist also has multi-channel video and the problem expands exponentially.

The Solution

AVB seeks to standardize real-time multimedia content creation, distribution, and performance around ubiquitous CAT5e Ethernet infrastructure. It utilizes well-established technologies as well as real-time clocking protocols to create a driverless and open standard that, like wireless Ethernet will "just work" in the majority of use cases. AVB was developed to add three major improvements to the current 802.11x protocol:

1. Precise timing to support low-jitter media clocks and accurate synchronization of multiple streams,
2. A simple reservation protocol to allow an application on an endpoint device to notify the various network elements in a path so that they can reserve the resources necessary to support a particular stream, and
3. Queuing and forwarding rules that ensure that such a stream will pass through the network within the delay specified by the reservation. [1]

For example, A MOTU AVB audio interface, when connected by CAT5e to any Mac Mini, will self-configure, and all the input/output channels on the device will be registered automatically with Apple Core Audio without the need to install drivers. Since PD also "speaks" Core Audio, it is simple to write a program which associates input and output channels with the artists PD code. This could even be scriptable with python. So for example, when the artist from the example above emails the eight channel composition as a PD file to the Museum, when the curator plugs in a Focusrite AVB interface, the input output channels are automatically registered with core audio, the Pure Data python script finds and maps the inputs and outputs it needs automatically, and the piece is ready to go. Of course there will always be some gain and EQ adjustments needed for pieces performed in different venues, but the promise of AVB is that the time saved in not struggling with driver downloads, USB latency issues, etc will make these types of performances far easier. And since AVB is an open standard it will be possible to amend the standard as we gain experience with what is needed for truly seamless setup.

The current AVB standard allows for 100 audio channels at 24-bit, 96k, distributed over seven AVB enabled switches, with guaranteed quality of service (QoS), sample synchronous output, and latency measured in the low microseconds, vs. milliseconds with Firewire or USB audio interfaces. This was calculated using the AVB Bandwidth Calculator written by Jeff Koftinoff which can be found at https://abc.statusbar.com/.

The Promise

The promise of AVB is not just that it can standardize Firewire and USB audio interfaces. Because it is based on Ethernet protocols, it becomes possible to utilize much larger channel counts for sophisticated next generation multimedia artistic compositions. For example, the "state of the art" computer interfaces currently max out at about 20 input and 20 output channels, while video tops out at about 5 channels for a single computer with multiple video cards. The technology for creating a 128 channel multimedia works exists but is prohibitively expensive for experimental or student artists. For example the Meyer Sound LCS series, utilized by Cirque du Soleil, can provide up to 500 audio input and output channels but the cost is in the mid six figures. Trying to use multiple interfaces on a single computer is an exercise in frustration, and there is no guarantee of latency or sample synchronicity.

There are some commercial, proprietary systems for high channel count audio systems (Cobranet, Dante, etc), but as single company proprietary standards they inhibit the emergence of a full interoperable ecosystem of devices. They require specialized driver downloads and sometimes need that company's hardware, not to mention they are extremely expensive. Therefore they are not very useful for the creation of multimedia and multichannel artistic compositions.

AVB will enable artistic compositions with hundreds of channels of audio playback and hundreds of channels of audio input or gesture input. It uses a distributed network of devices to play back media content with high fidelity and excellent user experience. Basically it lets users place audio devices and video devices wherever they want, and use the network to distribute and synchronize the resulting rendering. [2] Of course experimental multimedia is not the driving force behind AVB, it will have applications in any kind of system which needs to transmit time-sensitive data. The automotive industry is especially interested in this protocol as a way to control cars from a distance. [3]

AVB is an emerging technology; it has growing industry support, but it is not yet mature. As early adopters we have the chance to request features from the engineers working on this exciting new standard for content creation and content delivery with accurate time synchronization. Our demo will show a fully implemented multi-channel AVB system.

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Coding to Create Art in 1975

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Abstract

Early computer aided drawings were created in 1975 using Fortran, CalComp subroutines and a CalComp Pen Plotter. The gesture of making a mark was envisioned and experienced through the mathematics, the code and the drawing process. Making an image of something normally invisible to the human eye, came to fruition through this process. Wind gusts blowing against one's face, and light waves reflecting off of irregular surfaces were 'imprinted' on paper through the digital process. I incorporated mathematical formulas that described invisible phenomena from the natural world, into Fortran programs. In order to create drawings from this code, I integrated CalComp subroutines into the programs to implement instructions for the pen plotter.

My intention to create expressive drawings using the computer and pen plotter in 1975 disrupted the normal studio practice at that time. As my hand was not holding the pen, or the brush as it moved across an artist's canvas, there was early skepticism about the expressiveness and the craft of this process. I had an intimate relationship with the programs I developed and thus created very expressive drawings.

Keywords

Computer Aided Drawing
Computational Drawing
FORTRAN Programming Language
CalComp Pen Plotter
CalComp Subroutines

Abstraction

Forms change in the process of creative expression, creating dialogues about media and realms of art-making. Kandinsky explored the ideas of abstraction of form and substance, moving away from representational painting, creating planes of abstracted forms in rich colors. Representation and realism in painting was also threatened with the evolution of photography, as some thought it would replace painting. The integration of computers and coding into the process of artistic expression created a radical shift in the nature of creative studio practice. Waves of disruption in traditional approaches came with the introduction of numerous electronic devices into the field. The contemporary expansion of the digital studio invigorates and inspires the creative process. New processes such as computational photography and materials and equipment including 3D printers bridge the virtual and the physical realms, between the abstract and the real.

My drawings expressed physical forces in the natural world that are normally invisible to the eye. The movement of air currents, sound, and light waves are intensely visceral, yet invisible. My drawings create the sensations of these experiences. A sense of fluidity and movement resonate in these line drawings. They express the invisible forces embodied in the code. The drawing in Figure 1 illustrates the dynamic trajectory and resonance of the natural world.

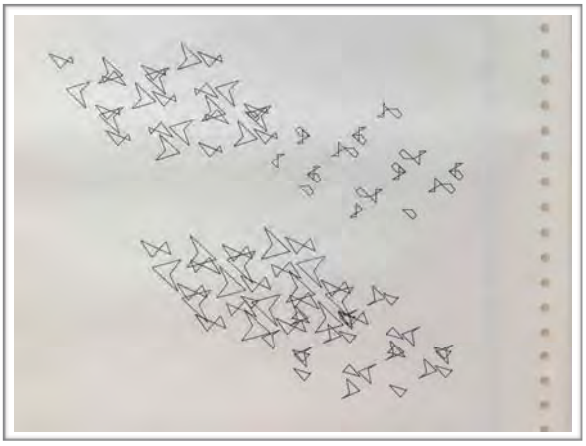

Figure 1. Computer -Aided Drawing 1975
Black ink on sprocketed plotter paper, 12 " Wide.

Digital Drawing

Writing my drawing programs, I created a series of data sets to be drawn by the CalComp pen plotter. Communication with the mainframe computer was through punched cards, much like those used to weave with a Jacquard loom. Each line of code was punched onto a computer card using a keypunch machine. Consequently a program occupied a shoebox full of punched cards. These decks of punched cards were

transported to the computer center and placed in a card reader which communicated the code to the computer. After four or six hours, sometimes 24 hours, a printout of the program and the data was provided. Upon reviewing the code on the printout, the data for the drawings was transferred to a large 16 BPI tape upon request. This tape was in a plastic disk approximately 18 inches in diameter. The tape was taken to the Geography Department where the pen plotter was housed. Technicians mounted the tape on a tape reader, and based on the data, the drawings were drawn out on 12 inch or 30 inch sprocketed rolls of paper.

Cartesian Coordinate System Verses Free Hand Drawing

Code has become an integral part of the contemporary art studio practice. Coding for plotter drawings and for contemporary 3D printing is based in the framework of the Cartesian coordinate system. This framework does not predispose the character of the output to linear, regular forms. The malleability of programming disrupts the linear nature inherent in the Cartesian system, and the repetitive functioning of computers. Coding creates a malleability parallel to that of actual clay. The intent of the artist determines the forms, not the process of coding or the framework of computing.

Digital Physicality

Abstract mathematical formulas that describe invisible phenomena in the natural world remain virtual in their formulaic state. Using a pen plotter these phenomena can be made experiential. Line drawings are created to express these phenomena, and to create an impression of the experience. Scientifically programs use mathematical descriptions to simulate a phenomena, or to represent it. The artist sculpts or molds the geometry into their own vision through coding. Digital descriptions are malleable and given form by the artist through the code.

Color

These early drawings were plotted in a Geography Department that used the plotter to create maps. At that time they used only black ink for the drawings. Envisioning color drawings, I used color xerography to introduce color into the drawings. I created a series of related drawings , each of which would be transferred into individual colors, each on a transparency. The individual color transparencies were overlaid into compositions. The drawing in Figure 2 is a composition created with four individual drawings.

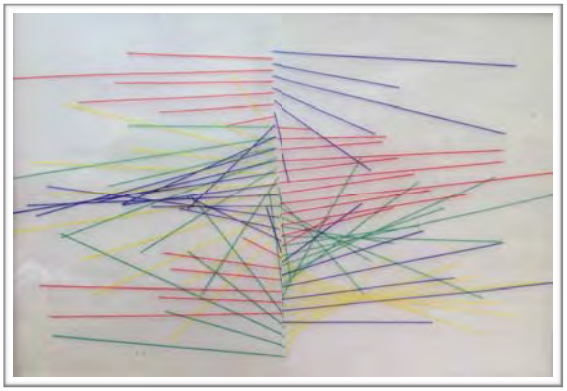

Figure 2. Fourier Transform 1976
The collection of the Block Museum of Art at Northwestern University in Evanston Illinois.

These drawings are in the collections of the Block Museum at Northwestern University in Evanston Illinois and the Art Museum at Northern Illinois University in DeKalb Illinois. The Illinois State Museum has a large collection of drawings that are currently being conserved and prepared for an exhibition in the near future that will include copies of actual Fortran programs. Individual collectors include Eduardo Kac of Chicago and Peter Thompson of Copenhagen. This collection is represented by the Black Box Gallery in Copenhagen.
blackboxgallery.com

These drawings with other early artwork are at joantruckenbrodart.com

Author's Biography

Professor Truckenbrod began working with mainframe computers in 1975 creating a series of computer drawings expressing invisible phenomena in the natural world. Using Fortran Programming Language and a Calcomp Pen Plotter, she explored the creative potential for digital artistic practice. In addition to writing and developing code, she used computers to create computer imaging, digital painting and to develop interactive installations. This artwork has been exhibited internationally. In 1988 she published a book titled *Creative Computer Imaging*. She was on the faculty in the Art and Technology Program at The School of the Art Institute of Chicago for 25 years. Currently she is creating *video sculptures*, juxtaposing video and sound with objects. This work is documented in a book published in 2012 titled *The Paradoxical Object: Video Film Sculpture* that includes installations of artists who have inspired her work.

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Collaborative Disruption: Video vs Object vs Video

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Abstract

Video sculpture is disruptive, both to the behavior of an object, and to the linear sequence of the video imagery. Objects have a vital impetus that acts upon the video as it permeates the object. This is an assemblage of unlike material and ephemeral forces combined in an interactive collaboration. Artists like Tony Ourlser, Joan Jonas, Krzysztof Wodiczko and Bill Viola have inspired this artwork. Confronted with an emotionally distressed facial image peering out from under an overturned chair is a highly charged experience for the viewer in a art gallery. Tony Oursler's installation *Stone Blue* projects this distressing video imagery with a confrontational dialogue, into a large ordinary pillow shaped like a body, disrupting the neutrality and passive character of the white pillow. Krzysztof Wodiczko projects facial imagery on to exterior of the dome on the Centro Cultural de Tijuana, disrupting the role of the building or architecture. Other artists including Ann Hamilton, Susan Collins and Anti VJ in the architectural projection "Desherence" have incorporated video projections to disrupt the flow or narrative in their installations.

Keywords

Video Sculpture, Physicalizing the Image, Chinese shi, African aale, Memory Work, Vigilant Things, Vibrant Matter

Introduction

Digital imagery occupies a precarious position between flat surfaces and material objects, between simulated three dimensionality and the physical world. Mostly the image is inseparable from the page or membranes which are not involved in the meaning, emotion or expression of the content of the imagery. In video sculpture images are propelled into objects which are embedded with social, cultural, economic and even political issues. The narrative of the video projection, and the visual tactility of the imagery radically shift the presence and character of the object. Objects take on new meanings with the costuming of video imagery and sound. However objects are actants and play a powerful role in transforming the interpretation of the video narrative as it is given physical form by the shape of the object. Video projection disrupts the static being and cultural framework of the object, simultaneously the three dimensionality, materiality and agency of the object disrupts the meaning and experience of the video.

Power of Objects in Video Sculpture

We imbue personal belongings with meaning and preciousness because of the role they played in our lives. Powerful social, economic and political signifiers are inherent in all types of artifacts. Objects carry "thing power" according to Jane Bennett in her book *Vibrant Matter, A Political Ecology of Things*. She proposes that objects embody a vibrancy of their own. They display a meaning and are active in creating the context of that meaning. Ms Bennett theorizes that materiality is as much a force as an entity and as much energy as matter. There is no fixed stability of materiality as there is a vital impetus embedded in objects. They have a intrinsic vitality with agentic capacity which disrupts the experience or interpretation of the video imagery. Things become actors with a vital impetus. However the theory is that actants never really act alone. The efficacy or agency of the an object always depends on the collaboration, cooperation or interactive interference of many bodies and forces. [1] The power of video sculpture embodies this assemblage.

Consider the Chinese tradition of "shi" in which the idea of congregational agency is an assemblage that owes its agentic capabilities to the vitality of materials that constitute it. The potential of this assemblage originates not in human initiatives but instead results from the very disposition of things. "Shi" is defined as the style, energy, propensity, trajectory or élan inherent in a specific object. According to this philosophy, this originates in the vitality of materials that constitute the group of objects or constellation.

In indigenous cultures objects embody the power of sacred, spiritual or ancestral rituals. Ritual objects are believed to cause actions as they posses an agency. For example the Power Figure in some African indigenous tribes are believed to heal people, or protect people when activated by a Shaman in a ritual ceremony. These and other hand carved objects are highly charged as they can connect people to other dimension of existence such as the spiritual or ancestral realm. In the Yoruba culture, constructions of ordinary objects become "vigilant things" embedded with power for protecting places, people or objects. Shards of pottery, discarded shoes, seed pods and sticks are combined into "ase-impregnated sculptural constructs". Ase has the "power to make things happen", transforming spirit and matter alike. These protective assemblages called "aale", emit strong emotional resonances. A black plastic bag filled with an implied potent substance is tied and hung from a stick over a pile of recently cut green branches, signifies ownership. Anyone who steals the protected things is warned by these aale and will suffer a great calamity. They are believed to have spiritual powers that will punish anyone taking the protected items, or invading the protected spaces. [2]

Another example of the agency of objects is discussed by Norwegian architect, Sverre Fehn in his approach to designing a museum that displays objects. His perspective is that the context of the museum exhibition injects a new personality into an object, including its existence over time rather than being static. He says that in a museum the object may demand a new place, and in fact the object will signal that a new placement is necessary. Its placement and corresponding journey identify how it can be the embodiment of an object's essence. The object is strong enough on its own to signal "come live inside of me" to the viewer. When the dialogue between the architect and the object evolves into an expression, the object and the way it is exhibited will demand a dialogue with the viewer. [3]

Designing the museum structure in dialogue with the objects to be exhibited, illustrates the power the object brings to the interaction in this case, of environment and object. This has a unique connection to creating video sculptures that engage time-based video imagery and sound, with an assumed static object. The object plays an active role in creating the gestalt of the artwork.

Power of Video Narrative

My installations of video sculpture were inspired by envisioning ritual and ceremony in indigenous cultures. Sacred symbols are painted on the nude body, concealed by darkness, and then revealed by undulating firelight as the person danced around a fire in the center of the ceremony. The symbols taking the form of the body, are visible in the flickering firelight as the person twists and turns in performance around the fire. With sound, imagery, motion and rich aromas, this creates a visceral experience.

In the video installation titled *Lightening in My Blood,* two videos are projected into a hand-made fiber chrysalis symbolizing a transformative space. The two different video sequences were projected from opposite sides of the translucent organza chrysalis, visually mixing within the form. Depending on the character of the imagery, sometimes one video would become prominent, followed by the other. The two videos had different lengths so they did not repeat their visual combinations. The intent was to create a transforming space that embodied the stages of life, and the rites of passage into the experience of later life. One video was a slow walk through a nursing home captured from the position of a wheelchair. The opposing video projected imagery of small baby fish obsessively jumping at a metal grill in a fish hatchery. Neither video is visible in its entirety, yet images of each meshed together within the large seven foot high chrysalis, suspended from the gallery ceiling. Both ends of life participate in this dissonant assemblage, the chrysalis acting to bring them together. Documentation of this installation is at: https://vimeo.com/128735895

The suspended cocoon is the actant, the operator creating the assemblage for the video sculpture. The collaboration, collision, or confrontation of video imagery projected into an object disrupts the visual narrative of the video simultaneously disrupting the implied metaphor represented by the object. Artifacts carry cultural, scientific, economic and political meanings. With their materials and form, together with individual, personal experiences, like stories, histories and memories, they are highly charged. Pair this with ideas, issues and events portrayed in video, and emotions are sparked. The power of video sequences is enhanced when it intervenes in the agency of an object.

Disruption

The video sculpture *Spirit Site* bears the resonance embodied in an empty white model house suspended on a platform from the gallery ceiling with clothes line. Video of a salmon run is projected into the open side of this house, filling the rooms with images of salmon swimming upstream against the current and jumping up waterfalls. The continuity portrayed by the life cycle of the salmon is mapped onto the lives of people who lived in this house as the video imagery also goes through the cutout door and windows of the house, onto the back wall of the gallery where it washes over photos of elderly people behind small window frames on the wall. The video imagery and sound

awaken the memories residing in the house and in the lives of the people included in this installation. The video projection of the salmon run disrupts the architectonic character of the house, transforming it into the bed of a rushing stream. The emptiness of the white house is filled with a salmon run. Simultaneously, the reference of this home and the photographs in window frames separated from the house, disrupt the cyclical flow with the implied cycle of life in the video. Documentation of this installation is at: https://vimeo.com/128730064

Collaboration

Traces of memories are embedded in and evoked by this model house activated by the salmon run. Objects like this have the power to trigger remembrances of events and people. Remnants or traces of social practice are left behind in objects, similar to those uncovered in archeological research. Artifacts are excavated, reconstructed from pieces and studied in order to provide insights and understanding of social and cultural practices of extinct civilizations. Material practices of these cultures leave deposits which are traces of various material practices. The book *Memory Work: Archeologies of Material Practice* by Mills and Walker discusses the memories possessed by objects, and the premise that materiality is a portal to understanding the connections between people through time, and diverse geographical locations. [4] Another video installations titled *Asymmetric Bodies* included a seven foot irregular shaped figure created with stiff pellon fiber. Three video projections engulfed this figure creating a mysterious *journey* moving around the figure. This trajectory was a passage through a mystical forest experiencing dark areas and lighter areas with a ominous figure appearing along the way. The video was created using a small wireless color video camera inside of the front car on an HO toy train which ran around a figure eight track on a platform in the forest. The video imagery was communicated wireless to the computer for recording and editing. The three video projections were synchronized to create the synthesis of the video journey and the fiber figure. The sound included the wind through the trees with periodic sound of the train moving on the track. [5]

Video sculpture is disruptive, both to the behavior of the object, and to the linear sequence of the video imagery. Each intervenes in the other. These installations create an assemblage of dissonant elements. An ephemeral component infuses resonance and meaning into a physical artifact with its own agenda and agency. Both powerful on their own, together create a “interactive interference” pattern of fluctuating materiality and transient forces.

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Professor Truckenbrod began working with mainframe computers in 1975 creating a series of computer drawings expressing invisible phenomena in the natural world. Using Fortran Programming Language and a Calcomp Pen Plotter, she explored the creative potential for digital artistic practice. In addition to writing and developing code, she used computers to create computer imaging, digital painting and to develop interactive installations. This artwork has been exhibited internationally. In 1988 she published a book titled *Creative Computer Imaging*. She was on the faculty in the Art and Technology Program at The School of the Art Institute of Chicago for 25 years. Currently she is creating *video sculptures*, juxtaposing video and sound with objects. This work is documented in a book published in 2012 titled *The Paradoxical Object: Video Film Sculpture* that includes installations of artists who have inspired her work.

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Collocations

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Abstract

Collocations is a work of experimental writing that explores the disruptive implications of quantum mechanics for science, philosophy, literature and art. Designed for tablet computers, *Collocations* appropriates two excerpted pages from Albert Einstein and Niels Bohr's debates about quantum physics and transforms them through algorithmically defined systems in order to produce an interactive work of innumerable poetic texts. Interaction with the work transforms the user into an experimenter whose physical manipulation of the device determines the materialization of any possible number of unique textual configurations in a dynamic, non-linear and kinesthetic reading experience. This paper contextualizes *Collocations* in relation to the fields of experimental writing and electronic literature, describes how the work operates, and demonstrates the correspondences between *Collocations'* formal structure and the quantum phenomenon of complementarity on which it is modeled. Video documentation of *Collocations* can be found here: https://vimeo.com/119868407.

Keywords

Digital poetry, quantum mechanics, tablet computing, software art, art and science, interdisciplinary research practice, interactive art, new media art, experimental writing, electronic literature

Collocations

Quantum physics has utterly transformed our understanding of the world, rewriting the laws of time and causality and proving that matter is fundamentally indeterminate. How can it transform the way the world is reflected back to us through artistic practice? A work of experimental writing designed for tablet computers, *Collocations* asks whether it is possible to create new forms of reading and writing that are as different from "classical" forms of reading and writing as quantum physics is from classical physics.[1] Using the quantum phenomenon of complementarity as a formal and conceptual model, *Collocations* responds to users' movements through space by staging collisions between poetic subtexts within two excerpted pages from Albert Einstein and Niels Bohr's historic debates about quantum mechanics. [1] Drawing on quantum mechanics' central principle that matter's ontology is never fixed but is instead in a continual state of flux as it moves across time and space, *Collocations* posits a new quantum poetics that resists fixed formations, allowing for a literary work that unfolds uniquely through a user's physical interaction with a device.

Collocations builds on and makes interventions into the fields of electronic literature and experimental writing. Chance operations and cut-up techniques have been used by literary avant-gardes for more than a hundred years and have played a central role in the history of electronic literature. While *Collocations* makes use of these strategies, the work neither leaves poetic significance entirely up to chance, nor cedes poetic agency entirely to an artificial intelligence. Instead, the algorithms that dictate *Collocations'* innumerable poetic possibilities have been written to bring together chance operations, weighted probabilities and the author's own poetic choices. The result is a work whose outcome cannot be predicted, but whose poetic vision remains cohesive.

Collocations also builds on the constraint-based literary practice most often referred to as "erasure poetics" but which I prefer to call "palimpsest aesthetics."[2] At the intersection of literature and the visual arts, palimpsest aesthetics explore the materiality of language and complicate the notion of authorship by appropriating and transforming already existing texts into new, "original" works of literature through operations of erasure and/or palimpsest. By bringing this practice into the realm of the digital through an engagement with quantum theory, *Collocations* torques palimpsest aesthetics' central concerns of materiality and authorship. In *Collocations,* language is a material that is erased, written over, encoded and recoded according to the quantum laws that govern matter at the subatomic scale. Moreover, by creating an interactive system whose poetic possibilities are indeterminate until a user interacts with the device, *Collocations* introduces a third term—the user—into palimpsest aesthetics' destabilization of the author.

Collocations is an open-ended work of experimental literature, not an illustration or demonstration of a scientific concept. Yet quantum theory is not merely its source

[1] *Collocations* was written for Apple's iOS operating system in C++ using the open source creative coding framework openFrameworks.

[2] I prefer the term "palimpsest aesthetics" for two reasons: "palimpsest" is a more accurate descriptor for the diverse ways in which this practice has been taken up; and "aesthetics" is a more versatile term for a practice cultural purchase beyond literature.

of inspiration or loosely defined starting off point. Rather, the work aspires to create a rigorous and methodical correspondence between scientific theory and literary form. To use N. Katherine Hayles' formulation, the unique way in which *Collocations* structures its user's experience forms a "material metaphor" that facilitates a "transfer of sense" between Einstein and Bohr's debates and the "material apparatus" that is comprised of the tablet computer and its custom software. [2]

Collocations takes as its formal and conceptual model the quantum phenomenon of complementarity, which stands at the heart of Bohr and Einstein's debates. Quantum physics demonstrates that a particle's fundamental properties always come in complementary but mutually exclusive pairs (most famously, position and momentum). Our ability to accurately observe these properties is limited: the more accurately we configure an experimental apparatus to observe a particle's momentum, the less accurately we will be able to observe its position, and vice versa.[3] According to the principle of complementarity, when the apparatus is configured to observe a particle's momentum, the particle's position cannot be observed (and thus known). But the theory goes even further to state that at the time of observation the particle does not *have* a single, determinate position—it is in an indeterminate state of "superposition." In other words, quantum complementarity not only has implications for the limitations of what we can *know*, it denotes a limitation of what *is*—its implications are not merely epistemological, they are ontological. The experimental apparatus and the object being observed are ontologically entangled: as the apparatus' configuration changes, so does the *ontological* nature of the object itself. [3]

In *Collocations*, the particle being observed is a dynamic page whose possible textual configurations are drawn from two passages excerpted from Bohr and Einstein's debates; the particle's two complementary properties are two sets of unique poetic constraints derived from each of these source texts; and the experimental apparatus that allows those properties to be observed is the tablet computer. The experimental apparatus' configuration, which determines the degree of accuracy with which each of the particle's complementary properties can be observed, corresponds to the tablet's orientation along the z-axis (Figure 1), which determines what percentage of text visible on the page is Bohr's and what percentage is Einstein's. When the tablet is perfectly right side up at 0° or perfectly upside down at 180°, the page shows either Bohr or Einstein's original text in its entirety. As the user rotates the device, however, the words within Bohr and Einstein's texts, which are differentiated by their opposite orientation, break apart and transform into one another.

At every degree of rotation along the z-axis, the tablet can also be rotated along its x and y axes (Figures 2 and 3), allowing the user to observe and make determinate the system's poetic constraints. The result of these poetic operations is represented by certain words from within Bohr and Einstein's original texts beginning to vibrate, becoming highlighted and forming poetic subtexts (Figure 4).

Every system of correspondence, no matter how rigorous, must eventually break down. When *Collocations* is configured to observe the poetic constraints associated with Einstein's text, the poetic constraints associated with Bohr's complementary text are not, in fact, suspended in a state of quantum and ontological indeterminacy. Rather, that indeterminacy—and its profound philosophical implications—are gestured toward through the work's visual and poetic form. The user's interaction with the device transform her into an experimenter whose acts of observation unfold unique textual configurations in a dynamic, non-linear and kinesthetic reading experience.

[3] To measure a particle's position, an experimental apparatus must be configured with a fixed platform, but to measure its momentum, it must be configured with a moveable platform. Because these configurations are mutually exclusive, it is impossible to accurately measure both properties simultaneously. See Barad, *Meeting the Universe Halfway*, 111-115.

Author Biography

Abraham Avnisan is an experimental writer and new media artist whose work is situated at the intersection of image, text, and code. Each of his projects appropriates and transforms a key 20th century text that challenges us to reconsider the most fundamental ways in which we understand ourselves and the world around us. He has presented and exhibited his work at the 2015 &NOW Conference of Innovative Writing, the 2015 and 2014 Electronic Literature Organization conferences, the Museum of Contemporary Art Chicago's Word Weekend event, and at Figment! and Centotto Gallery in New York City. His work has been published in *Stonecutter*, *The Poetry Project Newsletter*, *Drunken Boat*, *New Delta Review*, *Rain Taxi*, and others. He holds an M.F.A. in Poetry from Brooklyn College, and an M.F.A. in Art and Technology Studies from The School of the Art Institute of Chicago, where he received the New Artists Society Merit Scholarship. He maintains a website at http://abrahamavnisan.com.

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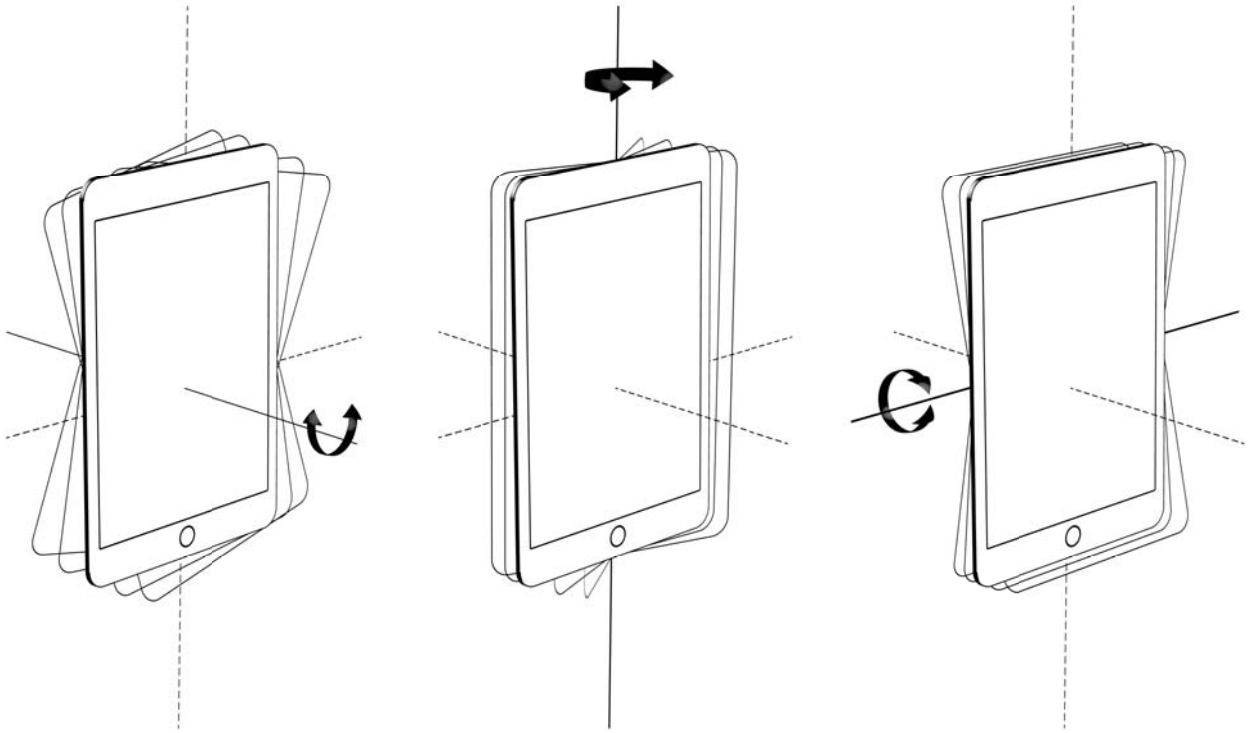

Figures 1, 2 and 3. Rotating the tablet computer on its z, x and y axes, respectively.

Figure 4. *Collocations* – installation view.

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DEL?No, Wait!REW: The Impossibility of Authenticating Erasure

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Abstract

This paper reports on my ongoing practice based research, which aims to examine the importance of the 'Delete' function in the context and practice of Media Art. DEL?No, wait!REW is an interactive installation, which de- and recontextualizes the process of data recovery by displaying found disclosures of retrieved data and posing a series of questions to the audience in a recurrent manner.

Keywords

Hard Drive; Interactive Installation; Digital Forensics; Data Recovery; Media Art; Delete; Save; Rewind; Residue.

Introduction

Emerging computational systems and digital information processing enable multiple backups of data by storing it on physical devices (hard drives) or web servers (the cloud), where the record has been saved in order to ensure it's preserved and can be accessed and retrieved at any time. On the other hand, deleting information permanently in the digital age has become a rather onerous task. [1] Previous research and media artworks have examined the importance of 'deletion' and its various cultural and technological ramifications. [2] [4] [6]

This paper introduces the DEL?No, wait!REW installation which takes on a forensic approach to a collection of discarded hard drives and constructively problematizes the notion of 'deletion,' confronting the audience with larger questions of how to secure deletion of data from a magnetic medium, data ownership and the ethics around data recovery. DEL?No, wait!REW also attempts to showcase and discuss some of the concerns raised among the participants of the installation.

Recovery process

I purchased online a collection of ten unformatted hard drives (SATA type) which had previously been used for video editing. Then I expanded my collection to over thirty drives, obtained from various sources: flea markets, scraps from old electronics and websites, where hard drives were bought and sold as commodities. I recovered a large number of lost files by scanning the whole disk or a partition of the drive. The recovery process was conducted by using open source data recovery software --TestDisk and PhotoRec.[5]

In order to organize this accidentally found archive I followed a simple methodology. I sorted the hard drives by serial number, source of origin, date, time elapsed to recovery, actual size of the drive, and the size of retrieved information followed by simple content information.

DEL? No, wait!REW

DEL? No, wait!REW is an automatized system which recovers files from discarded hard drives without the consent or the knowledge of the previous owners who presume their content has been deleted forever. In the ongoing conversation about the impossibility of erasing digital traces, the installation aims to confront participants with an ethical choice of whether to delete a recovered file or to save it by publishing it online.

The installation consists of three core elements: display screens showing the graphical user interface (GUI); a tangible physical interface, or controller; and a spatial element – a lit table top, which acts as one of two light sources.

The DEL?No, wait!REW installation is intended to be displayed in a dark space. A stream of light is cast by the screens and the lit table top. A spinning hard drive is connected to Display Screen No. 1, which shows the data recovery process in real time using open source software. A cold steel controller reminiscent of an industrial machine is placed at the center. [fig.1] The controller has two buttons: Delete and Save. Delete provides the option to permanently remove a file from the system; Save uploads the file online. Display Screen No. 2 highlights a custom written software, which facilitates user interaction by communicating with the controller. Once the save option is chosen, the retrieved file is saved on a remote server and published in an online gallery. Saved files get projected on Display Screen No. 3. The physicality of the hard drives, the source of the data recovery procedure, is present at the exhibition space. In some respects, DEL?No, wait!REW highlights the physical omnipresence of data storages and at the same time reveals the processes running on a machine.

Figure 1. Physical interface of a controller used in the DEL?No, wait!REW installation

Discussion

Several insights can be drawn from the participants' interaction with the DEL?No, wait!REW installation. For example, a major concern among the participants was how to achieve secure deletion of their electronic data.

According to previous technical research [3], in order to ensure that electronic data has been deleted permanently from a computer's memory, the drive's entire content must be overwritten with 0's and 1's an arbitrarily large number of times written to the same location as the original. Common practice shows that the only way to confirm that data is ultimately deleted is by physically destroying the hard drive. However, most users are unaware of or don't possess the technological know-how involving the structuring, storing and deletion of electronic data. DEL?No, wait!REW forces participants to rethink the fallibility of technology and what happens when they trash files into digital recycle bins.

The aim of the DEL?No, wait!REW installation lies in re-introducing the importance of the 'delete' function in the digital realm and setting up a series of questions providing grounds for further discussion. However it fails to reassure participants that when the delete button is selected, the data has been authentically deleted as it continues to exist on the magnetic disk, which is present at the exhibition space.

Another insight, which can be concluded based on participants' interaction is that often the viewers associate themselves with the actual owner/s of the hard drives who remain unknown. Giving the control to the participants to decide whether to make someone's data public or discard it without the knowledge or the consent of the previous owners highlights the inherently slippery nature of digital data and the resulting loss of ownership over digital information.

Conclusions

In this paper, I presented the installation DEL?No, wait!REW as a case study of an automatized binary system that aims to introduce the importance of 'delete' and its multiple aspects; the secure deletion of a data carrier, the loss of ownership of digital data and the ethics of data recovery. The DEL?No, wait!REW installation takes a second look at a collection of discarded hard drives containing digital files, which were thought to have been forever erased. The process of the aforementioned data recovery and data exposure is performed without the control or consent of the original creator.

Exposing the physical aspects of the data storage devices and showing in real time all the running machine processes succeeds in confronting the participants with the impossibility to authenticate erasure while hitting the delete key.

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Author

Michaela Lakova (BG) is a visual artist and researcher. She holds a Master's degree in Media Design and Communication from Piet Zwart Institute. She takes a lost and found approach to media. Her field of research and practice involves catchy bits and bytes of errors, systems malfunction and the inevitable generation of data traces and its problematic resistance to deletion.

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Disruption in Reconstruction

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Abstract

DIY for the digital artist must be thoughtfully considered. The unknown printing-*tech* at an online store is vastly different than the artist's substrate preparation and *pulling* a print. Art utilizing "newness" (and its ease) alone is no substitute for art historical knowledge, reflection and time-honored, maker-engaged technique. I specifically explore that of book and needlework artists in my work. Much of the value in the *computer art object* rests in its connection to art's roots.

Keywords

Digital Art, Art History, DIY, Printmaking, Inkjet Paper, Aura, Lace, Textiles

Introduction

DIY is an activity in which the creative consumer either produces, transforms and/or reconstructs material objects, typically seeking customization, product "specialization" or uniqueness. Applying Walter Benjamin's renowned argument, digital art has historically had barriers to overcome in terms of its aura or uniqueness. [1] The DIY culture, although it has roots in The Arts and Crafts Movement of the last turn-of-the-century, might end up devaluing high quality individual works or limited editions, if it disrupts the hands-on innovations electronic artists have recently achieved.

Computer-using art-makers are lately enamored by mass produced inkjet papers and substrates. These are their *DIY* raw materials for making art, either with their own printer, or via the commercially printed product (of their picture)... DIY for the would-be artist. Not only does this begin to dismantle a centuries-old *evolving* standard of professional art and design, it renders the process almost effortless. There is no need to understand art, its history, handheld tools and materials. Just push a button. But by giving new digital life to our visual *heritage* we achieve far more than by networking the maker to a trendy online print-shop.

I bear this out with my own work, as artist, educator and curator. The knitting together of every-thing happening *now*, the *NEW*, accomplishes less than the linking of past art to the present. This is constantly stressed in my courses, exhibitions and studio practice, and by my own teachers.

The New Versus the Old

Much value is to be gained by knitting culture(s) together over time or history. By analyzing the brilliance, and mistakes, of ancestral artisans and makers – and breathing new digital life into that aesthetic – we achieve more than by networking a creative user to a commercial printer. An aim of my work is to interrupt our culture's "NEW-is-what-matters" attitude(s), and to instead evolve and liven our consideration of the objects (art and artisanal products) of the past. The pieces referenced in my work create new connections and meanings when seen with a contemporary perspective. These should reflect a conflation of tradition with modernity; such material forms generated by employing new technologies – with a nod towards old technology – can extend our critical reflection.

It is so timely to look at the personalized ornamentation of the old world, as we now arrive at a *new chapter* in the bespoke and DIY fashion and product design timeline – custom made specialty items "printed-on-demand" and short-run (personal yardage) fabric, canvas and vinyl digital printing of all kinds. Anyone with a computer and the budget can design their personal art and accessories – even their raw goods (for furnishings and garments), either choosing from the huge libraries of imagery, or uploading their own, or both. The emphasis on de-industrializing so lauded by the Arts and Crafts Movement gets lost in the translation. The **old**, time-honored, human-touched (not machine-driven) way of making things that mattered most to William Morris and his followers is missing in this DIY.

The Line and the Ancestor

Line to define form and surface, the knotted, twisted and looped lines depicted by threads, wires and cord drives my historical research. While often viewing works in thread by Ghada Amer and Elaine Reichek, I found the need to focus on *line* used by textile artisans to enrich and personalize surfaces going way back. Months of study of ecclesiastical and ritual textiles have helped inform my work. My densely-layered prints [see below] are highly derivative of

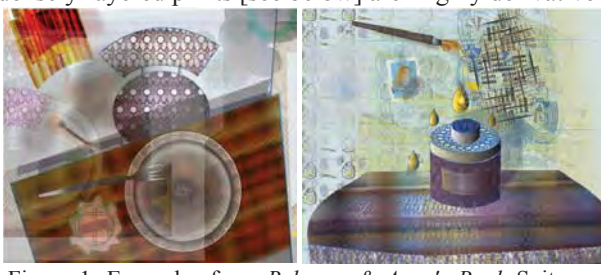

Figure 1. Examples from *Rebecca & Anne's Book* Suite; using lace; *The Grey Plate* (*l*); *The Glue Pot* (*r*), collection of Ido van Blijdesteijn; Copyright the author/artist

old world textiles. My primary focus is now historic lace, reconstructing this "mined" imagery through digital drawing, then experimenting with new interpretations of its relief surface.

Out of a desire to honor the old world needlework artists, I *coax* the image off of the monitor onto either sheer/filmy or soft/velvety intuitively-chosen substrates. Each image is the subject of experimentation, and necessary failure, in its digital printmaking phase. I print on translucent grounds, all sorts of plasticized surfaces, the wrong side of films and transparencies, and create my own polymer skins. Also hoping to print on actual skins like suede and vellum, my future "digital lace" may contrast or even defy its very support material. This process of tactile hyper-*awareness* and selection sets up very engaging technical challenges.

Although I find great value in collaborating with living colleagues, it is as if there were an ancestor inside of my head, beckoning me back. I often see this phenomenon, as well, in many of my most serious, and successful, students. We are told by New York Times art critic Roberta Smith that "especially in the digital era, culture exists in a state of simultaneity, where all of history is equally available for use." [2] In today's participatory culture of making, we posit that the greatest aesthetic growth is attained by knitting people/culture(s) together over time.

"Hands-On" Printmaking

I work with college students, teachers and retirees. Both young and old creative types are mainly interested in mass-produced inkjet substrates, and in easily making a digital print or ordering one commercially – "one touch printing." This is their DIY; yet this quite paradoxically frustrates the very goals of the heritage of the digital art-maker that I *know*. The would-be artist is simply backing out of the connection to the final and tangible work.

Editor-in-Chief of *Art in Print,* Susan Tallman, writes that "living in a world awash with reproductions, artists of all media have turned their attention to questions of replication and repetition... and the provocative gap between the material thing in front of you and the distant event to which it points," also inferring that these reproductions are overly-glossy standardized/mechanized inkjet prints. [3] Digital printmakers must define what materiality and **the print** mean in the 21st century. And if we are *defining* it, then why have a chemist, coder, or the print technician randomly found online, have the ultimate say?

Do artists/printmakers have an interest in this cleaned-up, homogenized, computer-printing aesthetic? An artist, I find it to be much more interesting when I have to discover the right surface or make my own substrate, even if it is full of imperfections. The creator is much more engaged in technique and new printing technology when one is challenged and tested by the materials. But this new sort of "automatic art" disrupts that sense of *quality* art, that definition of an artwork achieving merit because of the struggle, passion or "inner work" it required. Now anyone can *DIY* a stretched *(wrapped)* canvas landscape. "Amateur or evolving painters can use popular software or plug-ins for turning their digital photographs into paintings automatically, with a single mouse click," state William Jack and Jesse Leak in *Artblend.* [4] And when the tangible art object (say, the print) is also a one-click creation, what does this do to our notion of authentic computer arts?

Case(s) in Point: In My Studio

In a book-art series, created in my studio, we used paper embossed with looped, and crocheted strings, then printed with a pale lace design, and finally superimposed with a cursive statement about the murderous suffering of Jewish garment workers in WWII. Another suite features book-boards covered with collages of historic scenes blended with time-apropos fabrics (virtual or actual swatches). They are layered among translucent prints depicting a metamorphosis of sketchy lines into lace-tattooed vehicles, [see below] which are used here to symbolize escape.

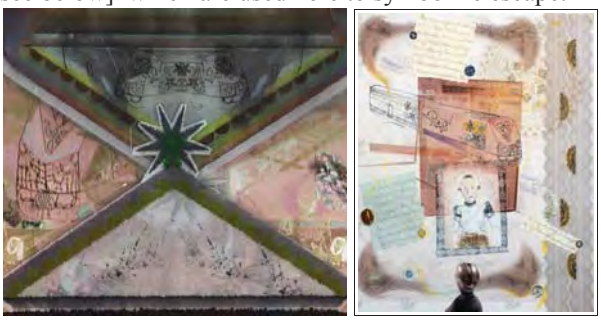

Figure 2: Examples of using lace marks; *Pushing the Envelope: Flap* (*l*) collection of Vilna Gaon State Jewish Museum, Vilnius Lithuania; *Hiding* (*r*); Copyright the author/artist

Other recent examples include tatted structures printed on metallic (InkAid-treated) substrates, *lace-drawn* images on pearlized vintage vinyl, and inkjet transfer prints of my "digital yarn" that disrupts an existing printed toile pattern. [see above right] In kindred work, artist Claudia Tait im*prints* hair-paintings. She writes "the original designs were created using 3D software (Maya) "hair" and "fiber" tools. The Maya files were converted using JacqCAD software and woven on a Jacquard loom," [5] using natural and beautiful damask fibers. It is especially intriguing to print fibers on actual, string-like fiber substrates and the imagery of metalwork onto metal; this inspires the next round of work in my studio.

Legacy of 20th and 21st Century Digital Art

Disrupting this DIY trajectory, with its inherent issues – hence reframing the entire digital art and printmaking process – may indeed become imperative. Material/image/concept/craft (or *artistry***)** all should come together aesthetically – so that the "product" is a barometer of culture, and does not devolve into the cliche print-on-demand stuff glutting the world. A well-studied and well-executed small-edition, or unique print, perhaps on handmade paper, has far more soul; the physicality and

aura of the well made digital art ***object*** can be our legacy – as opposed to commercial lowbrow/tacky, yet costly-looking, printouts. And electronically reconstructing/re-thinking past art can be most effective.

The computer art object rooted in our analog heritage, in an understanding of both its tools and products, yet sensitively and thoughtfully developed through digital process(es), will further the critical rhetoric on 21st century digital artforms. It is a challenge to clear away the cobwebs of meaningless mechanization and reproduction, yet keep the good parts of new technology. Through applying such lessons of the Arts and Crafts Movement, aesthetically commendable computer art-making can be in our future.

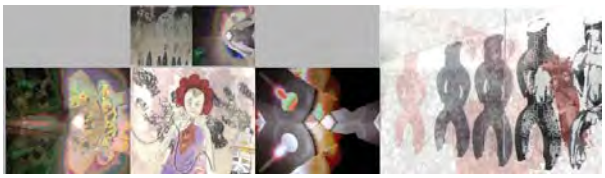

Figure 3. Example of metallic and handmade substrates; shadow/light and lace patterns digitally manipulated; *Nordic Kachina* (detail - 4 pages of the artist's book); copyright the author/artist

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Leslie Nobler is a digital artist creating prints, artist's books, and surface design. She exhibits and publishes internationally and has work in the collections of Sheffield International Artists Books at Bank Street Arts, England; University of Wisconsin at Green Bay; Academy of Jewish Museum Berlin – Library, among others. Shown in SIGGRAPH & Digital Salon (NY). Art Professor at William Paterson University (NJ) and curator/lecturer for cultural centers and museums. Recent work re*invents* artifacts using alternative digital printing, earning awards from the Surface Design Association and Puffin Foundation. BFA, University of Michigan, School of Art; MA, New York Institute of Technology; MFA, City University of New York - Hunter College

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Guerrilla Grafters

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Abstract

The Guerrilla Grafters graft fruit bearing branches onto non-fruit bearing, ornamental fruit trees. Over time, delicious, nutritious fruit is made available to urban residents through these grafts. We aim to prove that a culture of care can be cultivated from the ground up. We aim to turn city streets into food forests, and unravel civilization one branch at a time.

This project is, at its heart, a simple rehearsed gesture: a graft. This gesture is so demonstrative that it also generates discursive theater as described by Augusto Boal, and social sculpture as described by Joseph Beuys. We are in the process of developing an online map but in San Francisco, where city agencies denounce such generative acts of resiliency and sweetness, what kinds of information about these branches will ensure that they bear fruit?

Keywords

commons
distribution
cultivation
cities
resiliency
ecosystems
networks
information
visibility
sharing

Disruptions that lead to flourishing connections across difference

Guerrilla Grafters (guerrillagrafters.org) graft ornamental tree branches with fruiting branches on city streets. Over time, sterile plum, pear and cherry trees grow branches that bear a diversity of delicious fruit varietals well adapted to a city's microclimates. The small, micro gesture of grafting a fruiting branch onto a sterile tree matches a grand, macro gesture of transforming the city away from being a space of sterility and scarcity. The city, as pinnacle of civilization, with its resource drain and resultant stratification, can be grafted with flourishing ecosystems and diverse relations to become the site of a post-civilized mode of being where nature and culture reconvene: wild, collaborative, and productive. [1]

Guerrilla Grafters disrupt the binary of public and private in the city to usher in new relations — between various human and non-human fruit eaters, between pollinators and flowers, between property owners and fruit eaters. When a city street tree is grafted with viable fruit, a diversity of pollinators, birds and small critters may reveal themselves in and around the trees; to this, we say let's erect a hawk or an owl pole and bring in a keystone species. Fruit may fall and if we create more permeable surface around the tree we might create richer soil for plants like comfrey, yarrow and clover that can nourish the tree through nitrogen fixation and biomass. Underplanting can also help to sequester urban pollutants and keep them in the soil. And so a simple gesture can be the beginning of the restoration of ecosystems in our midst, enabling the conception of the urban environment itself as a renewable ecosystem. This work disrupts with a proposal for an unconfined urban commons.

Figure 1. Photograph by David W. Crane.
Graft by Margaretha Haughwout and Tara Hui.

Disruptions that lead to disembodied sites of non-care

More controllable urban agriculture projects, which are more easily contained in areas deemed distinctly public or distinctly private can be understood in contrast to the kinds of commons that result from the generative gesture of the graft. Also, vulnerabilities across different kinds of commons emerge when information becomes fully public and thus easily accessible. In the gestation period of our project, we had numerous embodied and disembodied challenges from San Francisco city agencies that resulted in a more nuanced approach to documenting the activities of grafters and the condition of the grafted trees. The project has been very popular in the minds of Bay Area residents. We like to attribute the popular press Guerrilla Grafters have received to the simplicity of the idea; through a simple graft, fruit is available to city dwellers. Some city agencies however, have been less approving. Though many

reporters have been careful not to disclose the locations of our grafts, some photographs and reportage made it easy to figure out the locations of a selection of the trees we grafted. Because of this, a number of trees we grafted in a downtown location were brutally cut back presumably by the San Francisco Department of Public Works one year. These trees were so severely pruned that some of them contracted diseases due to weakness and have not recovered. In essence, our attachment sites, both disruptive and generative sites of fruitfulness and care, were turned into detachment sites of non care.

Figure 2. Guerrilla Grafters logo.

This event spurred numerous conversations among core grafters; we considered the non-representational means of organizing on the ground and the web based connections that are made online. The non-representational means of organizing on the ground is fluid and not necessarily documented. Local connections establish networks of trust. Care, which Donna Haraway defines as the "… *obligation* of and *capacity* for responsive attentiveness," [2] can be established through neighborly connections because sociality begins to be built around the action and proximity to the tree. But research, as well empowering urban grafters globally, are also critical goals of the Guerrilla Grafters project, and these goals benefit from digital networks that encourage novice grafters and applications that can track the success of varietals in various microclimates.

This tension between local trust networks and digitally distributed ones is not new; it is often drawn out in endeavors where the commons take root and where potentially sensitive information is established. Representation and visibility seem critical to the momentum of projects that seek involvement and that aim to move beyond the sphere of public and private, and yet can also make them vulnerable to agendas of property and ownership. Part of the work of the Guerrilla Grafters is to expose the reach of support for an urban commons.

Sites of contestation and exchange

These direct and indirect relations become a kind of participatory theater around this graft, this proposal for free and accessible fruit. The guerrilla graft is the kind of art practice that upsets preconceived balances and purposefully toys with a frame in order to intensify the focus on each aspect of the project including the responses to the gesture of the graft and the resultant proposal for free fruit. So if city agencies declare this work an act of vandalism, this declaration becomes a part of the performance, and subject for analysis. Rather than our position only being brought into a set of legal and capitalistic narratives, we bring them into our story, our play. Indeed, the gesture of the graft invokes a celebration and a fight. There is a collective "yes" that emerges from the idea of ingesting one's city and engaging it in ways that do not involve having to make a purchase, and a resounding "no" that emerges from departments in the city revealing themselves to be in service to the mechanisms of ownership and profit.

We can thus understand the gesture of the graft as generating what Augusto Boal called discursive theater. Boal proposes a kind of theater for the people that collapses the proscenium and uses sites of daily life as the stage. Boal sees that this kind of theater never ends and is a kind of continual rehearsal. In this kind of theater we ask how we can rehearse a different world. "Contrary to bourgeois code of manners," says Boal, "the people's code allows and encourages the spectator to ask questions, to dialog, to participate." [3] In this kind of theater, we see tension and fights as being class commentary. The better the fights, the more passionate the positions, the better we have done our jobs. It makes all involved an artist and a performer.

Importantly, much of this theater happens in the imagination. We *imagine* the graft bearing fruit when we attach green wood…. Disembodied bureaucrats in the mediascape *imagine* a civilized member of society slipping on cherries that have fallen on the sidewalk amidst homeless getting munched on by rats and dying of the plague. Guerrilla Grafters argue that these specters are meant to turn us away from an engagement with the landscape of our city and each other. We celebrate these unrealized utopias and dystopias as part of our theater, but it is unfortunate when these imaginings result material disconnections, and detachments. We imagine an encounter with difference that could be an encounter of repair….

The practice of guerrilla grafting is a performance of abundance that in effect reveals the legally sanctioned performance of scarcity that we participate in daily in the US, and forms a background for the contestation about what the city should be, and who may or may not benefit. The material graft, the connection between fruit bearing branch and sterile tree can also be seen as what Joseph Beuys calls "Social Sculpture." In this way, the graft is a material art object that results in resource and information exchanges; we understand these exchanges to fold nature and culture.

Distributed relationships, resiliency and the politics of visibility

Figure 3. Guerrilla Grafters. Photograph by Nicolas Zurcher

Distributed relationships have the potential to facilitate commons management in ways that can usher us from scarcity to abundance, from the bare sidewalk to the informative graffiti tag, from non-art to art and create platforms for challenging what urban art, urban health, and urban foodscapes can look like. Distributed relationships can be understood both on local and global levels. The coordination of events and scion trades, easily disseminated grafting kits, education and documentation encourages commons management on the local level. Digital networks can facilitate a call to action in terms of tree identification, grafting, oversight and gleaning for local groups world-

wide. But as we have outlined, these same networks make the sites of our grafts vulnerable to damage. We would like to think that through information design and networks of care, trees will be looked after, fruit will be distributed properly, and people will have the guidance to not only watch their step, but to identify the tasty varietal that is hanging overhead.

How can non-representational means of organizing on the ground be combined with the web based connections that are made online so that sensitive information stays safe? How can online maps and documentation systems be juxtaposed against analog, or less trackable and more distributed forms of connection? Just as urban commons practices elude the divide between public and private, information about these new ecosystems — information about grafts and fruit especially — cannot be understood as either wholly public or wholly private. A politic of radical openness and transparency, which is so often advocated for in spheres that value commoning and horizontality, can be detrimental when powerful vertical forces are at work to thwart these efforts and maintain the status quo. [4]

We collaborate with Falling Fruit (fallingfruit.org) to provide a map that shares the location of graftable trees, but not the location of grafts, to anyone on the internet. Encrypting data about the grafts themselves with a private key allows us to deepen networks of trust and care through coordination and research collection. In 2015 we are also researching and developing a process of embedding hidden RFID in our grafts so that neighbors and researchers alike can access information about grafted varietals in their midst. We invite messy, rebellious solutions to the ways information can be shared for the purposes of expanding the urban commons in ways that simultaneously collapse binaries between public and private, nature and culture.

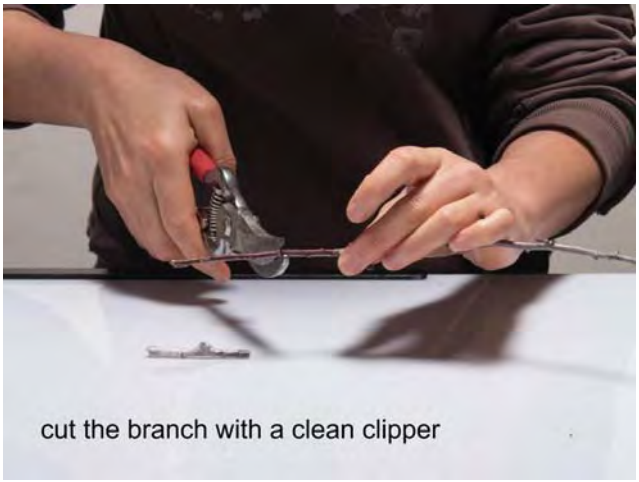

Figure 4. How to graft. Photograph by Robert Lopez

Audience Engagement

We turn audiences into agents with hands-on demonstrations, how-to videos, grafting kits, and through development of local relationships. For ISEA, we offer a demonstration of how to graft an urban street tree, how to use our internet tools, and simple, take-home grafting kits. We also invite the audience to converse with us on ways that digital networks can facilitate relationships and not more disconnection and non-care.

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Figure 5. How to graft. Photograph by Robert Lopez

Author Biographies

Margaretha Haughwout is currently a Senior Lecturer at California College of the Arts. Her new media art practice and pedagogy explore the implications of cybernetic worldview.

Tara Hui spends her time chipping away at hardened dogma, creating cracks for solutions to emerge. Her work is featured in many books about sustainability and urban permaculture.

Ian Pollock is an Assistant Professor of Art at California State University, East Bay. His work with communications technologies is featured in several anthologies of digital media art.

Figure 6. Gleaning in Oakland.
Photograph by David Rinehart

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Improvising virtual dancer meets audience: Observations from a user study

Alexander Berman, Valencia James

Abstract

The interdisciplinary project *AI_am* explores the potential roles of artificial intelligence in dance. One of the aims of the project is to create a performance where a human and a virtual dancer interact in real time in a mutual exchange where the human dancer and the avatar learn from and inspire each other. Apart from enabling an engaging experience, this kind of interaction would potentially also encourage movements that might otherwise not emerge from human improvisations. As a first step towards this goal, a method for generating novel dance movements from recorded motion sequences has been created. The next step is presented in this paper: an interactive setup where visitors can control parameters governing the avatar's improvisations. A user study of the installation indicates that the avatar's movements are interesting, engaging and inspiring. Implications of these results for future work are also discussed.

Keywords

Dance, Improvisation, Creativity, Art installation, Human-computer interaction, Expressive movement, Machine learning.

Introduction

The interdisciplinary project *AI_am* brings together the two seemingly disparate fields of artificial intelligence and dance to investigate the possible effects of their cross-fertilization. The ultimate focus of the project is to find out how AI can be used to transform the traditional exclusivity of dance to human bodies into a live interaction between physical and virtual bodies. One of the goals is to create a performance in which a human dancer and a virtual dancer have a fluid and interactive duet in real time.

As a first step towards this goal, a method for analyzing and generating movements has been developed. A small database of dance movements was recorded and reduced to a "pose map". An "improvisation algorithm" for automatic exploration of this map was then designed, traversing neighborhoods near observed poses and thereby reconstructing and synthesizing combinations of familiar and novel movements. These movements were manifested in the form of a dancing avatar.

The next step involved testing the software in the studio with the dancer in the research team, assessing its effectiveness as a tool for inspiring new and creative movement choices. The avatar's movements were observed, then imitated and used as a stimulus for further invention and development by the dancer. She confirmed that the software was indeed a useful tool for both improvisation and composition, and ultimately a promising partner for a stage performance. (Berman and James 2015)

Following this confirmation, it was determined that non-specialists should also be consulted as a future audience. An interactive art installation was determined the optimal way to introduce non-specialist audiences to the concept of a virtual improvising dancer. Participants were invited to manipulate its movements through the use of a touch interface. This opportunity was taken to collect feedback about how the participants felt about observing and interacting with the dancing avatar.

The paper begins with a description of the improvisation algorithm developed within the project. This is followed by a presentation of the interactive installation and observations from the user study. The presented project is then positioned in the context of related work. Finally, some conclusions are drawn.

Improvisation algorithm

Our method for generating novel movements utilizes a database of recorded human motion sequences which is analyzed statistically (Berman and James 2014). For purposes of simplification, the motion analysis focuses on the postural content of movements rather than their temporal dynamics. In other words, the analysis only deals with how limbs and joints are configured in particular moments, rather than how poses within a movement develop over time.

By performing a statistical analysis which reduces the complexity of the training data, a "map" of possible poses is created, containing regions of observed as well as unfamiliar poses. The analysis consists of two steps: First, recorded movements are stored as vectors containing orientation data for each joint, represented by unit quaternions (4 values). Secondly, the dimensionality of the data is reduced by nonlinear kernel principal component analysis (KPCA) (Schölkopf, Smola, and Müller 1998).

A motion database was created by recording about 5 minutes of material. The moves were performed by the team's dancer and were derived from poses that relate to certain spatial points, and the movement that arises from moving back

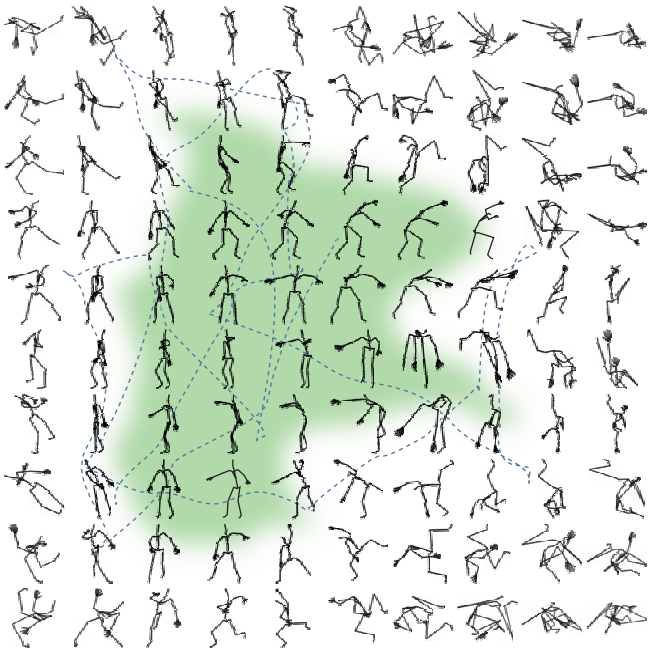

Figure 1: An example of a 2D pose map and a generated movement path. The green area represents the region of observed poses, while the surrounding areas contain poses without any direct equivalents in the training data. The blue dotted line represents an example of an automatically generated trajectory with a high novelty parameter. For the actual experiment, a 7D map was used.

and forth between these poses. A skeleton model with 52 joints was used, out of which 21 finger joints with static orientations were excluded from the analysis, yielding $31 \times 4 = 124$ input dimensions. By KPCA the database was reduced to a pose map of 7 dimensions, a value constituting a reasonable trade-off between simplification and accuracy.

A method for automatic exploration of the pose map was then designed. Trajectories across the map are generated by an algorithm and can then be synthesized as full movements by sequencing the constitutive poses denoted by the path. The algorithm was designed so that it would primarily generate paths in the vicinity of observed poses, thereby producing somewhat realistic and familiar output. On the other hand, it should also expose novel poses beyond observed territories. The requirements were satisfied by an algorithm based on randomness, attraction to observed poses (familiarity) and deviation from observed poses (novelty):

1. Select a random observed pose in the map as the departure point p
2. Generate a set of destination candidates $\{q_i\}$, where each candidate is a random observed pose plus a random vector of magnitude N (the "novelty" parameter)
3. Choose the destination q as the candidate among $\{q_i\}$ whose distance to p has the smallest difference from the preferred distance E (the "extension" parameter)
4. Choose some intermediate points between p and q, where each intermediate point lies between a point on the straight line between p and q and its nearest observation in the map (closer to the nearest observation for lower N values)
5. Smooth the resulting path using spline interpolation
6. Create the next trajectory by treating the current destination as a departure and repeating steps 2-5

Figure 1 shows the contents of a pose map and an example of a generated trajectory.

Interactive experiment

The most recent phase in the project is an interactive experiment where the improvising avatar is projected on a screen in simple stickman graphics (figure 2), while its behavior can be controlled in real time by audience members utilizing a tablet (figure 3). The graphical user interface consists of three sliders corresponding to different improvisation parameters (figure 4).[1] Conceived and realized through a participation in the ARTSHO5 exhibition in Istanbul (November 2014), this occasion allowed us to observe and assess the responses evoked in the participants in order to inform continuation of the project. The experiment enabled several questions to be asked to an audience of non-specialists: Are the avatar's movements interesting and/or inspiring? Is the user interface intuitive and engaging? How is the simple appearance of the avatar received?

Results

About 20 people interacted directly with the installation, and 7 user experience questionnaires were filled. Participants ranged from ages 18 to 55 including students, art bloggers, artists, and teachers. The reception of the improvising avatar was very enthusiastic. 6 out of 7 found the installation easy to operate. All found the movements interesting, with excitement and curiosity being the most popularly reported emotions felt by participants while interacting with the avatar. 4 found the stickman appearance engaging. Some liked that the movements were very clearly visible, while others could relate emotionally to the avatar.

During the presentation of the software, some audience members laughed uncontrollably at the strangeness of some of the avatar's moves. Others were stunned by the complexity of its novel movements. Some audience members even tried to imitate the avatar's movements. Although the intended interaction was through the tablet, some participants reacted kinaesthetically with full body motion, turning the installation into a "dance karaoke". Such participants seemed to become quite immersed in following the avatar's movements and only let their focus move away from the avatar after they had become too tired to continue. These participants were not inclined to interact through the tablet.

Suggestions from participants included a higher resolution, a more anatomically correct representation, and a variety of avatar appearances to choose from. One participant proposed projections of the avatar on all four walls, enabling a more

[1] Videos can be found at `http://timebend.net/AI_am/ISEA2015/`

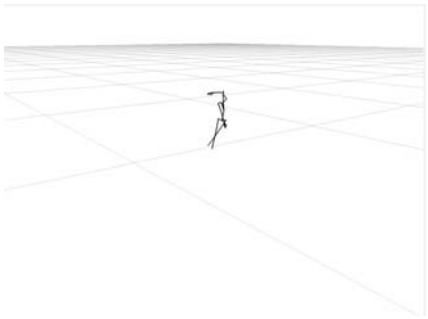

Figure 2: Screenshot of the avatar.

Figure 3: Participant using tablet.

Figure 4: The user interface.

immersive experience. Another person suggested to introduce the installation to children because they would gladly follow the avatar in its dance.

One possible improvement of the user interface was identified. The sliding bar controlling the degree of novelty in the avatar's movements used the terms "imitative" vs "original", which caused misunderstandings as "original" was confused with the reference to the training data given to the avatar; the term "novel" might have been a better choice.

Related work

The AI_am project explores the use of software to develop novel movements and stimulate choreographic ideas. A few precursors to this work deserve mentioning. The interactive software LifeForms was used by Merce Cunningham as a choreographic tool in the creation of the performance Trackers (Schiphorst 2013), and Wayne McGregor and his dance company have used Choreographic Language Agent (CLA) created by OpenEnded Group in rehearsal as well as development (deLahunta 2009). The abstract geometric forms generated by the CLA software have recently been replaced by a more human-like shape, used as an "eleventh dancer" in the studio (Rothwell 2014). There are also related examples of real-time interactions between virtual and human dancers, e.g. recent work at Deakin Motion.lab where an avatar projected on stage recognizes and responds to the movements of a human dancer (McCormick et al. 2013). In contrast to these examples, the presented project combines computerized generation of novel movements with real-time interaction between software and dancer.

Conclusions

Despite the small number of participants in the user study, some conclusions may be drawn. The user interface was fairly intuitive, and the avatar's movements were generally found to be interesting and engaging, despite the simple visual appearance. The most novel expressions by the virtual dancer caused both laughter and amazement in the audience. The most surprising outcome was the "dance karaoke" that emerged spontaneously. All in all, the results indicate that an interaction with this kind of kinaesthetically creative avatar can be both interesting and rewarding, and that a more compelling and immersive form of interaction could strengthen this potential even further.

In future studies, it would be interesting to involve more dancers in evaluations of the software. This would enable specialist feedback regarding movement qualities and choreographic potential. Planned future work will also explore real-time input from motion sensors enabling a full body kinaesthetic interaction between a dancer and the avatar. In our eyes, the current experiment confirms the relevance of this pursuit.

From a more general perspective, the study suggests that novel movements generated by software can engage and inspire minds and bodies – an insight that hopefully can be generalized beyond the methods and approaches adopted in this specific project and challenge common conceptions about creativity and autonomy in machines.

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Live sculpture

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Abstract

"Live sculpture" is an interactive and performativity video-sculpture built as a communicating mirror where the body of the viewer is fully participating.

Keywords

Sculpture, interactive, software-art, participative, installation, 3-D.

Short poster-presentation

When the audience is in front of the "Live sculpture" mirror is scanned and filmed in real time by a web-cam installed behind the frame, then revived and reshaped in a human scale video projection, as a three-dimensional marble sculpture.
This new three-dimensional live image of the viewer-sculpture is entirely built of an ever-changing interactive mesh, tuning into and reacting to body movement, environment light and speed of the spectator's movement.
My artistic research has always analyzed changes in 'liquid space' throughout a variety of techniques, technologies and devices.
The 'liquid space' in "Live sculpture" unfolds by the protagonists themselves aiming to reshape the human being condition, transforming it into something alive and vibrant, challenging the notion of sculpture itself.
The mirror is a sort of "mirror-mirror on the wall", but instead to make appear the 'fairest of them all', it creates from the viewers, distorted three-dimensional monsters of themselves bringing out the hidden and chilling part of the psyche. The experience of watching themselves in another atmosphere begins a voyage where synthetic shapes become design, structure, figure and illusoriness.
A sensitive, unsolved, mental and transitory vision of the body is adjusted to the hidden requirements of the explorer (audience).
The artwork is closely linked to the aesthetic and to the tensions of the new technologies exalting the conjunction between what is visceral, voluptuous and mind-expanding.
If the space is the extension in all the directions, by our intuitions, of the real world in which material bodies are placed, Live sculpture wants to expand these possibilities of perception.

"Live sculpture" is also a software-artwork (osx App) that can be considered a unique piece. Although it is digital and reproducible, it appears different every time thanks to the spectator's ever-changing subjectivity. "Live sculpture" restores the aura of digital artwork and solves the issue related to the multiple in art. It's a multiple but always a different one.

1 How I've designed Live sculpture

I've built "Live sculpture" using the free developer tools Quartz Composer and Xcode. In Quartz Composer I've set-up the work-flow scenario using a video input (a webcam) device connected to several patches performing many functions – eventually rendering in mesh. I haven't used any prefab app in QC. Then, I've constructed the software (osx-app standalone) within Xcode using the Cocoa and the Quartz Composer frameworks that are able to import and rework the Quartz Composer files.

2 How I did the idea of Live sculpture

On 2009 I created "The virtual Prigione", I launched on January 2010 as a net-artwork performing an interactive portrait - of me - a web based video-sculpture inspired by the concept of the latest "unfinished" sculptures of Michelangelo, so named "Prigioni."

Figure 1: *"The Virtual Prigione", net-artwork and IOS App.*

Figure 2: *"Live sculpture", software-artwork and video sculpture.*

Then, I created an IOS-App version of the net-artwork project where the virtual statue – a sort of cyber human figure - is totally dynamic and interactive; changing diverse poses, it can be sculpt just using the finger as a chisel.
In both the versions (IOS-App and web based artwork), "The virtual Prigione" represents various states of being. The spectator can choose to liberate the sculpture from the marble and its dependence material – so, the body-statue sublimates and the marble becomes virtual idea. Or, the user can also pick the option to imprison the statue into the marble, bringing it to the primordial state where the mass has a simple/essential geometric figure.

References

"Live sculpture", interactive video-sculpture on mirror and/or software-art piece running on mac-osx; time variable, by Chiara Passa. Video and software piece preview: http://www.chiarapassa.it/videoenglish.html Images: http://www.chiarapassa.it/livesculptureimages.htm

Bibliography

http://www.chiarapassa.it/videography.html

"Live sculpture" was presented and exhibited in several festivals, conferences and exhibitions:

2015 - "EVA London" Electronic visualization technologies in art, design & music, conference, London.
2014 - DRHA conference and exhibition. University of Greenwich, London.
2014 - XIII Festival Internacional de la Imagen, Manizales.
2011 - FILE | Electronic Language International Festival, São Paulo.

Author biography

Full CV- statement with exhibitions, talks, festivals, prizes and conferences:
http://www.chiarapassa.it/Artisticprofile.html
Artist/conceptualizer and lecturer. Studies: Artistic Lyceum, Fine Arts Academy of Rome where graduated; master in new audio-visual mediums at the Faculty of Modern Literature. Lived around. At the moment I'm living and working in Rome.
My artwork combines different media as: internet-art projects, animations, interactive video-installations, digital art in public space as site-specific artworks and video-sculptures. I develop also internet-artworks as widgets, apps and web-apps for mobile platforms.
I use the new technologies in a wide-range production in order to comprise its intrinsic language, experimenting in rigorous and personal way on the unknown creative possibilities that the new media are continuously offering to me.
Selected Exhibitions

My artwork was internationally exhibited from festivals, conferences and institutions, most important per year:

• "Morphos", Vortex Dome Los Angeles. Curated by Ethan Bach. (2014);
• Media Art Histories 5: RENEW conference, Riga. (2013);
• "Not Here Not There" LEA-Leonardo Electronic Almanac, MIT Press (2012);
• "AppArtAward", ZKM|Zentrum für Kunst und Medientechnologie, Karlsruhe (2011);
• FILE | Electronic Language International Festival, São Paulo. (2011);
• "Soft Borders Conference-upgrade international", São Paulo, curated by Martha Gabriel. 18-21 of October (2010);
• Artech 2010 "Envisioning Digital Spaces", international conference on digital art, Guimarães, Portugal (2010);
• Electrofringe - festival of new media art, Newcastle, Australia. (2008);
• Festival A10 Medialab, London (2008);
• MAK - Museum of contemporary art (Vienna 2007);
• Milano in Digitale, Festival di Arte Elettronica, Fabbrica del Vapore, Milano (2007);
• MAXXI- Museo Nazionale delle Arti del XXI Secolo, Roma (2006);
• CCCB – Centro de Cultura Contemporània de Barcelona (2006);
• Museo Nacional Centro de Arte Reina Sofía, Madrid (2006);
• BizArtCenter, Shangai (2005);
• Centro per L'Arte Contemporanea Luigi Pecci, Prato (2005);
• MACRO - Museo di Arte Contemporanea, Roma (2004);
• PEAM - Pescara Electronic Artist's Meeting, Pescara (2004);
• 11° Biennale of young artists of Europe and the Mediterranean countries. Cosmos – a sea of art". Athens. (2003);
• VIPER - International Festival of Film, Video and new Media, Basel (2003);
• "XIV Quadriennale" Anteprima. Palazzo Reale, Napoli (2003);
• GAM - Galleria d'Arte Moderna Torino. Torino (2001);
• GNAM - Galleria Nazionale d'Arte Moderna, Roma (2001);
• Biennale de Valencia "El mundo Nuevo", Valencia (2001);
• 48° Biennale di Venezia, Venezia (1999);
• Fondazione Bevilacqua La Masa, Venezia (1999).

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MIRAWORLD - poetic science as design methodology

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Abstract

MIRAWORLD models an interdisciplinary design methodology centered on poetic science as exploratory research prompt. Wonder is a reawakening of spirit within the sense faculties. It can emerge as a bi-product of science unlocking the world around us. MIRAWORLD explores poetic science as a methodological design framework for evoking a sense of wonder across three cinematic media arts projects centered on the poetics of the life-cycle of the immortal jellyfish.

Keywords

Wonder, Poetic Science, Methodology, Interactive Design, Transmedia, Worldbuilding, Evocative Visualization, Marine Science, Interdisciplinary Science, Life-cycle, Immortality,

Introduction

MIRAWORLD is a media arts world and accompanying design methodology that emerged out of a multi-faceted exploration of a naturally occurring biological process: the lifecycle of Turritopsis *dohrnii*, the immortal jellyfish.

The biological structure acts as a contextual framing, research prompt, and unifying theme that generates multiple interdisciplinary arts and science media explorations. It foregrounds knowledge and outcomes associated with arts and design practice experimentation within the realm of interdisciplinary arts science research. It asserts the unique potential arts practice engagement contributes to interdisciplinary learning.

This abstract briefly describes each mode of exploration, contextualizes it within a larger poetic science methodology, and considers this methodology's contribution to a new understanding of interdisciplinary arts science research centered around transmedia design principles.

Miralab

Miralab is a 3D PC downloadable video game about exploring an underwater eco-system as an immortal jellyfish while solving eco-system and survival puzzles to progress further in the world. As the jellyfish morphs through its lifecycle, the game's graphics shift to represent the corresponding change in perspective associated with that stage of life-cycle.

As an adult, (fig.1), the world is bright, complex, and fully formed. As a primitive embryo, the world appears larger, and as a series of simple lines (fig.2).

Miralab was developed as part of a year long Advanced Games Project course within the USC Games curriculum. Amanda led a team of 40 students through the challenging task of developing game characters based on existing biological eco-systems and processes. We approached Miralab with a sense of appreciation for both the science upon which the game is based, and respect for the unique interactive design,

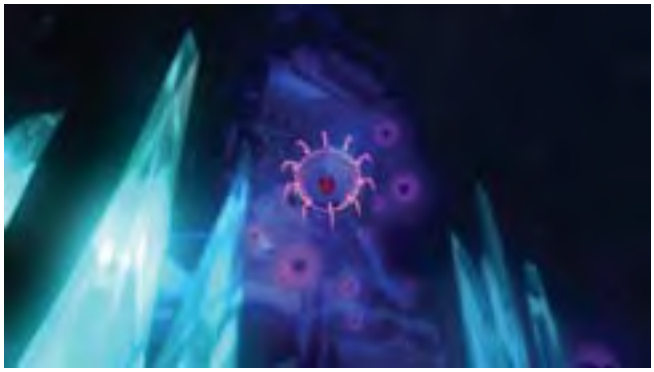

Figure 1. Miralab Screenshot 1- adult. ©Amanda Tasse

visual, and auditory interpretations student creators chose to embody. In this way, Miralab became a method for tuning the balance between respect for the knowledge and practice of both disciplines. As part of the design process, students met with experts at local aquariums to learn and see jellyfish life-cycles in process, and shared our game with the scientists as it progressed.

The Miralab game is the most literal of the projects in that you play as an actual immortal jellyfish surviving within an underwater eco-system. However, rather than

Figure 2. Miralab Screenshot 2 - embryo phase. ©Amanda Tasse

pure scientific visualization, it generates poesis through playful aesthetic immersion within a space of wonder, a creative dream laboratory of imagining a fascinating life-cycle and otherworldly world as it emerges from the interdisciplinary wild lands overlapping art and science.

Through allowing student designers, engineers, and artists to follow where their own wonder is sparked and re-interpreted within their own disciplines, we hoped that the game might transmit this curiosity to players, such that if they so desire, they might seek out deeper discipline-centric knowledge of the game's themes, rather than have it forced upon them.

Mira

Mira is a short Sloan Science Awarded film about a marine biologist who studies the life-cycle of the immortal jellyfish while risking everything to conceal a medical condition that threatens her ability to do the work she loves. Mira's characters - a scientific illustrator and a scientist - study the lifecycle of the immortal jellyfish through their respective lenses.

As a linear live-action narrative storytelling mode, Mira allows for multiple layers of subtextual meaning as interpreted by the audience through the characters. Mira relies on metaphorical connection between the protagonist's struggle with temporal lobe epilepsy and its associated short-term memory loss and the transformational journey of the jellyfish on both a micro and macro scale. The greater narrative goes through a cyclical arc as the main character cycles through her own micro arcs.

MiraViz

MiraViz is a series of interactive data visualization projects that emerged stylistically from MIRAWORLD. Each project visualizes the life-cycle and habitat of the immortal jellyfish on a literal pictorial level through employing avatars and characters from its natural eco-system. The life-cycle process is visualized through considering the life-cycle of data. Over time, data visualized as pictorial elements within the ecosystem deteriorates and then clones and regenerates itself.

The MiraViz touchscreen project (Fig.3) is inspired by Amanda's interest in using real-world activity to drive a multi-user shared responsive landscape. It reflects activities, moods, and the health and wellness temperature of a building's inhabitants. Though it rests upon complex indoor location tracking technology, its primary goal is to use this information to 1) visualize collective data-based landscapes and 2) to provide a new model for systemic location-based play.

Figure 3. MiraViz. ©Amanda Tasse

MiraFlux (Fig.4), a collaboration between Jen Stein of the USC Mobile & Environmental Media Lab, Amanda Tasse, and Anton Hand of Rust Ltd., is a visualization of energy usage within USC's 2013 Solar Decathlon house. The technology and visualization are driven by Solar Decathlon power. The system is especially unique in that it demonstrates how a robust entertainment experience can easily be powered by green energy.

Figure 4. MiraFlux. ©Amanda Tasse

Conclusion

MIRAWORLD is a multi-part media arts world consisting of three main modes - linear narrative film, data visualization, and a video game - that explored a theme from science as its motif and unifying structure for a laboratory of poetic science exploration. Each mode interpreted the life-cycle through unique practices associated with it natively. Through reinterpreting a biological process through this multi-modal lens, a new frontier of interdisciplinary arts and science knowledge was created and transmitted.

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Old Tech and New Spaces: Repurposing Payphones for Community Design

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Abstract

The Leimert Phone Company is an experimental community design collective based in South Los Angeles. Our goal is to shift from designing technology for a neighborhood by planning technology as part of the neighborhood. By repurposing unused payphones and other public furniture, our designs seek to reinforce the identity of the neighborhood and create new forms of civic engagement. The collective is run through workshop teams composed of university technologists, artists, and designers who work with local artists, musicians, and concerned citizens. Members bring a variety of knowledge sets that contribute to imagining alternative systems that are culturally specific to the historically black arts community of Leimert Park. Our workshops are structured around rapid-prototyping, embodied prototyping, radical accessibility, and speculative design. In this presentation, I'll explain the socio-cultural dynamics that inspired the collective, our methodology for maintaining a balanced participatory design process, and the impact the collective has had on reshaping public space and social relations in the neighborhood.

Keywords

Participatory Design, Social Art, DIY, Urbanism, Placemaking, Residue, Social Spaces, Speculative Design

Introduction: Alternative Systems

> [Artist] invent new spheres of reference to open the way to a reappropriation and a resymbolization of the use of communication and information tools outside of the hackneyed formulae of marketing.
>
> – Gilles Deleuze [1]

Modern neighborhoods are hybrids, emerging from the planning of physical space and increasingly digital layers of mediated communication. [2] The future of local communities may depend on the ability to plan their own technology, not just create content. As digital technologies permeate civic life and public space, the tension between top-down planning and local participation raises concerns about local empowerment. The possibility exists of planning technological systems that uncritically reproduce hegemonic or exploitative social relationships. [3]

Community participatory practices have developed in order to better address these socio-cultural concerns. [4] Yet current social models, including civic hackathons and community planning meetings, tend to privilege one kind of expertise at a time, at best designing a technology to address a community issue. The process rarely combines the user-centered methods of designing technology with explicit processes of community-centered negotiation.

Our community design collective, the Leimert Phone Company, seeks to address these issues through a nuanced methodology that develops technology from the bottom-up. Because our designs are centered in public space, they must be *radically accessible* in order to not exclude anyone nor exaggerate pre-existing spatial hierarchies through technology. Payphones and public furniture were ideal because of their simple usability, functionality, and pre-existing cultural significance. After two years of working together, we've discovered four major strategies for accessible and sensitive technological designs:

1. Sustain a Participatory Culture. Support a process that is playful and insistently open, feeding off the neighborhood's cultural practices. Specifically, we echo the criteria outlined for *participatory culture* by Henry Jenkins, et al., in *Participatory Culture*. This includes low barriers to participation and ensuring that all contributions are appropriately valued. [5]

2. Deepen a Neighborhood Story. The neighborhood identity has implications for economic development and civic engagement. Rather than presume to invent the grand narrative or avoid it, find a way to retell it that includes alternative visions. Begin by identifying the cultural assets that make the neighborhood distinct. Especially for historically marginalized neighborhoods, telling the story of "who we are" gives power and roles for local voices that lack elite technology skills.

3. Mix Technologies of Old and New. Frame the desired product as larger than any single technology, yet cheaper and more obvious than we might expect. For example, consider the role of "paper as mobile media."

Low-tech and low-cost shifts the conversation to planning the *social* side of socio-technical systems, and helps to build technology skills and confidence in design participants.

4. Rotate Institutions. A central practice of planning is to look beyond the most immediate users to consider all stakeholder groups, including non-users. Power relations between groups are at the heart of sustainability and equity concerns. To resist calcifying at one power hub, deliberately rotate the physical site of design, and recruit a rotating cast of institutional figures. (We alternate running workshops at USC and at the Kaos Network arts center in Leimert Park.)

Back Story: Prototyping Cultural Forms

Leimert Park has an exceptional cultural core and history. Yet, that identity is threatened with the next 5-15 years of projected growth and gentrification. [6] As a planned community developed in the 1920s, Leimert Park has a unique layout with a central plaza that is a perfect venue for festivals, events, and protests. [7] But the rich public space of the neighborhood is also ripe for redevelopment plans that come on the coattails of a recently proposed subway line.

Leimert Park is a beacon for African American culture and arts, whose residents have included Ella Fitzgerald, Ray Charles, and former L.A. Mayor Tom Bradley. Filmmaker John Singleton calls Leimert "the black Greenwich Village." [8] As South Los Angeles searches eagerly for urban development models, are there alternatives to the growing gentrification?

The most immediate limitation of tech-centric approaches is the equity of participation. Technical expertise is not evenly distributed. Concerns over the digital divide are replaced by a technological "participation gap". [9]

So part of the process of incorporating technology was finding alternative methods of prototyping while teaching technical skills. Each step was incremental and playful. As Rita Raley claims in *Tactical Media*, these types of projects, "are not oriented toward the grand, sweeping revolutionary event; rather they engage in a micropolitics of disruption, intervention, and education." [10]

The prototyping process was about teaching the logics of socio-technological systems as much as coding. Borrowing from game design theory, workshops were structured around rapid, paper-based prototyping. [11] Then groups would perform as the payphone itself, in order to work out an embodied sense of what the social relations around the payphones might look like. This type of *embodied prototyping* allowed the groups to quickly test the design before committing any materials to actual construction. It offers deep insights by engaging multiple senses of meaning making and observations on how social rituals might develop around the design. Taking the performances further, teams also came up with more polished, *speculative design* videos called "scenarios." Scenarios provide a compressed means for presenting short stories about the use of technological designs. [12] Much like the embodied prototyping, scenarios were a way to concretize multiple design concepts into an elegant example of the total user experience. In video form, scenario prototypes allowed teams to create speculative evidence of how their design would function.

The final group videos then were shown publicly as groups "pitched" their designs to interested community members and local stakeholders. This "pitchfest" was the first of a number of public exhibitions and events that we would hold. These events, which will be discussed in the "Final Designs" section, provide crucial feedback and dialogue within a larger social context. One of the major issues with community based art and design is the assumption that a community can have a singular, monolithic identity. [13] By constantly looking outward with each step of the designs, the collective engages with the complex, open identity of the Leimert Park Community.

Final Designs

Since the initial workshops, we've completed a number of designs and public interventions in Leimert Park. Our first finished payphone, the raspberry-pi powered "Sankofa Red", was displayed in late 2013. In was a hybrid design that incorporated group concepts such as: a large speaker connected to a microphone and audio input for public performances, audio stories from local jazz legends, a cell phone charging station, and a digital display of local events. Through a class at USC (but open to Leimert Park residents), we moved beyond the payphone and created drum machine bus benches, digital archives in newspaper boxes, socially networked gardens, and a children's public art display.

Figure 1. Workshops, public exhibitions, and the "Sankofa Red" payphone. Photos by ©Karl Baumann. Logo by ©Meryl Alper.

The later projects were exhibited during a public event in which we also collected signatures towards an application for a "pedestrian plaza" to permanently block off a street between the Kaos Network community art center and the central neighborhood park. The event and the application were a success and the pedestrian plaza has been constructed. Thus the collective is not merely centered on a single object but a larger project of building relationships, participatory infrastructure, and community capacity for shaping the future dynamics of public space in the neighborhood.

Acknowledgements

The Leimert Phone Company has a rotating membership of permanent and semi-permanent members across disciplines within the university as well as outside of the university. It is composed of communications, journalism, fine arts, and cinema students working with local artist, musicians, and community members. Many of the local artists are tied to Ben Caldwell and his Kaos Network arts center in Leimert Park. Ben Caldwell is a cofounder of the collective, along with Prof. François Bar, Benjamin Stokes, and Karl Baumann. Often we run workshops at conferences, but our other core members couldn't make this event due to scheduling conflicts. Parts of this document, particularly our four findings, are based on a recently published article, which is linked in the itemized list.

Itemized List

List of Additional Information on the Leimert Phone Company:

- Our recent "Neighborhood Planning of Technology: Physical Meets Digital City from the Bottom-Up with Aging Payphones" article in *The Journal of Community Informatics*: http://ci-journal.net/index.php/ciej/article/view/1090
- Our website with additional blog posts, videos, and information: http://leimertphonecompany.net/

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Author Biography

Karl Baumann is a digital artist, filmmaker, and scholar. His current work explores interactive and mobile media to navigate the complex layers of urban spaces. Karl's methodology is based on addressing complex social issues through immersive, participatory projects that explore the future of civic engagement, social networks, pedagogy, and public space.

After completing an MFA in Digital Arts and New Media (DANM) at UC Santa Cruz, Karl taught media literacy with the Boys and Girls Club and was active in Occupy Oakland. In addition to his locative and playable media projects, Karl has produced multiple award-winning documentaries and experimental videos, within the US and internationally. He is an Annenberg Fellow in the Media Arts Practice (MAP) PhD program at the University of Southern California. Karl is currently working with the Media, Activism, and Participatory Politics (MAPP) project, the World Building Media Lab (WBML), and the Annenberg Innovation Lab (AIL).

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Postcard Memories: an interactive tablet application for elders with early-stage dementia

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Abstract

In this demonstration, we present 'Postcard Memories', an interactive tablet application to create a social space for elders with early stage dementia. The touchscreen tablet application encourages people to create, organize, and send digital postcards that combine photographs and short text with audio and video. Users can send digital or print postcards to family, friends, and caregivers to encourage memory recall and facilitate social interaction. Results from a mixed method user study indicate that people find the interaction with the application enjoyable and meaningful.

Keywords

Digital artifacts, early stage dementia, elders, universal sensitive inclusive design, social space, postcards, tangible artifacts, touchscreen tablet application.

Introduction

Postcard Memories is an interactive tablet application that we designed to engage elders with early stage dementia, with their family members, friends, and caregivers in the tasks of: creating, sending, organizing, and printing postcards to maintain and preserve memories.

Our research questions are, "How can the collaborative creation of narrative-based digital and physical postcards and collections of postcards enhance connection and communication with family members, friends, and caregivers? Can this process assist elders by enhancing memory, speech, and other cognitive abilities?" Users can create and send digital or physical postcards in the application, and they can create a digital "Memory Book" [1, 2] that they can also print and view. The application, although intended for elders with early stage dementia, benefits everyone interested in exploring the creation of digital or physical postcards to preserve memory.

The functionality of the Postcard Memories application follows the following three stages:

Stage 1: Initiation
Users create postcards with Postcard Memories. They decide to send digital or physical postcards. Music or video can be attached to a digital postcard for the recipient.

Stage 2: Response
Initial postcard is received; recipient can create a new postcard to respond to the initial postcard.

Stage 3: Organization and Review
Sent and received postcards can be organized into a coherent narrative. The narrative can be viewed in a Postcard Memories gallery. User-selected postcards can be printed individually or compiled into a digital or physical Postcard Memories book.

Early stage dementia (ESD) differs from early onset dementia (EOD); EOD occurs in adults under age 65, whereas ESD is determined at the time of, or after a diagnosis of dementia. [3] Adults with ESD can talk about their experiences of living with dementia and express what living with a diagnosis of dementia means to them. [3]

Our objectives in this study are to learn how adults with ESD engage with the experience of recalling and organizing memories with the touchscreen tablet application. We are investigating elders' and caregivers' preferences in the interactions with the final outputs of the digital and tangible artifacts. Additionally, we are interested to see if, and how well elders recall, share, and re-experience these narratives with their caregivers.

Methodology

This is a mixed-methods study involving a comprehensive methodology and study design. A preliminary study at OCAD University with healthy adult students took place from June 2014 to May 2015. A second full study will be conducted in the summer of 2015 at Scarborough Community Health Centre and Toronto Rehabilitation Institute.

Each study follows a similar design, involving three phases of data collection: i) One to two user testing sessions; ii) a semi-structured interview (preliminary study) or debriefing session (full study) and iii) a self-administered questionnaire. We apply the "think aloud" method [4] during the user test sessions, wherein participants describe their interactions, outcomes, and difficulties with the application. We combined this method with thematic video analysis [5] in the preliminary study to learn how partici-

pants are progressing with the application, and about what needed to be revised in the application design (Figure 1).

Figure 1: (Top-bottom, left-right) Tap, drag, scroll, point actions from video data

The semi-structured interviews in the preliminary study were transcribed and coded using grounded theory. [6] We went through a rigorous process of axial, open, and selective coding to come up with three theoretical propositions to test against our research questions. Since the full study involves elders with ESD, we plan to extend the common iterative design methodology [7] to a "User-Sensitive Iterative Design" (USID) methodology that is catered to participants who might, or might not, be familiar with a formal design research process. [8] Similarly to iterative design, USID projects involve participants at every stage of the process, but in USID researchers use "sensitive consultation" techniques to ensure participants are able to participate at the level they are comfortable with. [8] We will interview four dyads, make changes to the application that address feedback received during our consultation with participants, then test another four dyads and continue until we have reached a point of data saturation.

Newell, Gregor, Morgan, Pullin & Macaulay state, USID "suggests that the users are firstly people and that the designer should develop an empathetic relationship with them, rather than treat them as 'subjects' for usability experiments." [8, p. 237] Although the humanistic USID approach is comparable to the methodology of iterative design, additional evidence-based research needs to take place before USID replaces the methodology of iterative design. [7, 8]

Findings and Discussion

Results from the self-administered questionnaire in the preliminary study show that participants enjoyed adding media to postcards, especially video. The video analysis findings were supported by findings from the interviews, where most participants reported that adding media to the postcards was the most meaningful part of the experience.

The design, development and testing of a touchscreen tablet application with healthy adult volunteers has revealed intriguing questions for the full study, such as how adults with ESD might interact with touchscreen tablet applications designed for sharing events, and why and how narrative creation and postcard sharing might be meaningful. The use of the think aloud technique for data gathering has been successful for providing rich data to support our thematic video analysis (Figure 1). Future directions will involve comparison of results of the preliminary study with the full study to learn if the USID approach is supportive, or not, for adults with ESD. Likewise, data from both think aloud sessions will be useful to compare, to learn if participants in both groups experienced a greater sense of success when completing tasks.

The Postcard Memories application gives all users—friends, family— a way to create new stories and retell old stories. The experience of telling, retelling, listening, and hearing life stories is an experience that is perhaps beneficial to all people. As the study continues, and we gather feedback at our ISEA 2015 demonstration, we seek to investigate if the act of retelling specifically offers a greater sense of agency and recognition [9] to the stories that adults living with early stage dementia might share with their family, friends, and caregivers.

Project website:
http://research.ocadu.ca/mobilelab/project/postcard-memories

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Author Biographies

Martha Ladly is a Professor of Design, teaching in the Digital Futures Graduate and Undergraduate Programs at Ontario College of Art & Design University (OCADU), as well as the Interdisciplinary Master's Program. Dr. Ladly specializes in teaching and practice-based research in design, art, media, and technology. She is the former Associate Dean, Graduate Studies, at OCADU. Dr. Ladly is a senior researcher with the Mobile Experience Lab and a Network Investigator with the Graphics, Animation, New Media National Centre of Excellence. Dr. Ladly past positions at OCADU include Chair of the Research Ethics Board (2008-2011) and Graduate Program Director of the Interdisciplinary Master's Program in Art, Media, and Design (2009-2011). In addition, she recently led the development of the Graduate Program in Digital Futures. She was the Director of the Canadian digital arts and culture website HorizonZero (www.horizonzero.ca). Dr. Ladly is a Registered Graphic Designer.

Dr. Frank Rudzicz is an expert in speech recognition and artificial intelligence in applications designed for individuals with special speech characteristics at Toronto Rehabilitation Institute (University Health Network). His work in natural language and speech processing is multidisciplinary and involves machine learning, human-computer interaction, artificial intelligence, computer vision, speech-language pathology, rehabilitation engineering, digital signal processing, and linguistics. His research augments existing techniques by refining the statistical relationships between neural, articulatory, and acoustic levels of speech within modern automatic speech recognition systems. These augmented speech systems can be for several applications including: i) automated human-computer dialog systems that include speech synthesis to help individuals complete daily tasks and ii) prosthetic communication aids for human-human interaction that modify the acoustics of hard-to-understand speech to make it more understandable. Dr. Rudzicz is also Assistant Professor, Department of Computer Science, University of Toronto and Associate member, School of Graduate Studies.

Bryn A. Ludlow is a PhD Student at York University in the Faculty of Graduate Studies, York and Ryerson Joint Graduate Program in Communication and Culture. She holds a BFA in Integrated Media from the Ontario College of Art & Design University (2010) and a MA in Health and Aging from McMaster University (2012). Bryn has presented her research on body mapping at national and international conferences, including at the University of the Witwatersrand, Johannesburg, South Africa (2011). Her "Body Spaces" vector illustrations are published in "The Medical Post", and "Ars Medica: A Journal of Medicine, The Arts and Humanities".

Ana Jofre's interdisciplinary practice is grounded in a diverse academic background, which includes a PhD in Physics from the University of Toronto. Ana started pursuing art as a professional practice and exhibiting her work while serving as a full-time faculty member in the Department of Physics at UNC Charlotte, where she conducted and published research in experimental biophysics. At this time, she also completed a BFA with a concentration in ceramics at the same university. A romantic at heart, she found herself more motivated to make a cultural contribution to society than to collect and publish additional data. She recently completed the MFA program at the Ontario College of Art and Design University in Toronto, Canada. Her current practice integrates knowledge and methodologies from various disciplines to create aesthetic experiences of 'presence'.

Laura Wright is an artist, producer, writer, and interactive designer based in Toronto, Ontario. She completed a Masters of Fine Art in the Digital Futures Initiative at OCAD University where she explored interactive video, application design, and digital art installations. She recently took part in an international exchange with the American College of Greece in Athens where she worked to re-invigorating the 2004 Olympic venues with digital art interventions. She exhibited an interactive art installation called Arduino Disco for Toronto's 2013 Nuit Blanche. Wright has a Bachelor of Journalism degree with Honours from Carleton University in Ottawa, Ontario. She worked for several years as a news reporter and editor for CBC News, based in Yellowknife, Northwest Territories.

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A Wearable Experiment to Radiate Prosocial Wellbeing Through Psychophysiological Mirroring of Laughter

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Abstract

Based on a practical somaesthetics framework emphasizing the values of self experiences, this paper presents the design rationale of a responsive dress, Laughing Dress, which employs laughter as an agent to highlight the unobvious and unspoken social distance between strangers and inverting our cultural notion of public self-containment. The proposed wearable dress is used to investigate the concept, "disruption for reformation". Throughout the design process, the prototype addressed the research question, "Can exposing self-representations through synthetic sound as inner voice and rhythmic light as somatic energy rattle and provoke reposition of us against existing social norms of private-public space?" The research instrument aims to break personal boundaries by magnifying wearer's self-presence, enticing a psychophysiological mirroring of laughter in another entity, and evoking a sense of curiosity through a display of visual aesthetics. The unusual display and magnification of self-presence within public setting contributes to disruption of social expectation on self-containment in public, reflection upon the organic form of human-to-human interaction, and initiation to realign our behaviour.

Keywords

Wearable Technology, laughter, responsive wearable, psychophysiological mirroring, social mimicry, emotion contagion, prosocial behaviour, social convention

Introduction

City is built upon decades of structures and regulations, where its culture plays a major role in its inhabitants' social behavior. Social changes emerged from new innovations and political movements reconcile behaviour incrementally, but the repercussion might be far-reaching. Advancing technologies have created a new era of communication where people of different location and time are able to connect and reconnect quickly and effectively via telecommunication. The emerging behaviour led to the major shift of attentional focus towards handheld devices and other forms of electronic, thus consequencing on a lack of face-to-face communication between one another.

Laughter is a universal form of human communication that indicates intrinsic emotion, mood or personal expression outwardly. Neuman et al. describe this involuntary mimicry of expression as mood contagion, which aligned with Van Barren et al.'s view point of a mirroring of postural, emotional, and behavioural reaction from the observer [9, 20]. Laughter's contagious ability makes it an intuitive, yet fitting medium outcasting positive energy from oneself to another, thus disturbs the social silence within a self-containing culture and invites a merging of personal space.

Research Potential

Advances in telecommunication technologies have allowed our communication across distances to be instantaneous, efficient, and dynamic. While they have allowed for users to remain socially connected across multiple platforms simultaneously in the digital realm, it has also created a phenomenon of physical isolation between users in our physical world, resulting in the loss of intimacy and connection between persons.

A recent meta-analysis of social interaction in Vancouver, Canada, demonstrates that large numbers of residents in metro Vancouver experience social isolation and disconnection [21]. The largest community foundation, Vancouver Foundation, conducted a mixed method study with 3,841 participants in 2012, where 34% of the participants felt difficult to build new social connection in Vancouver. 60 % of the participants only have short conversation with any of their neighbors less than 2 or 3 times a month. Moreover, 26 % of house tenants never speak with their neighbor more than once a year. 25% of the participations felt lonely, where young adults, new comers to the country, and new members of the neighborhood aged 25 to 34 experienced social isolation the most. In addition, Perissinotto et al. pursued a longitudinal cohort study of 1604 participants in psychological and health condition and found that 43% participants experienced a lack of social contacts and felt disconnected with their community [11]. They assert that the social isolation in adults older than 60 years could cause some functional decline in mobility of their body and even death.

The desire to revitalize the diminishment of face-to-face communication in our technological advancing society motivated a research exploration on the concept of "disrup-

tion for reformation" through interactive public art. We implemented a research prototype that encompasses materiality, poetics, and semantics of interaction for practical somaesthetics. The interactive dress aims to investigate whether a combination of synesthetic laughter with rhythmic light patterns provides sufficient somatic stimulations to provoke self-reflection and induce physiological mirroring of positive bodily expression for behavioural changes among others in public settings [Figure 1].

Research Domain & Related Work

Catalytic creations can cause social changes. We see the potential of disruptive innovation to trigger realization, reflect, and reactions to ingrained social norms. With the overarching inquiry of "whether a display of self-representations through synthetic sound as inner voice and expressive light as somatic energy rattle and provoke reposition of self among others within the same public space", the research instrument, Laughing Dress, ameliorates the domains of interactive body visualization art, psychophysiological mirroring of laughter, and practical somaesthetic.

Public Art on Body Visualization

The initiation to cause change in our society calls for a work that engages the public. This elicited researches and works to explore the notion of self as an agent to transform one's situated space. Rafael Lozano-Hemmer's Pulse Room [8] bio-detects and translates participants' unique heart rates into one of the 300 incandescent lamps within the overall installation space. This process leads to 300 individual flickering light patterns as means to explore self-regulation of one's intimate heart within public space. George Zisiadis's Pulse of the City [22] converts a pedestrian's real-time pulse data into music that projects through a speaker at one of Boston's city sidewalk. This installation aims to reconnect pedestrians with their body rhythms while celebrating their use of public space in a playful manner. Additionally, installation works such as Feel_Perspire [4] and Pulse and Bloom [14], highlight the potentials of displaying biofeedback interaction for audiences' reflections upon the relationship of their personal bodies within public and social realm. Thus, inspired by the problem of self-isolation within public spaces, the display of personal body visualization on the Laughing Dress is a viable form for a controversial interplay between private and public.

Psychophysiological Mirroring of Laughter

Laughing is one of the natural body expressions that represent joyful emotional states in ourselves [15]. Provine further highlights the contagious quality of the sound of laughter and its ability to increase feelings of warmth and connection between individuals [12, 13]. Fukushima et al explored the concept of psychophysiological mirroring behaviour by developing a system, which produces laughing soundtracks that synchronize with the user's desire to laugh in order to induce more laugher [3]. Through the experimental study, they demonstrated that the synthetic laughter extended the duration of user's laugh. Shahid et al.'s study [19] with the Adaptive Affective Mirror further reinforces the potentials of laughter as audiovisual feedback to elicit positive emotions from users. Through Laughing Dress, we hypothesize the following: Laughter is a contagion for happiness, which can foster opportunities for social interaction between strangers.

Practical Somaesthetics

Practical Somaesthetics is one of three fundamental branches of Somaesthetics introduced by Richard Shusterman [18]. It highlights the participants' aesthetic appreciation of bodily experience and their embodied reactions to the interaction. Through soft(n) [16], Schiphorst argues the consideration of poetics, materiality, self-experience, and interaction semantics as invaluable design resource in the craftsmanship of embodied interaction. Exhale [17], Cardiomorphologies [7], and Below the Belt [5] examine the correlation of personal breath and emotional expression between individuals during the making of interactive experience across bodily and social realms. These bio-interactive installations align with the framework as they afford somatic experience through the processes of self-awareness, -reflection, and -representations to provoke understanding on the research concept and engage the audience within their situated, public space. Wo.Defy [6] further highlights the use of this framework by crafting a wearable, narrative space that allows the wearer and audience to culturally reconnect and reengage with the Chinese suffragette history from the late 19th to early 20th century. In our motivation to reveal the self-lived experience to the public realm, Laughing dress applied the bodily practices in somaesthetics framework to magnify self-representation of wearer, disrupt social boundary, shift the attention of passerby, and reform social interaction.

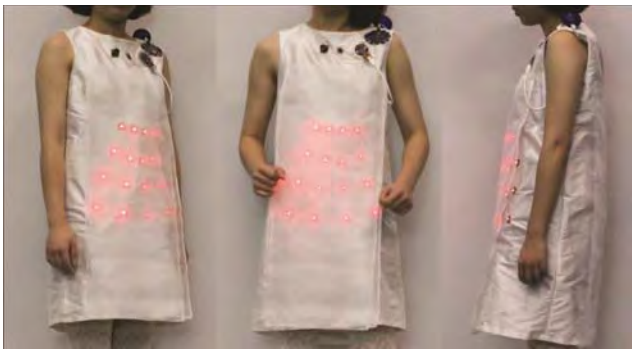

Figure 1. Laughing Dress. © SFU SIAT Soma Embodied Wearable Group 2014

Design Rationale: Laughing Dress

We aim to probe with the expression and communication of laughter on interactive wearable to encourage prosocial behaviour between the wearer and speculators within a public space. The materiality of raw technologies on the Laughing Dress and the poetic expression of wearer's presence as visual aesthetics serve to welcome interaction

through honest epiphany of the wearer's being. To help establish a connection between individuals, the prototype's interaction module is driven by interpersonal proximity to obscure the boundary between personal and public space. The subconscious psychophysiological mirroring of synthetic expression in the body and the generated opportunity to connect among one another stimulate thoughts about the disruptive experience as ways to reflect upon our being. Laughing Dress amplifies wearer's presence both visually and audibly as a non-conventional paradigm to rattle existing social structure of public behaviour.

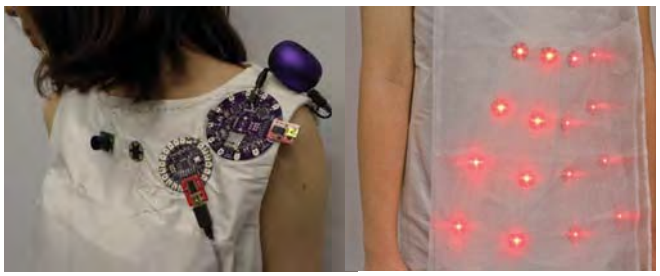

Figure 2. (Left) 4 series of Lilypad LED Pixels, (Right) From left to right: Ultrasonic distance sensor, tri-axis accelerometer, Lilypad Arduino microcontroller, Lilypad MP3 player, mini speaker. © SFU SIAT Soma Embodied Wearable Group 2014

Materiality and Poetics of Revealing Inner Self

Laughing Dress displays wearer's body state and presence as synthetic positive expressions to external entities to establish curiosity and conversation in hopes to foster social comfort and trust. With laughter as agent for emotional transference through psychophysiological mirroring, we translate the by-product of laughter into a series of expressive light patterns. The generated lights accompany the simulated sound of laughter on the wearable prototype as an allegorical reference to the invisible energy radiating from the wearer's laughter. The tri-axis accelerometer at the collarbone region cause changes to the LED light pattern at the lower torso region [Figure 2]. As the gestural movements of the wearer increase, the XYZ values detected by the accelerometer increase, which maps to a higher intensity output in the LED lights [Figure 3].

The exposing technologies on the soft interface align with the conceptual intention to reveal the authentic self; the work extends an invitation to the spectators to overcome self-containment. The visual aesthetics of Laughing Dress represents the wearer's presence, which breaks the veiled social boundary, initiates opportunities for social interaction, and aims to increase prosocial behaviour between the wearer and her spectators.

Interaction Semantic: Breaking Private-Public Boundaries

We employed a human-computer interaction approach to explore a solicitation of positive face-to-face communication; the dress elicits a positive feeling and fosters trust between strangers to disrupt against our culturally accepted practice on personal space. Research highlights that physical distance correlates to the social distance between two persons [2]. Using an ultrasonic proximity sensor at the collarbone region, we map the amplification of the laughing sounds to the physical distance between the wearer and spectator; the increase in volume indicates a closer social distance between the two. As a result, the expressions of laughter infers to the intensity of positive mood generated from the interaction between the wearer (conceptualizer) and participating spectators (interlocutor).

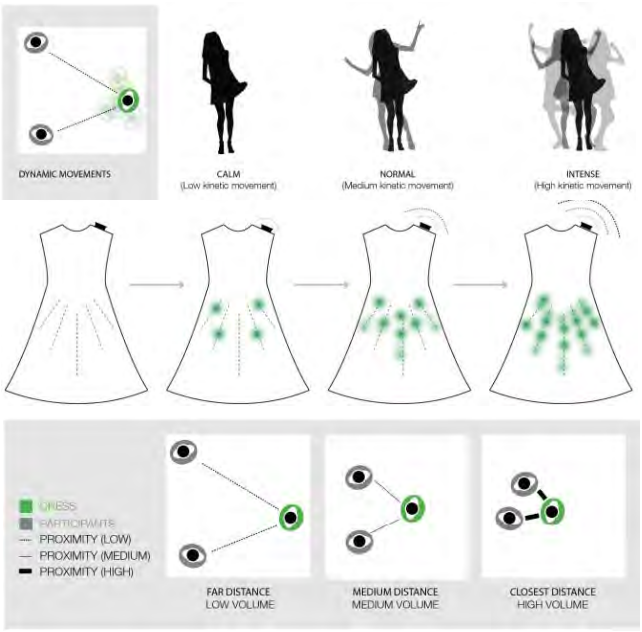

Figure 3. The Interaction Model (Wearer's Moveents, Sound & Light Output, Proximity) © SFU SIAT Soma Embodied Wearable Group 2014

Somatic Experience for Reformation

While individuals differ in their sensitivity towards emotional contagion [10], research indicates positive mood has greater inter-influences than negative mood [1]. As a result, Laughing Dress uses laughter as a positive emotional contagion to encourage social interaction between strangers within a public space. Through the wearable display of laughter accompany with light pattern expressions, the dress transmits enjoyment and positive mood from the wearer to the spectators through the involuntary mimicry of laughter. The interaction aligns with Neuman et al.'s description of mood contagion [7] and reveals a similar impact as Van Baaren et al.'s as they claim that the wearer's facial, postural, and behavioural expressions can produce movement, facial, and vocal mimicry synchronously as evidences of emotional responses [20]. To foster positive social bonding in a public space, Laughing Dress can be used to encourage spectators to smile, laugh and make eye contact, then stimulate prosocial responses and behaviour between the wearer and spectators through psychophysiological mirroring of positive audiovisual expressions.

Conclusion and Future Work

Laughing Dress is a research instrument that aims to investigate whether an interactive garment can repurpose an existing human quality, laughter, within an everyday design context to highlight the salient proximal distance between people within public spaces and bear prosocial behaviour through involuntary mimicry. This interactive public work employs a disruptive medium for self-reflection to cause reformation of self, towards others, and within our society. Laughing dress generates visual and audio expressions by means of one's physical energy and the proximal distance between individuals of a shared space. The alienation of this familiar bodily experience arises awareness, induces interest, and creates dialogues among strangers; the psychophysiological mirroring encourages prosocial behaviour towards one another, which challenges the existing self-containing culture.

We believe that laughter holds a charismatic quality where people of all ethnic background can understand intrinsically. We aim to take the responses from Laughing Dress experience to proceed forward to a practical solution where an appropriation of laughter can be used in an everyday application to elicit social connection, positive attitude, and prosocial behaviour in public setting.

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Senseparation

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Abstract

This paper describes the interdisciplinary joint project Senseparation [1] that focuses on the cross-border networking of people between virtual and real space. We set up an encounter between two persons located at different places to encourage people to think critically about today's online communication. In our experiment, one person in a virtual reality (VR) installation (CAVE) [11] or wearing Oculus Rift glasses is able to interact with another person located in a dark room wearing a vest with vibration motors, compass and controller. The person in real space is represented as an avatar in the VR environment. The one in the real space is able to perceive the person in the VR environment with tactile and auditory senses. Spatial audio in the dark room supports the representation of the proximity of the two people. The person connected to the VR environment can interact with the avatar and touch it by means of a 6 degree of freedom input device. Touching the avatar gives also visual feedback on the avatar. We separated tactile, visual and auditory feedback for this encounter in order to increase the intensity of the distant encounter.

Keywords

Telehaptic, Wearables, VR Environment, Performativity, Tactile Feedback, Interaction, Virtual Reality

Introduction

Research in the field of Human Computer Interaction (HCI) aims to make the communication with the digital data more human and intuitive. Encounters in the virtual world and over distances are quite common today.

Ways of getting in touch with people have changed completely since the Internet has become part of daily life. For hundreds of years people usually met personally in real life and then perhaps became friends. Nowadays it is often the reverse. People often meet first on the Internet before meeting in real life. One real world impact of digital communication is that we dispense with the bodily nearness to our communication partners.

Despite all the advantages of digital communication this means a disruption in our habits. In digital communication we are limited to reading, listening, seeing and interacting verbally and visually. What about the body language, the body expressions and gestures, the expression of emotions, the warmth, the breath, the personal charisma and the smell of a person? Based on these thoughts, we have developed a concept of a telehaptic encounter between two people in distant places.

Related Work

Solve et Coagula (SeC)–mating man and machine by Stahl Stenslie combines interaction between a person, equipped with a bodysuit with built-in pressure sensors and vibrators, and a virtual cyberorganism. The artificially intelligent virtual creature speaks to the user through spatial sound and is able to touch him or her. SeC 'attempts to sensorially pair man and computer together'. While the user experiences SeC in an immersive VR world with visual, tactile and auditory stimuli, these are separated in our project: the VR user has a visual experience while the other user perceives auditory and tactile feedback. [2]

Can you see me now? by Blast Theory in collaboration with the Mixed Reality Lab is a chasing game which overlaps a part of a physical with a virtual city by the use of handheld computers connected over the internet. This game is closely related to our project in terms of interest about proximity between participants in the real and virtual world superimposed. [3]

Sommerer and Mignonneau communicate body sensations and smell with touch-devices shaped as gourds. They share private body sensations like heart beat, blood volume pressure, pulse, skin conductivity, sweat and smell, with strangers over the mobile phone network. These sensations are perceived via vibrator motors, ventilators, micro-electro-mechanical and micro-bio-electrochemical actuators. They investigate how technology has changed our lives by exchanging privacy for mobility and connectivity. [4]

Concept

The goal was to stage a telehaptic performance with tactile, auditory and visual feedback and to get information on triggered emotions. In this type of encounter sensual components are missing compared to encounters in the real space. Which sensory perceptions are necessary to raise positive emotions in a virtual encounter?

To find out these conditions, we have developed an experimental setting. The sensory experience takes place in two different locations. By means of an avatar, the user in the virtual reality is able to interact using an input device with the person in the real space, in a dark room wearing a vibro-tactile vest. The position and orientation of the avatar corresponds to the position of the person in the dark room. Each contact between the user in the VR environment and the avatar gives an additional visual feedback on the avatar in the VR environment. In return, the person in the real space is able to perceive the other person with tactile and auditory senses. Vibration motors in the vest give tactile feedback at the contact points. We selected three different

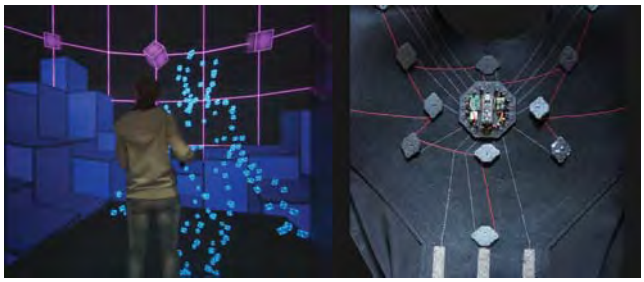

Figure 1 VR environment, vibro-tactile vest

touch patterns for the interaction with the avatar: hit, touch and bump.

We opted for the CAVE as the interface of the encounter to achieve a higher degree of immersion and presence and thus achieve an intensification of the encounter. Sound in the dark Room supports the representation of the proximity of the two persons.

Design

We designed a vest, the avatar and the virtual world environment in which the avatar is presented and the sound.

Garment Design

Wearables show [5] or hide [6] the integrated technology. We have combined both options. In our weareable design we played with the exciting contrast of cool technology and warm materials like fabric and felt. This idea represents our basic concept, where we combine human encounters, human proximity and thus warmness with functionality and the coolness of technology. We applied wires clearly visible on the vest, similar to a "network" pattern, alluding to the type of encounter [Fig. 1]. For tactile feedback we integrated 16 vibration motors along the spine, at the shoulders, the elbows, the breast and the hips.

Avatar Design

The degree of abstraction was a key element in the design of the avatar. First, the avatar provides enough mental room to imagine a real person behind it and is gender non-specific. Second, it is a pleasant and non scary counterpart. Based on the research on the Uncanny Valley effects [7], we decided against a photo-realistic rendering of the avatar. Inspired by existing projects [8] we have chosen a visualization in the form of a cube cloud. These cubes convert into a human silhouette when the two people come closer to each other as shown in Figure 1.

VR Environment Design

The VR environment where the avatar and the real person meet consists of a floor plate which is the same size as the dark room. It is surrounded by a larger virtual globe that is open at the top and is only restricted by a wire frame combined with blocks [Fig. 1]. This design element reflects the networked encounter. The lower part of the globe consists of a geometric architecture with blocks.

Dark Room Design

The dark Room is equipped with position and orientation tracking for a single user and a spatial 4-channel audio system. The tracking system consists of a single Kinect camera, used in depth mode, to capture the dark room user's position. The orientation of the user is sensed by a compass module integrated in the vibro-tactile vest. A communication server connects these components for exchange of data between them and the VR installation.

Sound Design

We use five separate sounds for the sonification of the VR user in the dark room: position and velocity, as well as the three touch patterns hit, touch, and bump. Position and velocity sounds are constantly played back as spatial sound in order to experience the exact location of the person in the VR installation and therefore the proximity of both participants. The main concern of the sound design consists of not losing these semiotic links between action and sound. The spatial audio system is realized in Pure Data, using the Ambisonics technique. [10]

Hardware Components

The virtual world can be displayed with an arbitrary VR installation like a CAVE or other multi-display installations. An alternative, easily reproducible setup consists of an Oculus Rift, a low cost HMD as an immersive display as well as a Razor Hydra input device. To realize the cross-platform and cross device functionality the application makes uses of OpenSG [12] as a scene graph and VRPN [13] for the abstraction of input devices.

The model transfer was implemented in VRML [14].

Conclusion

Senseparation establishes a critical reflection about distant encounters between virtual and real space. With Senseparation as an ongoing research project, we continue our investigation in opening the limits of digital communication: as a first step, we implemented the characteristics of someone getting close as tactile and auditory feedback on the one side and abstract visual output on the other side. Additionally different physical contacts are perceptible. Participants can compare the experience with isolated visual versus tactile and auditory senses.

Initial observations showed, that the users' reactions are ambivalent in terms of the triggered emotions. Most users felt comfortable about the VR environment. Also, the appearance of the avatar was evaluated in a positive way. The avatar was described as non scary and gender unspecific. It gives enough space to imagine another person. The situation in the dark room was described as ambivalent. It was confirmed that the sound reflects the proximity of the other person very well. The vibration feedback however needs to be optimized. Therefore further research is necessary. Body contacts could be felt, but they are not detailed enough to reflect real touches. However, the positions of the vibrations motors were described as well located.

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The Aesthetics of Activism: See-through Effect

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Abstract

For this demonstration the authors intend to present the *Aesthetics of Activism* as a work-in-progress. This interactive artwork explores the nature both of audience engagement as well as the interdisciplinary conditions of its making. The work is designed to visually represent an assemblage driven by people's bodies that are tracked and translated into interactive collage elements via motion sensors. Images projected are composed from a mixture of algorithmically scavenged social web resources and artistically curated and altered videos. The demonstration will present a new interactivity feature that continuously tracks a body, coupling it with a distinct eyehole (a region distributing transparency), allowing one of the composition s retrial layers to be viewed. The experience provided points towards the ways technological advances transform and shape public spaces, thereby subverting familiar strategies of activist practice while rendering possible new forms of aesthetic resistance.

Keywords

Interactive Art Aesthetics Code Literacy Activism.

Introduction

The *Aesthetics of Activism*[1] is an interactive work-in-progress designed to facilitate aggregation of visual material from social networks to form themed compositions that can be explored jointly within a shared interactive space. It seeks to combine reflection on the algorithmic conditions of contemporary digital attention economies with an awareness of the interdisciplinary circumstances of technology production. To this end, aesthetic principles underlying human-made visual compositions are translated into algorithm. Generated and curated content is combined within interactive collages exhibiting a multi-layered structure. The work is part of a larger research study that investigates the broader context of social, digital, and cultural production 3 .

For this demonstration, we worked with social web resources related to Canada's Kinder Morgan protest[2] to present a new feature that couples every tracked body with an eyehole shaped lens that allows one of the composition s retrial layers to be viewed. As seen in Figure 1 each time a new body enters the interactive zone a distinct eyehole transition (i.e. region redistributing transparency) is created. Each tracked body is coupled with a distinct eyehole such that a different layer becomes accessible to the respective audience. When more bodies enter the interactive zone, more layers are partially revealed. The exact configuration and structure of visibility thus depends both on the number of present bodies as well as their collocation.

Whenever no people are present within the interactive zone, the system slowly cycles through available compositions as seen in Figure 2. The nature of the composition is a variable that rests on the described 'see-through' effect, revealing additional content or creating a thematically motivated contrast. Depending on the site of demonstration the work illuminates glimpses of hidden layers or invites sustained exploration amongst people interested in the retrial layers.

Figure 1. This illustration demonstrates the effects of four people collocated within an interactive zone.

Figure 2. This illustration demonstrates the effects of the system generating image composition without people present. As time lapses the image layers thin until they fade completely.

[1] Aesthetics of Activism documentation: interactionart.org
[2] David Suzuki Foundation's blog on Kinder Morgan's Trans Mountain pipeline project: http://davidsuzuki.org/blogs/panther-lounge/2012/07/we-are-the-kalamazoo/

Layered images are seldom exported to visual 'consumers'. By exhibiting a multi-layered surface the piece hints towards the interdisciplinary circumstances that produced the artwork. Our goal is to demonstrate how traditions both from the visual arts such as assemblage making [1], as well as, digital practices such as interactive collage [2] can be used to make statements about real-life events.

The proposed demonstration as illustrated in Figure 3 can be projected onto a white wall, projection screen or, ideally, a glass surface for rear projection (e.g. a store front window). The generative part of the composition is created from aggregated social web resources as displayed in Figure 4. As seen in Figure 5 the installation requires reduced lighting and an unobstructed interactive zone infront of the display surface.

Figure 3. Aesthetics of Activism work-in-progress projected onto the Surrey Central Library, BC, Canada

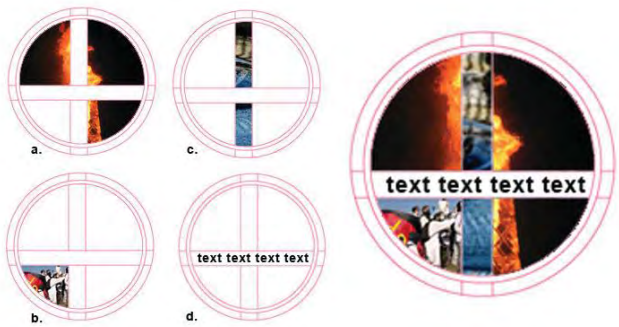

Figure 4. This illustration maps the generative composition aggregated from social web resources. The placement of each layer represents: a) context, b) contrast, c) people protesting, and d) text related to theme.

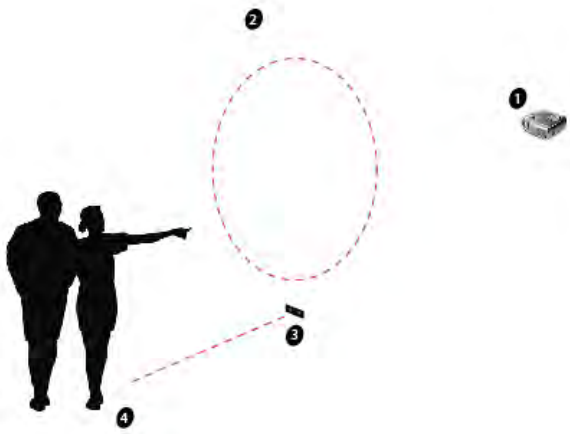

Figure 5. This illustration shows the general set-up: 1) Projector and Laptop computer, 2) Screen, 3) inect sensor, and 4) Interactive zone in front of the projected images.

Conclusion

In this submission we have briefly introduced the *Aesthetics of Activism* as a work-in-progress investigating the broader context of social, digital, and cultural production. Our proposed demonstration intends to invite conference attendees to experience our new interactive feature that couples every tracked body with an eyehole shaped lens activating the retrial layers of the artwork as seen in Figures 1 and 2. Our future work will continue to explore the creation and detection of social media patterns and interactivity as a mode of cultural production combining formal and non-formal aspects of aesthetic phenomena such as painting, nature, or mathematics.

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The D-Box: How to Rethink a Digital Musical Instrument

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Abstract

The D-Box is a novel digital musical instrument that can be modified and hacked by the musician, subverting its original design. The possibility to rethink and appropriate a musical instrument in unexpected ways is not common when dealing with digital circuits and hard-coded software. In this short work, we first briefly introduce the details of the hackable design that characterises the D-Box; we then describe how 3 musicians transformed their D-Boxes into 3 radically different instruments, according to their own artistic needs. Finally we argue why and how this is relevant to the domain of instrument design, music and creativity. This work comes together with a demo session, during which the audience will have the opportunity to replicate step by step the 3 hacked instruments and make music with them.

Keywords

Hacking, Appropritation, DMI, Embedded Hardware

Introduction

The evolution of a musical instrument is often times unpredictable. Designers and musicians continuously revise their instruments, adding and discarding features, likely producing a gradual drift from the original design. This is particularly true for successful musical instruments characterised by a long life span. A good example is the guitar, which has been rethought less than a century ago with the introduction of electric amplification, or brass instruments like trumpets and horns, now featuring piston or rotary valves to allow pitch change. Similar reinterpretations of an instrument may help its diffusion and keep it popular over time.

However, the possibility to *rethink an instrument* and push towards new creative boundaries must not be taken for granted, especially in the domain of Digital Musical Instruments (DMIs). The usage of digital technologies makes available novel musical systems, but often leads to intrinsically "black box" designs, hard-coded, difficult to understand and to modify. In contrast with this trend, we developed the *D-Box*, a novel DMI based on embedded technologies and specifically designed to be appropriated and repurposed in unexpected ways.

Hackable Design

The D-Box is a *hackable instrument*, supporting and eliciting modifications by the performer through circuit bending techniques. These techniques consist of exploring and hacking the circuitry underlying an electronic device, adding/removing components and connections to subvert its functionalities and find novel idiosyncratic musical features (Collins 2008). Although born in the 70's, this practice still deals with the building blocks of modern electronic instruments and is theoretically capable of fostering creative misuses and modifications of DMIs. Unfortunately, circuit benders prefer focusing on toys or inexpensive musical instruments (Ghazala 2005), since latest DMIs are likely to produce silent configurations or even break when hacked. This is mostly attributable to the usage of small and fragile integrated circuits, digital logic and hard-coded software processes.

The D-Box is a first attempt to regain the flexibility and the reintepretability of old electronic instruments even when latest generation digital circuits are used. Although apparently very simple, this instrument is characterised by an innovative rationale, that is the result of more than one year of studies on performer-instrument interaction and design for appropriation. The D-Box appears as a self-contained, 15 cm laser-cut wooden cube carrying a BeagleBone Black[1] (BBB) embedded computer and a full range speaker. Two multi-touch strips are attached on one side of the enclosure, one laying on top of a force sensor. The metaphor of the instrument is fairly straightforward: tapping on the touch strip opposite the speaker triggers a sound loaded on the BBB, with position controlling pitch and pressure determining volume; additionally, a bandpass filter can be controlled touching the second strip, introducing up to 5 independent bands. Sinusoidal partial synthesis is used to playback the samples. Attached to the inside of the D-Box there are also 2 piezo microphones, amplifying the mechanical and acoustic sounds resulting from the interaction with the body of the instrument.

However, the complexity of the hackable design of the D-Box revolves around its internal circuitry and its connections with the on-board software. Opening the side panels of the enclosure it is possible to access a breadboard populated with standard electronic components, as shown in Figure 1. The resulting circuits are connected to the embedded computer

[1] http://beagleboard.org/black

via a custom *cape* (expansion board), which equips the BBB with 8 analog inputs and 8 analog outputs. This network of connections, collectively called the *matrix*, creates feedback loops between the analog electronics (including audio and sensors' input) and the software, which is running on a ultra low latency, hard real-time custom Linux system. Synthesis parameters are extracted from the voltage signals sampled in software and fed back into the circuit as analog outputs, linking most of the mappings and sonic behavior of the D-Box to the current state of the matrix. For more information about feedback loops, technical specs and musical features of the instrument, please refer to (McPherson and Zappi 2015).

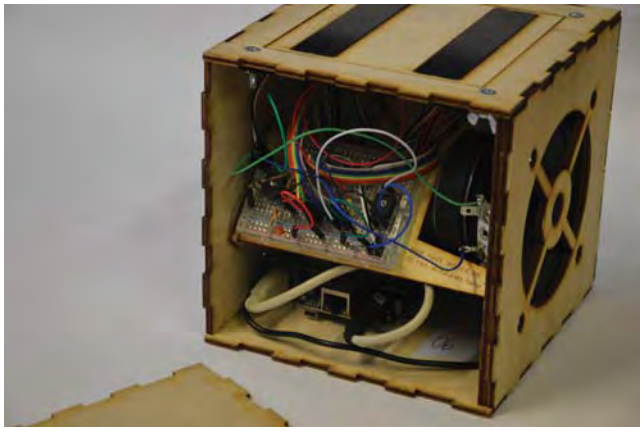

Figure 1: The inner breadboard of the D-Box, carrying the circuits which define the instrument's behaviour. The two touch sensors lie on top of the wooden case while the speaker is embedded on a side.

As discussed in detail in (Zappi and McPherson 2014), the simplicity of the original metaphor encourages the modification of the instrument. Any electronic components can be used to relax constraints, add, modify and remove features. The inner circuitry can be hacked connecting together unrelated parts of the matrix to create unpredictable time-varying behaviors, also feeding back the audio output onto the breadboard. Furthermore, differently from a *modular* approach, the space of possibilities is not defined a priori. In a modular system, strictly connections and sounds pre-thought by the designers are accessible; only the musicians who found themselves comfortable with these set of features will keep on playing the instrument. As opposed, hackable design theoretically gives the possibility, even pushes to drift from the original instrument, engaging with creative configurations unfamiliar even to the designers. This could be particularly relevant in the context of artistic creation and for the development of the instrument itself.

D-Box Hacks

To test the D-Box and the hackability of its design, we ran a user study with 14 musicians. Each participant was given a D-Box and was asked to prepare a live performance in few weeks. Although not forced to hack the instrument, almost all participants decided to modify their box, in some cases thoroughly subverting its original design. Before analysing the global outcome of the study (Section Discussion), in the next sub-sections we will highlight 3 of the most remarkable hacks that we encountered. Technical modifications will be explained step by step, with the aim to explain how differently these instruments evolved and how this process made possible the development of extremely diverse personal playing techniques.

Hack #1 The whole hack from Participant ID 5 (P5) targets precise timing and control, resembling an acoustic or electric instrument. None of the original features of the D-Box were discarded; the performer changed the pitch range of the instrument to comfortably play a tune he composed and then extended the instrument's metaphor with new elements. As first step, P5 loaded 2 custom sounds on the BBB, one sustained, the other percussive. He then added two push buttons to enable pitch control through the manipulation of a Light Dependent Resistor (LDR), one button pulling the pitch up, the other pushing it down. Furthermore, when both the buttons are pressed, the second sample is activated and its attack is enhanced by an abrupt pitch shift, acting as a fast envelope. The buttons and the LDR are exposed on one of the side plates, while the matrix is sealed inside of the closed case, making it inaccessible during musical performance. The resulting instrument is capable of both pitch and rhythmic fine control, mostly based on instantaneous exchange of mechanical energy with the performer, on buttons, touch sensors and tapping the side plates; this makes it ideal for "instrumental interaction" (Cadoz 2009) based on coordinative skills.

Hack #2 P8's instrument is designed to mix sensors and matrix interaction to create rhythms with unpredictable timbral textures. The pressure input from the first touch sensor acts no more as volume control, it is used instead to switch between 2 custom loops, yet leaving position to control pitch. The finger position read from the second touch sensor determines the playback length of the current sound, i.e., the number of samples looped when the sound is triggered. Also audio inputs are included in the hack; one of the piezo signals is shorted to the clock circuit of the system, so that tapping the box interferes with the playback speed of the samples. Differently from P5's hack, the instrument is supposed to be played with the side plate open, acting on the inner circuitry. P8 prepared the matrix with additional jumper wires allowing to quickly short together the pitch and the clock circuits, and to swap between capacitors of different size; this causes musical autonomous processes, like pitch oscillations at varying frequency and glitches. Furthermore, during the performances, P8 used a small vial to pour water on the capacitive pitch sensors; using only one drop, he obtained infinite sustain of a precise note, while wetting the whole surface he triggered continuous and chaotic pitch changes, caused by water evaporation. P8's instrument is a complex device carefully tailored according to P8's needs. It is partially controlled by the performer and partially dependent on some level of self-agency of the system, making available what Johnston et al. defined as "conversational mode" of interaction (Johnston, Candy, and Edmonds 2008).

Hack #3 P10 is an experienced circuit bender and he modified his D-Box making use of typical circuit bending tools and techniques. We gladly acknowledged that, for the first time, P10 managed to make use of his hacking skills to probe and modify a DMI, rather than cheap/old instruments and electronic toys. His hack revolves around 4 potentiometers, that can be used to dynamically connect different parts of the matrix and modify the electrical behavior of the circuits. Each potentiometer is configured as a variable resistor, using two wires: the first one is steadily fixed to a specific circuit (the clock rate, the partial waveform generator, the sound selection and the amplified audio output); the other is floating and can be attached anywhere on the matrix through a crocodile plug. Moving these connections and playing with the indeterminacy of floating wires it is possible to assemble complex circuits, characterised by unstable/time-varying electrical configurations. These autonomous processes gain primary control over synthesis; the touch sensors are almost dismissed, while the performer directs, combines and shapes sounds using the matrix, leveraging his intellectual skill in an "ornamental mode" of interaction (Johnston, Candy, and Edmonds 2008).

Discussion

Other participants showcased intriguing hacks and unexpected playing techniques. One performer directly touched the circuits with his hands, leveraging his own skin conductance to inject electrical interferences into the matrix and generate glitches. Another participant hooked up to the matrix an Arduino, programmed to switch between samples according to the level detected by the piezos. Another one added potentiometers to precisely control speed and pitch of his samples and play along with DUB sequences running on his laptop.

It is immediately clear the wide variety of personal style (Gurevich, Stapleton, and Bennett 2009) that characterised the study. The instrument has been interpreted and (mis)used in several different ways, exploring diverse sets of affordances, using techniques that go beyond the imagination of the designers and playing a wide range of music genres. Interviews with participants suggested two main motivations for physical modifications of their D-Boxes: as a means of overcoming limitations of the device and as an expression of personal performance technique. Both these cases proved beneficial to the creative process of music making, using disruption to open up new musical features more in line with each performer's attitude. Furthermore, the same process helped the performers master the instruments in few weeks of practice, by means of converging physical skills' development and instrument adaptation.

The complexity of some hacks, often quite obscure and unexpected even to the us, D-Box designers, suggests that the space of possibilities accessible through hacking is ultimetly determined by the performer's creativity, rather than fixed by the choices from the original designers. However, it is still unclear whether and how these hacks could consistently be part of the evolution of the instrument's design, and be accepted as standard features by future D-Box performers.

Conclusion

The D-Box is a DMI specifically designed to be completely reinterpreted by musicians, by means of circuit bending. We introduced 3 hack examples we documented during a collaboration with a group of musicians. Each hack differs in terms of internal working, interaction and skills necessary to master the instrument, showing how quickly and divergently the D-Box can evolve when played by different artists. As suggested by the whole group of musicians, these features are likely to benefit creativity, musicianship and virtuosity.

This work comes together with a practical demo session on D-Box hacking. The demo will first introduce the hackable design of the D-Box; then some copies of the instrument will be made available and used to recreate step by step the 3 hacks described in detail in the paper. Technical/critical analysis will include circuital configurations, mappings and specific playing techniques. Finally, participants will be encouraged to add original modifications to the instrument. Reactions will be annotated and the different interpretations triggered by the hacks will be discussed with the audience.

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On "Thirteen Ways of Killing a Scrub-Jay"

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Abstract

"Thirteen Ways of Killing a Scrub-Jay" [1] is an online work of electronic literature by the author. A prose-poem in the form of a blog, it explores a modern theme of violence while playfully or darkly echoing Wallace Stevens' well-known poem "Thirteen Ways of Looking at a Blackbird." "Scrub-Jay" transforms Stevens' structure of thirteen meditative stanzas into the reverse-chronological narrative of blog entries for thirteen consecutive dates. Each entry, along with an original arresting image, describes a different method used by the unidentified blogger-narrator to kill a Western Scrub-Jay. Scrub-Jays, an aggressive and violent species, can be annoying not only to other birds but also to humans; certainly the narrator finds them objectionable. In the course of these thirteen blog entries, the narrator's murderous methods evolve from the more distant to the more intimate (if read in chronological order), or from the more intimate to the more distant (if read in "blog order"). Thus the work comments on the blog form as well as the Stevens poem.

Keywords

Electronic literature, e-lit, blog fiction.

13 Days. 13 Jays. 13 Ways. (With apologies to Wallace Stevens)

I.

Wallace Stevens' famous 1917 poem "Thirteen Ways of Looking at a Blackbird" [2] consists of thirteen short sections or stanzas and has been described as aphoristic, cinematic, and reminiscent of haiku or Zen koans. Although ostensibly unified mainly by repetition of the signifier "blackbird," the poem is more about different "ways of seeing" or shifting imaginative perspectives. As B.J. Leggett writes, "The poem illustrates Nietzsche's view that the world 'has not one sense behind it, but hundreds of senses'-- i.e. multiple perspectives and multiple truths.... And aphorism in early Stevens, as in Nietzsche, is a way of depicting the resulting multiplicity of senses without discrediting or trivializing any particular depiction." [3]

II.

Stevens' modernism, and the influences of the visual arts on his work — impressionism and cubism in particular — are also reflected in the poem's free verse, shifting points of view, and disruptive, discontinuous, nonlinear narrative. These formal rebellions can be seen as postmodern impulses at a time, with World War I just ending, of disruptive change in the world and in the arts.

III.

Nearly a hundred years later in another disruptive time, "Thirteen Ways of Killing a Scrub-Jay" uses text, images, and code to transform or subvert "Thirteen Ways of Seeing a Blackbird" for the digital postmodern, or post-digital, post-human world of the 21st century. (See Figure 1.) As the artist, I will be wise to leave such analysis to the experts, the scholars and critics. Does "Scrub-Jay" fly in the shadow of Stevens' poem or wing off into different airspace?

IV.

Helen Vendler says that "Stevens is almost medieval in his relish for external form." [4] Written in free verse, "Blackbird" both follows and flouts formal poetic conventions. "Blackbird" is ostensibly unstructured or loosely structured, while "Scrub-Jay" is ostensibly highly structured by the reverse-chronological date/time stamps of blog software. "Scrub-Jay" looks like a blog and rigorously follows some blog conventions while defying others.

V.

Blogs are supposed to be open, to accommodate collaboration and multiple viewpoints, and to facilitate commenting and linking. "Scrub-Jay" is closed, tightly controlled, and single-authored.

VI.

"Blackbird" offers vivid imagistic, cinematic use of language, influenced by modernist painting, and "Scrub-Jay" uses the multimedia affordances of online blogging to include actual images as illustrations for each entry.

VII.

Both "Blackbird" and "Scrub-Jay" follow the blog convention that might be called "analysis by juxtaposition" in successive stanzas/entries.

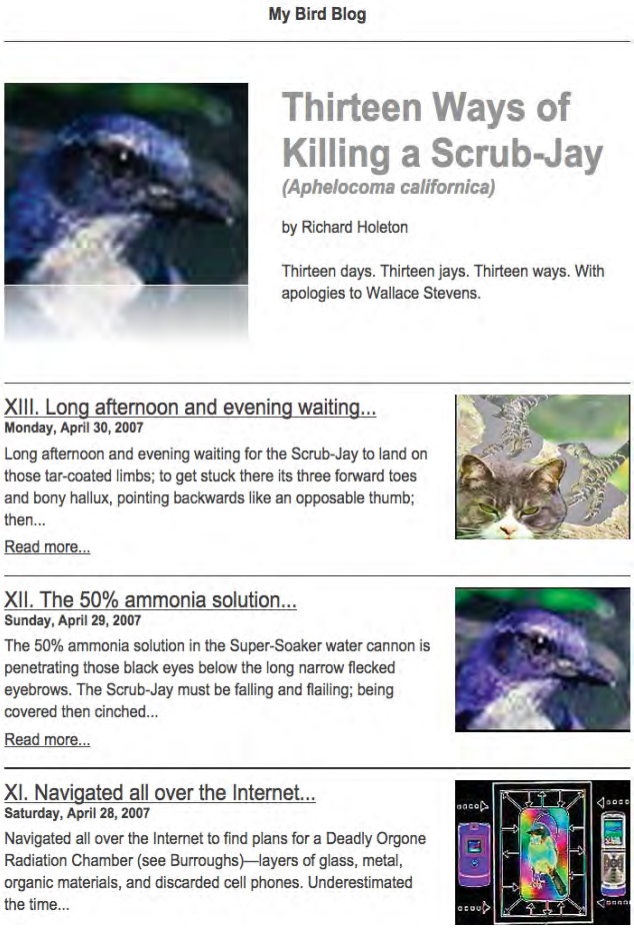

Figure 1. Screenshot from "Thirteen Ways of Killing a Scrub-Jay"

VIII.

"Blackbird" presents a fragmented self and reality; "Scrub-Jay" mimics the shifting syntax of "Blackbird" but seems to have a single, unified narrator and overall linear "plot logic" in which the narrator's violence grows less distant and more intimate over time.

IX.

Regarding "Blackbird's" celebrated "moving eye," "Scrub-Jay" points out that birds don't move their eyes, only their heads.

X.

"Scrub-Jay" systematically echoes and destabilizes the language of "Blackbird," sometimes playfully but always violently, into a weaponized 21st century context. A man and a woman and a blackbird become a man and a shotgun and a Scrub-Jay; beautiful whistling becomes cacophonous and enraging; barbaric glass becomes deadly; birds at women's feet become pornographic voyeurs; flying becomes falling and flailing; snow becomes a grave of tar. To natural features like snowy mountains, autumn winds, and icicles are added slingshots, pepper spray, and handguns.

XI.

Green light becomes digitized and irradiated.

XII.

The blackbird's knowing becomes the Scrub-Jay's undoing.

XIII.

In Stevens' poem, the blackbird "becomes a figure of the very language that effects a realignment of cognitive activity within language." [5] In "Scrub-Jay," the visual and aural descriptive rhetoric of bird-watching is folded into the violence of text and images.

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4. Helen Vendler, *On Extended Wings: Wallace Stevens; Longer Poems* (Cambridge: Harvard University Press, 1969), 75.
5. Beverly Mader, *Wallace Stevens' Experimental Language: The Lion in the Lute* (New York: St. Martin's Press, 1999).

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Wave voxel: A multimodal volumetric representation of three dimensional lookup tables for sound synthesis

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Abstract

Our research presents an extension to current implementations of table lookup techniques for sound synthesis. In this paper, we present methods for generating volumetric representations of data as three dimensional lookup tables for sound synthesis.

Keywords

3D lookup tables, wave voxels, three-variable functions.

Introduction

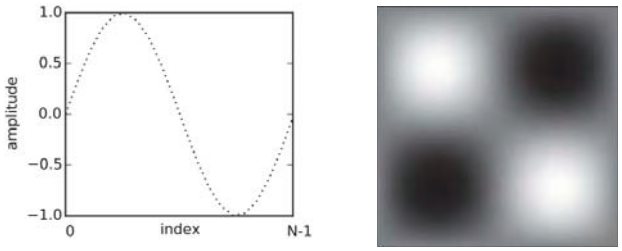
Table lookup techniques are widely used in many sound synthesis applications today as an efficient technique for signal generators (Roads 1996). In this paper, we propose methods to generate volumetric representations of data as three dimensional lookup tables for sound synthesis, based on previous research and experiments in sound synthesis by means of two-variable functions (Mitsuhashi 1982) (Aldo Borgonovo 1986). We introduce the term ***wave voxels***[1] to denote three dimensional lookup tables for sound synthesis.

An overview of 1D and 2D table lookup techniques in sound synthesis.

A one dimensional lookup table of length N is represented graphically in two dimensions as illustrated in figure 1a, where amplitude values (y-axis) changes through time (x-axis). x-axis spans from 0 to $N-1$, while y-axis stores the appropriate amplitude at location n of x-axis. A one dimensional lookup table with amplitude values for one cycle of an arbitrary wave is called a wavetable (Horner 1997) (Roads 1996). Indexing operations for a one dimensional lookup table occurs in one axis. For the purpose sound synthesis, consider a lookup table of length N containing amplitude values for one cycle of a sine wave. To produce a sine wave of frequency $1hz$, we continuously traverse from index 0 to $N-1$ using modulo arithmetic, at a rate of 0 to $N-1$ in 1 second. Traversing twice as fast (0 to $N-1$ in 0.5 seconds) generates a $2hz$ sine wave.

An extension to the wavetable was formally introduced in (Mitsuhashi 1982) as an alternative to frequency modulation (FM) synthesis. This method extends a one dimensional lookup table into two dimensions.

[1] Voxel is a portmanteau for volume and pixel.



(a) a wavetable (b) a wave terrain

Figure 1: An example of a 1D (a) and 2D (b) lookup table for sound synthesis.

Another technique employing two dimensional lookup tables is Scanned Synthesis, introduced by Bill Verplank, Max Mathews and Rob Shaw at Interval Research between 1998 and 2000 (Bill Verplank 1999). Two dimensional lookup tables are graphically represented in three dimensions. In a 2D wavetable of size N_x by N_y, location on x-axis (loc_x) spans from 0 to N_x and location on y-axis (loc_y) spans from 0 to N_y. z-axis stores amplitude values at coordinate (loc_x, loc_y).

A graphical representation of a two dimensional lookup table is possible using a three dimensional mesh surface where the height of a vertex at coordinate (loc_x, loc_y) represents amplitude on z-axis. Alternatively, it could be visualized as a two dimensional plot where a color at coordinate (loc_x, loc_y) represents amplitude on z-axis, as illustrated in figure 1b. A two dimensional lookup table is called a wave terrain in computer music terminology (John Bischoff 1978)(Roads 1996). For two dimensional surfaces, both x and y axes are used for indexing operations. Trajectory of an indexing operation used to read amplitude values in a wave terrain is called an orbit (Aldo Borgonovo 1986).

There are many implementations for generating wave terrains. Y.Mitsuhashi, A.Borgonovo and R.Golds implementation focussed on trigonometric polynomials for terrain generation (Mitsuhashi 1982) (Aldo Borgonovo 1986), A. Di Scipio experimented with functional iterations (Scipio 2002), H.Mikelson uses the Julia set as terrains (Mikelson 1999), D.Overholt fabricated a hardware interface for generation of user defined terrains (Overholt 2002), while R.Dannenberg and T. Neuendorffer uses real-time video images (Roger

B. Dannenberg 2003). Nearly all of the techniques mentioned employs unique indexing operations, each suited to their respective intended purposes.

The extension of wavetables to wave terrains by adding a second dimension opens up new possibilities. Consider a one dimensional lookup table (wavetable). The indexing operation is only possible in one axis, where a vector may only move forwards or backwards. Adding a second dimension (wave terrain) opens up more degrees of freedom in movement. Besides moving forwards or backwards, a two dimensional space allows a vector to move to the left, or right. A third dimension (wave voxel) allows additional movement along the vertical axis, upwards or downwards, besides the capability of moving forwards, backwards, and to the left and right. Each of these movements translates to a unique sonic characteristic when synthesized.

Wave voxel

A voxel represents a single value on a regular grid in three dimensional space (Huges et al. 2013). Voxel models are volumetric renderings commonly used in medical imaging applications, simulation of scientific data and in video games. A voxel model of size N_x, N_y and N_z contains $N_x \times N_y \times N_z$ individual voxels, while a set of voxels is called a voxel stack. The term wave voxels refers to voxel models catered for sound synthesis applications.

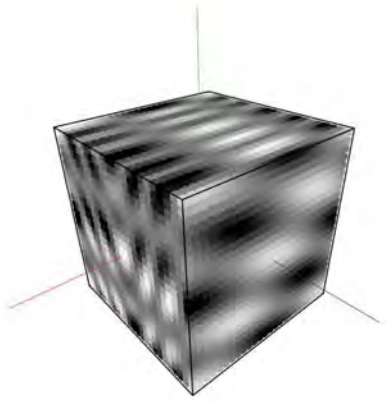


Figure 2: An example of a stack of wave voxels

Voxel stack

The resolution of a voxel stack is its size ($N_x \times N_y \times N_z$). A high resolution stack yields smoother amplitude transition from one voxel to the next, albeit with significantly larger memory requirements. Figure 2 illustrates a stack of wave voxels. Color of each voxel represents amplitude value stored in the three dimensional lookup table at corresponding locations. Amplitudes between 1.0 and -1.0 are mapped to color values 0 (black) to 255 (white).

As an example, the following pseudocode generates a voxel stack using a single cycle of cosine wave on all three axis. For each voxel, $voxel(x, y, z)$ in a voxel stack of size N_x by N_y by N_z,

Algorithm 1 Cosine wave voxel model

for $z = 0\ ,\ z < N_z\ ,\ z++$ **do**

$$val_z = cos(2\pi(z/N_z))$$

for $y = 0\ ,\ y < N_y\ ,\ y++$ **do**

$$val_y = cos(2\pi(y/N_y))$$

for $x = 0\ ,\ x < N_x\ ,\ x++$ **do**

$$val_x = cos(2\pi(x/N_x))$$

$$voxel(x, y, z) = val_x \times val_y \times val_z$$

A voxel stack can be viewed as multiple layers of wave terrains stacked on top of each other. Figure 3 illustrates three slices along z axis of said voxel stack at location $z = 0$, $N_z/2$ and $N_z - 1$.

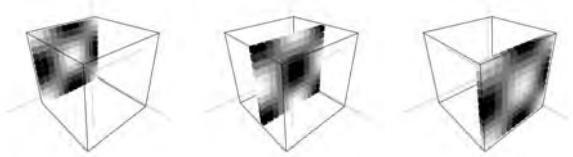


Figure 3: Slices along z axis of a voxel stack [Left to right] voxel(x, y, 0), voxel(x, y, N/2), voxel(x, y, N-1)

Indexing a voxel model is done in three axes. Just as indexing operations for two dimensional surfaces, there are multiple possible approach for orbit definition. Certain approach to indexing might be more suitable for specific purposes. For example, sequential scanning might be more useful for data signification projects, while a more dynamic path might suit artistic applications better.

One way of indexing a stack of wave voxels is by adding a third axis (z) to the orbit equations for wave terrains as presented in (Mitsuhashi 1982) and (Aldo Borgonovo 1986). This third axis would share the same number of variables as both x and y axes, as shown in equations 1, 2 and 3.

$$x = 2f_x t + \phi_x + Asin(2\pi F_x t + \varphi_x) \quad (1)$$

$$y = 2f_y t + \phi_y + Bsin(2\pi F_y t + \varphi_y) \quad (2)$$

$$z = 2f_z t + \phi_z + Csin(2\pi F_z t + \varphi_z) \quad (3)$$

In the equations above, t denotes time, f_x, f_y and f_z denotes linear frequency and ϕ_x, ϕ_y and ϕ_z denotes linear phase. While A, B and C denotes amplitude, F_x, F_y and F_z denotes frequency and φ_x, φ_y and φ_z denotes initial phase. It is important to note that equations 1, 2 and 3 presents only **one out of many** possibe ways of indexing a three dimensional lookup table. We chose this particular implementation by Mitsuhashi and Borgonovo as an example because it presents a degree of flexibility and simplicity in defining an orbit trajectory.

Multimodality of voxel stack contents

Voxel models for sound synthesis could be constructed using different types of sources. In this section, we present four identified examples of sources along with the proposed application.

Trigonometric In voxel stacks shown in figure 2 and 3, the contents of both stacks were generated mathematically using trigonometric and windowing (tapering) functions.

As shown in algorithm 1, individual voxels in a stack are the product of sample-wise values from signals on each axis. With trigonometric functions, this method is akin to combining both frequency modulation (FM) and amplitude modulation (AM) synthesis. This approach would be suitable for computer music applications.

Audio samples Each axis of a voxel stack could also store a short segment of recorded audio. A voxel model of size N_x, N_y, $N_z = 512$ could store 512 samples of audio at each axis.

These 512 samples could be continuously extracted from a longer audio recording. Samples on each axis could originate from different locations of the same audio file, or from different sources altogether.

Each axis could also traverse an audio file at different rates and directions. This method can be thought of as three dimensional sample granulation, another example of an approach suitable for computer music applications.

Video A live camera feed could be used as the source for generation of voxel stack contents. The resolution of these sequence of images should be scaled to the desired voxel model size. A voxel stack of size N_x, N_y, $N_z = 512$ could store 512 frames of 512px by 512px image sequence.

A voxel stack could be created by layering each frame of the resized image sequence. For example a video stream of size 640px by 420px needs to be interpolated and decimated appropriately in order to construct a 512px by 512px image. A streaming rate of 30fps and a stack depth of 512 voxels would store around 17 seconds of video.

Alternatively, a multiple camera configuration could be used to computationally reconstruct a volumetric scene (Slabaugh et al. 2001). This approach might be more suitable in a more controlled environment, perhaps in an interactive audiovisual installation and/or interactive performance setup.

Recorded & simulated data Recorded data such as MRI scans and simulated data such as smoke and fluid simulations could also be used as voxel stack contents. Audification of such data could be useful for research in auditory displays.

Conclusion and future work

We presented methods for generating volumetric representations of data as three dimensional lookup table for sound synthesis. We addressed the multimodality of this technique, suggesting suitable sources for creation of voxel models for use in computer music applications, as an element in artistic installation projects and data sonification projects.

Another interesting prospect to explore is the creation of hybrid voxel models. A stack of voxels could be created using an audio sample on one axis while using trigonometric functions on the other two axes.

For future work, we will also be exploring different indexing techniques for use with wave voxel models. We are interested in understanding how different methods of indexing operation behaves harmonically. We hope to study and understand spectral characteristics of different indexing techniques in order to distinguish and match the appropriate possible techniques with an intended application.

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'LET'S TALK BUSINESS' – an installation to explore scam narratives

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Abstract

16th century 'face to face' persuasion scams adopted to letters, telephone, fax and Internet with the development of new communication technologies. In many of today's fraud schemes phone numbers play an important role. Various free-to-use on-line tools enable the scammers to hide their identities with fake names, bogus business websites, and VoIP services. These fake businesses or personas can appear more legitimate when connected to a phone number, enabling a faster, more personal contact to the victims. With the typology of a sample probe of 374 emails, commonly used in business proposal scams, the emails were categorized and tested to see how believable the proposals sound once the scammers were contacted by phone. The research can be explored in a 5-channel interactive audio installation called 'Let's talk business' that uncovers which business proposals and scam schemes are commonly used, and how believable the proposals sound once the scammers are called.

Keywords

phone scams, audio installation, interactive storytelling, reverse engineering, artivism.

Introduction

Phone fraud can be described as a 'fraudulent action carried out over the telephone' and can be divided into 'fraud against users by phone companies' (cramming, slamming), 'fraud against users by third parties' (809-scams, dialer programs, telemarketing fraud, caller ID spoofing) 'fraud against phone companies by users' (phreaking, dial tapping, cloning) and 'fraud against users by users' (vishing, SMS spamming). The different fraudulent actions can also be divided into technical hacking, social hacking, and mixes of both. [4]

Curious anti-scam activists called scambaiters adapted more of the social engineering tactics to find methods to safely communicate with scammers, finding out how the scams work in order to warn potential victims. This artwork focuses on the 'user to user fraud' that is done by email and phone scams. Typically these scams involve storytelling and some sort of social engineering, where the fraudster creates a hyper-realistic 'too good to be true' situation for a mark, in order to extract sensitive data and/or money from the victim. [2] [3] These scambaiters host informative websites where scams are reported and host forums where people can discuss suspicious business proposals.

Fake businesses and personas can appear more legitimate when connected to a phone number, enabling faster and more personal contact to the victims. [1] By using services like Gmail the scammers gain access to popular VoIP services as Google talk or Skype. Additionally to this call diversion services offer scammers a way to hand out a regional phone numbers, yet answering to the calls where ever they are. These free tools enable the scammers to hide their real identities and to be in contact with the victims using fake names accompanied with diverted contact numbers. Our intention was to uncover which business proposals and scam schemes are commonly used and how believable the proposals sound once we called the scammers.

The Dataset

As a raw dataset I took a sample probe of 374 emails with phone numbers that were collected over a time period of three weeks from Nov. 11 to 30, 2014, from the 'scammed.by' scam email database. In 2010 this website was created under the name 'baiter_base', a place for scambaiting activists who document the activities of Internet scammers. The website provides a service to send in suspected scam emails, which are then automatically analyzed, categorized and published. From the emails we then extracted the phone numbers per country. The top five countries, in total 277 emails, were further categorized according to their narratives structures. Afterwards by using a VoIP service, we called scammers from some of the top five countries trying to cover a variation of the ten scam scheme types. Through this experiment we experienced that the phone conversations in comparison to the emails were very personal: some scammers were very open to explain their shady businesses, others preferred to use email and keep the phone conversation as brief as possible. Some of the scammers used voice-morphing software to anonymize their natural voices resulting in a rather creepy effect. The conversations with the scammers were recorded and some of the stories were edited and can now be listened to through the SPAM-cans in the art installation.

The Installation 'Lets talk business'

After categorizing the scam narratives we proceeded to call the scammers. Prior to calling scammers, we wanted to know what means were

necessary to stay anonymous and safe without leaving a trail that could lead to us. An interview from the ‘Area 419’ podcast series explained one method for setting up a connection to a scammer. ‘Area 419’ was a popular radio podcast that aired on a weekly basis between Feb. and Oct. 2010. (Area 419, 2010) The podcast covers background stories of the scambaiting forum 419eater.com; advice on scambaiting, including interviews with scam-activists and audio clips of phone calls with scammers. Podcast #2 includes an interview with a scambaiter called ‘SlapHappy’, who talks about his experiences with calling scammers. He uses a VoIP service and has a worldwide plan to call any landline for free. When a scammer doesn’t fully trust him in an email conversation, he calls them to build up his trustworthiness. For him it is hard to realize that there is a criminal talking on the phone, trying to persuade him to pay money. Often, the poor connection quality and the scammers’ thick accent make a conversation hard to understand. He uses the ‘cold-calling’ method to call the scammer and improvises during the conversation.

Next a VoIP account was setup under this pseudonym including a worldwide landline-calling package. The Quick Time Player software was used for recording the voices of the scammers. Before calling the scammers we created a fictional persona with name and country of origin. When a connection to a scammer was established, the scammer was informed that the email was received, but not all relevant parts fully understood, so the situation and the next steps should be explained to us once again. Then the scammers had time to explain the situation and how we should proceed further.

The installation consists of five modified SPAM-cans (see Fig.1 [C]) that are normally used to store precooked ‘SPiced hAM’ produced by the Hormel Foods Corporation. According to Merriam-Websters dictionary, the naming of unwanted mass advertisement as ‘Spam’ originates from ‘the British television series Monty Python’s Flying Circus in which chanting of the word Spam overrides the other dialogue’. The sketch premiered in 1970, but it took until the 1990s for mass emails, junk phone calls or text messages sent out by telemarketers to be called ‘spam’. [5] While most of the scam emails tend to end up in the SPAM folder, we chose to mediate these stories through physical SPAM-cans.

Contact microphones and audio players are attached to four of the cans, so that visitors can listen to the scammers’ different narratives that were recorded. The fifth device has two buttons: one button connects the visitor to a randomly chosen number from a scammers database, the other button disconnects the call. Next to the work is an information board providing instructions for talking to the scammers. With the fifth can we want to provide the visitor with an opportunity to be anonymously connected with an scammer. This is an experience of being nervous about who will answer the phone, trying to understand the narrative, and judging whether one would fall for such an offer or not. By providing instructions to the visitor, we want to pass on some guidelines and open questions that the visitor can ask the scammers. The guidelines include ‘Play along to figure out the scam’, ‘Never tell any personal information’ or ‘You are talking to criminals – still they are humans! Open questions can help the scammers to tell more about themselves or their schemes; ‘Tell me what do we do next?’, ‘How can I trust you?’ or ‘Is this operation safe?‘. On a wall next to the pedestal are two clocks indicating 'Local' and 'Nigerian' time (see Fig. 1 [A]). The best placement for the work is on a 50x50x130cm pedestal (see Fig. 1 [B]). Inside the pedestal there is a computer with an Internet connection that ables the anonymous VoIP communication between the visitor and the scammer.

Figure 1. The installation setup

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Authors Biography

KairUs is a collective of two artists Linda Kronman (Finland) and Andreas Zingerle (Austria). Our work focuses on human computer and computer mediated human-human interaction with a special interest in transmedia and interactive storytelling. Since 2010 we have worked with the thematic of internet fraud and online scams. www.kairus.org

Panel Papers

Analyzing Disruptive Tactics and Strategies in Media Activism

1st Lorna Boschman[1], 2nd Michael Heidt[2], 3rd Vicki Moulder[3], 4th Robin Oppenheimer[4]

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Abstract

Our 21st century media environment has grown more immersive and predominant with the invention of communication technologies such as telephones, satellites, video cameras, and computers. We are all now electronically connected, able to communicate, observe, and react to what is happening anywhere in the world in an instant. How do we make sense of these myriad electronic messages and messengers? Can we trust or understand the monetization processes behind the code that creates and designs our mediated contemporary reality? More importantly, how can we disrupt and transform the mainstream media's dominant control over most of these messages? During this panel, we shared our knowledge of disruptive media activism, presented in three parts: a) Examining its historical origins; b) Merging cultural and technological processes to undermine a code-controlled Internet; and c) Populating our shared public social networks with culturally-competent media artifacts, transcoding experiential knowledge into short digital stories

Keywords

Media Activism, Guerrilla Television, IndyMedia Center, Culture Jamming, Digital Storytelling, Cancer Treatment, LGBT Health, Experiential Knowledge, Coded Infrastructures, Aesthetics.

Introduction

Our panel discussion began with Robin Oppenheimer's historical analysis of media activist strategies in the United States. Victoria Moulder and Michael Heidt discussed their collaboration – demonstrating how, by disrupting the algorithmic structures of commercial search engines, we can serve activists. Lorna Boschman discussed a cross-Canadian research study of LGBT cancer patients who used digital stories to disrupt mainstream cancer narratives. Our panel joined with audience members to address the following questions:

– Media Activism Tactics: What can we learn from early media artist/activists? What are the disruptive tactics and strategies they pioneered that can help current and future generations make social change happen?
– Coded Infrastructures: Is code a purely technical, politically neutral medium? What is the relationship between digital spaces and social activism?
– Sharing Experiential Knowledge in Cancer Narratives: How can researchers work with artists and mentors to support digital storytelling among LGBT cancer patients so that socially relevant health knowledge is shared online and in workshops?

Be the Media: Media Activism Tactics

Presented by Robin Oppenheimer

Like today's Millenials who grew up on the Internet, early media activists were the first generation to grow up watching the "new" technology of Television. They were mostly college students radicalized by the counterculture politics of the late 60s who also read McLuhan and understood the power of mass media to inform and shape their lives.

Guerrilla Television

I have identified 3 eras or historical periods of collective media activism in the U.S. The first is the *Guerrilla Television* era of the mid-1960s through mid-1970s. The *Guerrilla Television* era started with the invention and U.S. marketing of Sony's portable Portapak video recorder. It was the first time ordinary citizens could record video onto tape and edit it, however crudely. As described by media arts historian Deirdre Boyle, "Video pioneers didn't use covered wagons; they built media vans for their cross-country journeys colonizing the vast wasteland of American television. It was the late sixties, and Sony's introduction of the half-inch video Portapak in the United States was like a media version of the Land Grant Act, inspiring a heterogeneous mass of American hippies, avant-garde artists, student-intellectuals, lost souls, budding feminists, militant blacks, flower children, and jaded journalists to take to the streets, if not the road, Portapak in hand, to stake out the new territory of alternative television." [2]

The phrase "Guerrilla Television" comes from journalist Michael Shamberg's 1971 book of the same name. *Guerrilla TV* was a *Whole Earth Catalog*-like publication documenting an international network of video collectives and artist/activists who communicated via print, mail, and by travelling and showing work**.** This and other publications such as *Radical Software* represent a larger alternative media movement in the late 1960s that took a critical stance toward mainstream media and stressed an alternative approach to media coverage of issues and events.

Mindy Faber, a video artist who worked for an early video art distributor Video Data Bank, describes the aesthetics of Guerrilla TV. "The raw energy and immediacy of the guerrilla cinema-verite style was an aesthetic principally dictated by equipment limitations. Since videotape editing was difficult on the first reel-to-reel systems, most vid-

eos occurred in real time, without much editing. Use of the wide-angle lens which for TVTV [an early Guerrilla TV collective] became a stylistic trademark, was a technique employed that would compensate for low lighting conditions. These along with other characteristics such as the lack of voice-over and the use of the cameraperson/interviewer style of journalism purposely countered the slick, polished, rapid-editing look of commercial television." [7] Guerrilla TV groups were also part of the art world and they embraced the documentary form as art. They used video as a testing ground for the re-invention of journalism, media language and collective action.

Activist Video Movement

The second era is the Activist Video Movement of the 1980-90s, when video camcorders became more ubiquitous and affordable. With the election of Ronald Reagan and the rise of the conservative Moral Majority, the ever-increasing corporate stranglehold over commercial television became more apparent. Younger video artists embraced the playful intervention into mainstream television through Do-It-Yourself collective groups that also included hip-hop and punk musicians.

The convergence of these new political, cultural, and economic forces led to the establishment of Paper Tiger Television (PTTV), a New York-based collective of media activist/artists founded by Dee Dee Halleck and others. Feminists, gays, blacks, AIDS activists, and other social change progressives worked with Paper Tiger TV producers at a local cable access station to produce weekly shows.

Jesse Drew, a media arts historian and professor, describes Paper Tiger's tactics: "Paper Tiger TV emerged in the early 1980s from the beginnings of a different form of new technological infrastructure… cable television. Building from the success of media activists' demand for public-access TV channels from the cable conglomerates, a group of activists, academics, and artists chose to use these newly won television channels to focus on the media themselves. PTTV released a prolific barrage of half-hour critiques of mainstream media programming on Manhattan cable in 1981, opening with a hand-made, funky, decidedly low-tech look. This low-tech aesthetic was not only the result of a miniscule budget, but a conscious effort to show the public that anyone can make media. This demystification of television technology became a prime aspect of the Paper Tiger style." [5]

A short video clip of Dee Dee Halleck's PTTV compilation[1] was exhibited at the Whitney Museum of American Art in New York. In the video Halleck talks about the low-tech, creative aesthetics using chromakey and other video editing tricks invented by artists such as Joan Braderman to critique mainstream media TV shows such as *Dynasty*.

Video artist Sherry Millner described the "bargain media" aesthetics of PTTV. She stated, "Since it is not obliged to attract huge audiences, bargain media does not have to be nice, pleasant, or well-behaved. It doesn't have to sugarcoat its intentions. Throwing aside expectations about what media should look like or what it should say, bargain media can afford to be offensive and to encourage people to take sides. Like it or not you are always fighting two battles at once; for an alternative content embodied in an alternative form." [18]

Out of PTTV and other collectives came the idea for a national network of channels and producers linked by satellites. The Deep Dish TV network was established in the late 1980s. It distributed PTTV and other progressive public access TV shows to community TV centers in the U.S. and internationally before the Internet was available. Deep Dish provided collectively-produced media programs critical of the Bush administration's Gulf War, editing short pieces created by local media activists into a crazy-quilt collage that showed what mainstream media wasn't showing – opposition to the war in communities across the U.S. and internationally.

Jesse Drew describes the tactics and look of Deep Dish: "The Gulf Crisis TV Project was formed in the fall of 1990 and put out a call for video documentation of local antiwar events, as well as to disseminate interviews with dissident experts and intellectuals ignored by mainstream media. Also welcomed were artistic and cultural works that critiqued and illuminated what was happening in the Gulf. 'It contained the work of over a hundred producers, from dozens of locations. The work ranged from rallies, to comedians, to guerrilla theater, to intimate interviews, to didactic charts and history texts…The programs bristle with anger and outrage, but also have humor, music and dramatic moments.'" [5]

Independent Media Center

The third collective media activism era began with the creation and launch of the Independent Media Center (IMC) in Seattle during the World Trade Organization (WTO) conference in late 1999. Some of the people who created the IMC were also PTTV producers who brought their experience, aesthetics, attitude, and vision of an international collective of media producers already making and distributing their own TV shows over a network. They helped establish the IndyMedia Center (IMC) and website during the 1999 WTO meeting. Working outside mainstream media systems, they webcast to the world for the first time first-person videos from the streets of Seattle in almost real time, 24 hours a day. [4]

Using the slogan "Be the Media!" they demonstrated the visual power of making grassroots media collaboratively. They worked with environmental activists, union leaders, community organizers, Internet engineers, and media professionals to create an alternative media production and broadcast center operating out of a shabby downtown storefront in the midst of teargas and confrontations with police. Their powerful images inspired media and political activists worldwide, and IMCs sprang up in countries as diverse as Mexico and Italy.

This new form of collective electronic media activism

[1] Dee Dee Halleck's PTTV compilation can be viewed at (www.youtube.com/watch?v=d7QOllR1YBQ).

isstill in its formative stages, but its collaborative activist tactics continue to evolve with every new movement, from Occupy Wall Street to the streets of Egypt and Ukraine. Its aesthetics and ideas emerged from the murky, hand-held subversive videos of the Guerrilla TV era, through the Activist Video Movement era that birthed the alternative 'bargain media' aesthetics of PTTV and the pre-Internet DDTV network that then led to the first IndyMedia Center in Seattle during the WTO.

Collective media activism embraces a low-tech collage look that emerged from the technological limitations of the Portapak. It references popular media culture and symbolizes an alternative approach to making TV by people with something to say, not corporations trying to sell something. It deals with serious subjects like global warming and government overthrow using an often playful, irreverent attitude that shows its '60s counterculture and avant-garde art world roots where musicians, dancers, performance and video artists often worked collaboratively to create biting critiques of mainstream media. This movement also networked people, ideas, images and spaces to circulate their videos that predated the Internet. It birthed the first IMC as a model that current and future social movements now emulate to promote media activism around the world.

Coded Infrastructures

Presented by Victoria Moulder and Michael Heidt

In this section Moulder and Heidt discuss their aesthetic strategies for relating the formal traits of code with the situational requirements of concrete activist practice.

Introduction

Effective activism, both online and offline, is premised on a reflection of the spaces within which and against which it operates. Analysis, reflection and renegotiation of digital spaces however, are counteracted by the hidden nature of their coded substrates.

The reflections we put forward here, aim to explore the conditions and possibilities of a[rc]tivist practice within the context of contemporary digital infrastructures. The argumentation draws on contemporary philosophy and social theory as well as on discourse surrounding the phenomenon of code literacy. [6,16] During the discussion, one of our own projects, a series of art installations called the *Aesthetics of Activism* (2014) [12,21] serves as a concrete point of reference and contestation.

Within our collaboration we have been experimenting with various compositional frameworks and thematic structures creating digital assemblage from footage of activist action in the form of uploaded images, video and text. We use material retrieved from the social web and arrange these digital found objects using handcrafted algorithmic devices. In this presentation, we briefly sketched the tendencies within contemporary digital culture that we responded to with the art practice we created.

Hidden Deep Structures, Overpresent Surfaces

Primarily, our practice is motivated by a concern with the way aesthetic experience and user-screen dynamics are negotiated within contemporary device ecologies. Digital interfaces more often than not present themselves as an unorderly assemblage of visual stimuli, fervidly competing for the viewer's attention. Every button on every screen wants to be clicked, tapped or slid - messages and videos keep injecting themselves into our field of vision – erratic beeps and flashes quickly do away with whatever cognitive reserves remain. In this respect, the Internet presents itself as something of a cheerily anarchic mess, seemingly devoid of structure, as is reflected in the anarchic overtones of phenomena such as early net.art [8] or the exuberant promises of past and contemporary cyber-utopianism [19].

As we all know, at the same time, very clear and distinctly strategic, often economically motivated, intentions are inscribed within the formal systems determining interface behaviour. Almost every one of our actions within the digital sphere is recorded, coded as data, stored and monetised. Generated data, analysed into patterns, in turn influences and optimises the way content will be displayed in the future, in order to generate yet more revenue by shaping future interactions. This tendency of commercialised sanction goes so far that certain forms and patterns of interaction themselves tacitly become the subject of patent ownership. This typically happens when companies acquire patents of technology that implicitly specify forms of interaction.

The gravity of this state of affairs of course depends on your valuation of interaction as a social phenomenon. We conducted analysis through the lens of cultural theory as explored by Heidt [9,10]. In this context, we draw on a form of cultural theory known as practice-theory [22] stating that social structure is reproduced through routinised forms of behaviour and interaction, rather than through collectively held ideas or norms. Material frames such as kiosks, vending machines, and digital algorithms gain special attention within this theoretical tradition [15]. They structure and reinforce these routines, thus containing tacit knowledge. Within this theoretical framework, having patents on interactions and routines thus gains a special degree of severity. Since society consists of patterns of behaviour, owning and shaping these patterns is tantamount to owning social structure within this interpretorial framework.

When acting in and through the Internet, we often find ourselves in a profoundly alienated and commercialised space in which ownership of technology bleeds into ownership of patterns of interaction. This development is masked by the *hidden* nature of the digital spaces framing and sustaining said interactions. We do not know nor can we directly influence the algorithms forming the material base of platforms such as Google, Facebook, or Twitter. In effect, what can be observed is an interweaving of cultural and technological phenomena. This poses both a conceptu-

al as well as a pragmatic artistic challenge to which we have been trying to formulate a response.

Transcoding

In order to face this challenge and create material for our art practice we offer a conceptual framework influenced by the notion of 'transcoding.' It is based on a critical reading of *The Language of New Media* [17], which Moulder developed into a theoretical framework aimed at informing artistic practice as well as art-science cooperation. [20, 21]

Theorists who evaluate Human Computer Interaction (HCI) design from a cultural perspective began to expand the concepts surrounding 'transcoding'. In 2001, Lev Manovich introduced the concept of 'transcoding' as one of the five principles or layers for understanding new media artworks. He suggested that the **culture layer** and the **computer layer** influence one another. The cultural layer includes categories such as the stories we create. The computer layer includes the interfaces use, their functions and data structures. [17]

Other scholars like Jeff and Shaowen Bardzell agreed with Manovich's overall interpretation of transcoding and have expanded the concept to include an interaction layer that is further divided into four categories: designer, interface, user, and social ecology, so that more critical concerns can be addressed. [1] What we've seen here is a certain interweaving of cultural and technological phenomena, a tool to critique technology from a cultural perspective.

Within our own art practice transcoding functions as an interpretive device, that allows for the intertwinements of cultural and technological phenomena, to be described through one shared lens. In other words, we use transcoding to define a type of artistic practice that blends multiple perspectives into one visual and audio output. We do not try to counter one perspective with another; instead we propose to use code as a unifying element and reconfigure the modes of presentation highlighting activist phenomena. We redesign presentation so that the power that is afforded by contemporary coded infrastructures might be transcoded into forms that are remotely less oppressive.

In relationship to the *Aesthetics of Activism,* the concept of transcoding provided a metaphor to describe the ways both we as human actors as well as the algorithms we produce, concretely gather and assemble content from the social web documenting activist practices. We looked at ways to collect online data and build large-scale physical compositions with this data in physical places.

Based on this research, we are creating operational boundaries designed to inform the compositional layout and the themed structure (how the information is ranked, sorted and filtered) for presentation on Internet. In the current iteration of *the Aesthetics of Activism,* the virtual composition is shaped by these compositional layers: a) the event context, b) the opposing elements, c) real-life documentation related of the protest. [Figure 2] These layers are combined through the system interface to create one. [Figure 1]

Figure 1. This image demonstrates how the *Aesthetics of Activism* appears as people interact with the artwork. Sensors track people's movement and reveals different compositional layers.

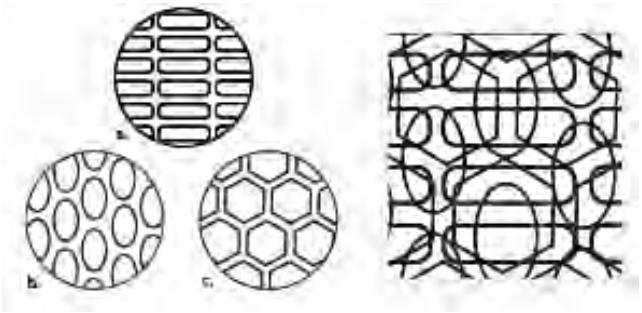

Figure 2. Compositional layers are combined to create one image.

The physical prototype is still in process, but generally, it is designed so that it can spontaneously report on emerging issues. In a presentation of our artwork, we projected images, video and text related from the Kinder Morgan protest[2] on Burnaby Mountain in British Columbia, Canada. [Figure 1] We incorporated an image of Jakub Markiewicz, who pinned himself under a Kinder Morgan jeep in order to stop construction of an oil pipeline. As activists uploaded video and images from the protest site, the system created multiple views of the generative compositions in a different public location.

In effect, the work is trying to call attention to the way digital spaces operate and reproduce. As was mentioned in the beginning, for activism to be effective, it has to understand the space in which it operates. When organising a rally or leading a demonstration in meatspace[3], you need to have a certain understanding of how the specific site affords the action you are trying to mount, be it a town square, a financial district, or the streets. This entails understanding who runs security, how participants can enter and leave the space, and how attention is allocated between statements within it. The way sound travels and the way posters and other visual stimuli become visible and occlude

[2] Kinder Morgan Trans Mountain pipeline project is discussed in more detail by the David Suzuki Foundation: http://davidsuzuki.org/blogs/panther-lounge/2012/07/we-are-the-kalamazoo/

[3] William Gibson used the term meat as a metaphor for the physical world in his book *Neuromancer* (1984).

each other heavily influences this allocation of attention (and the thematic connections we are able to make). Within the web, or the so called social web for that matter, attention allocation is heavily determined by coded infrastructures, determining what shows up on your Google results page, what is hidden and displayed in sidebars, and what shows up in your Facebook and Twitter feeds.

In order to do justice to the diagnosed intertwinements of cultural and technological phenomena, we have outlined a strategy informed by media and cultural theories. Our strategy has been to embrace the described intertwinements of cultural and technological phenomena, potentially reconfiguring them through creative and artistic practices. To this end, we have proposed an appropriation of the concept of transcoding in order to render these processes accessible to a discourse operating within the interspace of art and science.

We have outlined a response that seeks to confront power effects manifesting within coded infrastructures on their own grounds. Hence, we have been trying to cultivate a practice rendering the interweaving of cultural and technological phenomena productively. We are not trying to disentangle theses layers to restore a state of purity; instead, we are entangling them differently. In the context of the *Aesthetics of Activism*, we created coded infrastructures ourselves that serve to expose the mechanics reproducing attention economies. Constructed installations try to reintroduce and re-situate abstract/formal machines for content aggregation into concretely situated activist practices.

Within this context, transcoding points to the importance of looking at on- and offline activism in tandem [13]. Phenomena such as 'Clicktivism' attest to the impotence of symbolic action constrained to the realm of the digital. Thought and action informed by transcoding have to avoid this pitfall through a creative intermeshing of on- and offline practices. The Latourian frame adopted allows for design styles that consciously orchestrate patterns of use and non-use into meaningful wholes [11].

It is a constructive and creative practice we have been espousing here. A stance further supported by a panel attendee who stated, "a position that might free activism from being perceived as necessarily having to oppose something, as being 'negative' or unproductive."[4] It thus might be aligned with projects situating practices such as liquid-democracy within local communities [23].

A[rc]tivistic Future

Hopefully, the discussion has elucidated some of the conceptual and artivistic possibilities inherent within contemporary net phenomena while pointing towards inner limitations and lurking practical pitfalls. The discussion departed from a diagnosis of the contrast between a sometimes chaotic aesthetic shell of web-structures and its highly formal material base. The hidden nature of the latter allows actors to inscribe economic and political interests without these becoming subject to public scrutiny and activist tactics. The aforementioned analysis was followed by a critique of the specifics of digital materials and the spaces constructed from them. These conditions of online practice can remain orthogonal to a concrete activist cause or directly or indirectly modulate, sustain, or undermine it.

Practices of aestheticisation of otherwise blackboxed formal procedures thus relate to the level of the political. In effect, both the hidden character, as well as the inherent formality of these codes, present art and artivism with a unique set of challenges. Latourian practice-theory together with a critical reading of the concept of transcoding were offered as conceptual devices seeking to provide novel impulses for art-science projects exploring this problematic. Working with interactive assemblage made from digital found objects was presented as a concrete artistic strategy of foregrounding the tacit level of coded infrastructures.

[4] There were many people who attended the panel. This statement came from a woman who had questions about how designers support empathy. Regrettably, we did not record her name.

Experiential Knowledge in Cancer Narratives

Presented by Lorna Boschman

For the past three years, I have been the Project Coordinator and a Post-Doctoral Researcher with Cancer's Margins, a cross-Canadian research study. We use a community-and arts-based approach to exploring sexual and gender diversity, and experiences of cancer health, support and care. We look at how LGBT people locate and share knowledge after they've been diagnosed and treated for breast or gynecologic cancer. Our research-based approach to digital storytelling combines professional mentorship with peer knowledge exchange to create powerful and personal digital stories.

As a researcher, I explore how we as media artists and activists can work with community members, not only to help them 'find their voice' but also to share their experiential health knowledge using digital storytelling techniques. The contemporary Digital Divide is not limited to addressing the affordability of technology. [25] Instead, the divide has become a chasm between those who have learned to use Information and Communication Technologies (ICT) as communications devices and those who have not. In our digital storytelling workshops, participants used digital stories to share experiential knowledge about cancer treatment and care, refining those stories by concentrated knowledge exchange with peers.

Introducing Cancer Margins

Cancer's Margins[5] lead researcher, Dr. Mary Bryson, began with a pilot study in the San Francisco Bay area five years ago. Since funding was secured from the Canadian Institutes of Health Research (CIHR) for a larger Canadian study, our team conducted interviews in six provinces. We

[5] Cancer's Margins site http://lgbtcancer.ca/

have interviewed 112 LGBT cancer patients and designated members of their support network.

To gather experiential knowledge from study participants, Dr. Bryson and I designed a weekend-long digital storytelling workshop, combining strong group feedback with professional video authorship mentoring. We build on my own professional experience in media arts, benefitting also from the approach of Joe Lambert and his colleagues at the Centre for Digital Storytelling in California [14]. Two 2014 English-language workshops were held in Vancouver and a 2015 French-language workshop was held in Montreal. All participants had been diagnosed and treated for breast or gynecological cancer.

Prior to participating in the workshop, the participant/storyteller was interviewed for 90-120 minutes by one of our researchers. With the participant's written permission, the interview was audio recorded, and in most cases, video recorded. In some cases, up to a year passed between the research interview and attendance at the Digital Storytelling workshop.

Just before the workshop began, the storyteller was assigned a mentor, typically a director/writer/editor or academic. The storyteller and the mentor were both provided with a copy of the storyteller's original interview transcript. The storyteller was able to recount the ways in which they conceptualized their cancer treatment at the time of that interview; the mentor was able to gain insight into the type of digital story that could be co-created during the workshop. Mentors who were documentary director/editors were especially adept in creating a story from materials similar to the photos and home movies that storytellers brought to the workshop.

Understanding Knowledge Projects

Cancer's Margins is a knowledge project, informed in part by the work of exemplary queer artists who have documented and analyzed their own cancer treatment using film and performance [3]. In the research study, we document how queer people gather and utilize knowledge as part of their decision-making process about cancer treatment and care. We consider access to culturally competent healthcare knowledge and the ability to mobilize that knowledge to be basic human rights.

Health knowledge projects differ from media activism in their focus. Rather than documenting demonstrations or teaching digital literacy skills, knowledge projects employ ICT to focus community-specific understandings of self-care and health management.

We have identified two concrete differences between our digital storytelling workshop and many media arts workshops. First, we begin by collecting data – the classic qualitative research interview and second, our focus during the workshop is not in teaching technical skills.

Storytellers were asked to tell a story about their experiences of cancer treatment and care as LGBT people. The interview transcript was introduced as a memory prompt for the storytellers. Workshop participants could choose whether to utilize the interview in their digital story or not.

Figure 3. Still from Cancer's Margins story *Centipede*.

Some participants did not want to look at their own interview transcript, or listen to the audio file, as it made them feel uncomfortable. Each participant completed their story before deciding whether to show it in public or not, a process approved by our Research Ethics Board. Participants were motivated to help others who were about to undergo cancer diagnosis, treatment and care.

Following our protocols, a queer woman who had been treated for breast cancer was interviewed; she designated her wife to be interviewed subsequently as her primary caregiver. In preparation for the digital storytelling workshop, they decided to share their transcripts with each other, a step that we would not have suggested because each interviewee had been assured of confidentiality. During the Digital Storytelling workshop, the partner who was treated for cancer used their recordings to simulate a dialogue, an account of the struggles and resolution they experienced as a couple and as the parents of a young child.[6] [Figure 3]

Teaching Digital Literacy by Sharing Knowledge

Another difference between media arts workshops and our digital storytelling approach is that we were not teaching digital literacy – the how-to side of media production. We were instead, creating an environment where people worked out how to construct a story about their experience with cancer treatment, support and care. While learning to use digital media technologies is important, the process of clarifying their stories about cancer was the priority during one short weekend. By providing an experienced mentor, we freed participants from the additional cognitive burden of having to learn to shoot or edit a video.

Our digital storytelling workshop consisted of cycles for participants – coming together to tell a first iteration of the story, going off to work with their mentor, bringing the storytellers back together to talk about their stories, going back out with the mentor, and coming back with a revised story. After the workshop, the storyteller continued to work with an editor until the digital story was complete. When the editing was concluded, the storyteller was in a position

[6] Centipede on the Cancer's Margin site: https://queercancer.files.wordpress.com/2015/01/centipede.mp4

to choose whether or not to share their story with the public or to limit viewing to a research context.

In the Montreal workshop, several participants created stories about living with metastatic cancer. In *just being*, [Figure 4], the author shares her approach to death and dying, and learning how to 'just be'.[7] She created two characters, Antouka and Okazou who represent her and her partner. When they want to talk about something really difficult, they ask themselves how these animated characters would respond.

Art Practice as Research Foundation

Our digital storytelling practices are built upon *photovoice*, an earlier 21st century public health methodology that trained community members to engage policy makers through photography. [24] *Photovoice* places an emphasis on what matters most to the community members and how their knowledge can be used to affect social change.

The Cancer's Margins digital storytelling workshops created an incubator for knowledge about how cancer treatment, support and care are experienced by queer people – each participant worked with a mentor who was experienced in constructing a public story; the mentors had strong insight into the participant's cancer experiences as a result of reading the transcript before the workshop; peers who had also experienced cancer were able to offer critical feedback that strengthened the stories; and most of our participants agreed to share their story so that healthcare providers and LGBT people who have recently been diagnosed are able to access shared knowledge in a way that is culturally appropriate for these communities.

Summary

In summary this paper has captured the thoughts of four speakers involved in the *Analyzing Disruptive Tactics and Strategies in Media Activism* panel at the 21st International Symposium of Electronic Arts in Vancouver, British Columbia, Canada. Robin Oppenheimer set the groundwork for understanding the history of media activism in the United States. She explained that 'being the media' was an activist's strategy rooted in the *Guerrilla Television* era. Oppenheimer discussed how the Ronald Reagan administration in the 1980s sparked a change in the way artists and activists worked together. Thus the launch of the Independent Media Center (IMC) in Seattle in late 1990's emerged as a training space for people working outside of mainstream media systems.

Michael Heidt and Victoria Moulder introduced transcoding as both a philosophical position and aesthetic strategy. The artists introduced their work *Aesthetics of Activism,* as an example of the ways we as human actors, and the algorithms we produce can be used to assemble content from social web resources.

[7] View *just being* on Lorna Boschman's Vimeo site: https://vimeo.com/142706695

Figure 4. Still from Cancer's Margins story *just being.*

Lorna Boschman introduced her involvement with the *Cancer Margins Project* as a digital storytelling approach. She discussed the importance of creating an environment where people can strategise collectively and learn how to construct a story through their experience with cancer treatment, support and care. Boschman explained that in today's digital world culture, barriers have less to do with access to technology [25] and more to do with how we can use digital stories to share experiential knowledge.

In closing, this panel was motivated by the possibility of creating systems for creative processing of content outside of the commercial monetizing platforms that pervade contemporary Internet infrastructure and attached interfaces. We leave you with this – now that the Internet of 'Things' has become completely monetized, how can we use technology to support digital social action?

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Authors' Biographies

Lorna Boschman is a Faculty Associate at the University of British Columbia and Project Coordinator for the Cancer's Margins study, led by Dr. Mary Bryson. This arts- and community-based LGBQ and T research project explores sexual and gender diversity, experiences of breast and gynecologic cancer health, support/care, and the ways we locate and share cancer health knowledge.

Michael Heidt is a computer scientist, emerging artist and PhD student studying at the Chemnitz University of Technology, in Germany. In his most recent media art installation, PRMD (2014) he explored practices of identity construction with respect to historical narrative and code; and the juxtaposition of digital form and interactional situations. Read more: http://crossworlds.info/people/phd-students/michael-heidt/

Vicki Moulder is the author of interactionart.org, an artist and PhD candidate studying at the School of Interactive Arts and Technology (SIAT) at Simon Fraser University in Canada. She holds a Master of Arts from SIAT and a Bachelor of Fine Arts from Emily Carr University in visual communications. Molder is a pioneer in the field of social art practice co-producing artworks with not-for-profit organizations since 1988.

Robin Oppenheimer is a media arts historian, curator and scholar who has worked in the field since 1980. She was Executive Director of two media arts centers in Atlanta and Seattle and, until June 2015, was a Lecturer at the University of Washington Bothell, with a PhD in Interactive Arts and Technology. Her areas of research include media arts histories, participatory media, and media activism.

Didactic Disruption:
Roy Ascott's Models for Arts Education and Research

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Keywords

Roy Ascott, Planetary Collegium, arts education, arts research, Plymouth University, CAiiA-STAR, interdisciplinary studies

Abstract

This paper summarizes a panel discussion held at ISEA2015 in Vancouver B.C. Its subject was artist and educator Roy Ascott's development of models for interdisciplinary studies in universities and distributed research centers.

Panel Summary

This panel discussed alternative models of arts education that have emerged from Roy Ascott's career and practice. Ascott, the founder of the University of Plymouth's Planetary Collegium, is widely regarded for his role as an arts educator and theoretician. In a field that integrates arts, technology and science, he has presented concepts and terminology that frame debates and define new territories. Ascott has published and presented his work internationally and has given keynote addresses at several arts-science congresses, including ISEA symposia.

It has been over 20 years since Ascott founded a radical distributed research center and doctoral program. He founded the Centre for Advanced Inquiry in the Interactive Arts (CAiiA) in 1994 at University College of Wales Newport, and later established STAR (Science Technology and Art Research) in the School of Computing at Plymouth University. CAiiA-STAR constituted a joint research platform with access to supervisory and technical resources at both universities.

In 2003, Ascott relocated the platform to Plymouth University, giving it its present name *Planetary Collegium*. The Planetary Collegium's global reach extends beyond the UK through mimetic nodes in Italy, Switzerland and Greece, with a new node currently forming in China. Having successfully graduated over 50 PhDs, the Planetary Collegium is now host to a dynamic community of over 70 doctoral candidates and researchers.

The panel reviewed the singular aspects of Ascott's pedagogical challenge to conventional models of advanced art research in Europe and North America. Its panelists presented a history of Ascott's innovative curricula as well as the development and operation of the Planetary Collegium and its nodes. In the course of the panel discussion Elif Ayiter presented Ascott's Ground Course as a precursor to his later work in distributed transdisciplinary education. Diane Gromala discussed the application of her experience with the Planetary Collegium on her research and professional development. Mike Phillips described Ascott's influence on artists and educators as a form of contagious virus of creativity. Paul Thomas discussed the influence of Ascott's integration of technology with art, and how it affected his career. Peter Anders moderated the discussion.

Summary papers by the panelists follow:

Elif Ayiter: Roy Ascott's Ground Course

The Groundcourse was a two-year long, cutting-edge foundation art course taught at Ealing Art College in London from 1961 to 1964 and at Ipswich Civic College in Suffolk from 1964 to 1967. Its radically innovative strategies never became wide-spread, nor did they extend into prevalent art teaching methodologies in England or elsewhere in the world. Thus to this day, for the most part, the Groundcourse is a well-concealed secret.

In her article for Frieze Magazine in 2006 Emily Pethick remarks that "with alumni that include Pete Townshend, Brian Eno and Stephen Willats there is no doubt that the courses in Ealing and Ipswich made their mark, and it is curious that, while renowned at the time, they have not been more widely acknowledged in British art history."

It is of no great surprise that the Groundcourse has no immediate siblings or easily identifiable ancestors within the historic flow of art educational theories that have been built upon each other, providing the antecedents to the post-modernist debate that is unfolding today. By placing cybernetics at the centre of his method, Ascott looked far beyond the theories that were available to him in art education alone, both in terms of its history as well as in terms of the different movements underway that were coeval to his inquiry.

Another difficulty in placing Ascott within the canon of art education is the transdisciplinary nature of his inquiry. Art educational theory has been known to look at other academic fields for theoretical input. Nonetheless a survey of its history lacks evidence of a successful merger of art and science at a cogitative level deep enough to qualify as a true precedent for Ascott's work.

Therefore, instead of trying to set up tenuous connections to established art educational theories that are built upon a rationally associated historic tradition, the genealogy of the Groundcourse, as well as Ascott's subsequent teaching practices, should be construed by examining Ascott's own sources of inspiration which mostly lie outside of this body of knowledge, i.e., Cybernetics and the body of Experiential Learning theories instigated by John Dewey.

Mike Phillips: Dancing on Tabletops (And Other Bad Behaviourables)

When art is a form of behaviour, software predominates over hardware in the creative sphere. Process replaces product in importance, just as system supersedes structure. Consider the art object in its total process: a behaviourable in its history, a futurible in its structure, a trigger in its effect.

Roy Ascott (1968) [1]

This quote was probably my first contact with the distributed Ascott mind. It must have been in a Leonardo Journal somewhere in the early 1980's, but it was the catalyst that made me realise that the Art College was doomed. Not the incredible pedagogic, haptic, hallucinatory, behavioural disruptive experiential education the Art College provided, but doomed because of its focus on 'things'! This quote is a requiem which marks the dissolution of the objet d'art. And of course all the markets, arrogance and institutions that glorify them.

Of course, thirty years later the Art College is clinging on and is probably generally not aware of this requiem, but for me, this quote gives a sense of hope. Now, through my twenty years involvement as a Principal Supervisor on the Planetary Collegium, I feel content that this repose for the soul of the objet d'art is being sung by the hugely influential international community of artists, designers, performers, architects, theorists and academics, all infected by the same viral realisation.

Figure 1*:* The President's Office Desk at Ontario College of Art! 1971. [Courtesy of the Estate of Roy Ascott].

What is interesting about this infection is that it is not just a pandemic, the contagion is not just a horizontal network of nodes, influences and value chains, it operates across generations, vertically, the first telematics temporal contamination, perhaps.

Ascott's creative practice is syncretic with his pedagogic strategies that draw on the inspiration to enhance creative behaviour through processes based on the principles of cybernetics. By founding the Ground Course at Ealing College of Art in 1961 he created a platform for a radical cybernetic approaches to learning through participatory, interactive and disruptive strategies that locate the viewer/learner as an active participant.

What is significant about the archaeology of Ascott's practice is that the 'things' he is most known for are ephemeral, temporal and transitionary - things with the least physical trace. The recalibration of human behaviour enacted through the Ground Course leaves few relics. As with the later telematic projects which predicted and defined protocols, behaviours and manners now hidden below the surface of internet transactions and online identities, there are few material artefacts. The recovery of Ascott's early work, exhibited the 'The Syncretic Sense' and subsequent exhibitions, reveals that the most important

components are not the wood and glass but the behaviour of the viewer and their transformation into an active participant.

This strategy of dissolving the material artefact into a sequence of behaviours is now an invisible process underpinning all of our digital transactions - logging on,

Figure 2 : Ground Course Behavioural Project 1963. [Courtesy of the Estate of Roy Ascott].

handshaking, parsing, messaging and interfacing with API's. Traces reverberate through Brian Eno (a young version Figure 2) and Peter Schmidt 'Oblique Strategies' (1975) and can be subsequently traced through to be manifest in the IDEO Method Cards (IDEO, 2002). [2] [3]

The vertical nature of this pandemic was evident on stage at the Brit Awards in 1996. A not-so young Brian Eno presented Thom Yorke of Radio Head fame – with Yorke almost as young as Eno was in 1961. (Figure 3) [4]

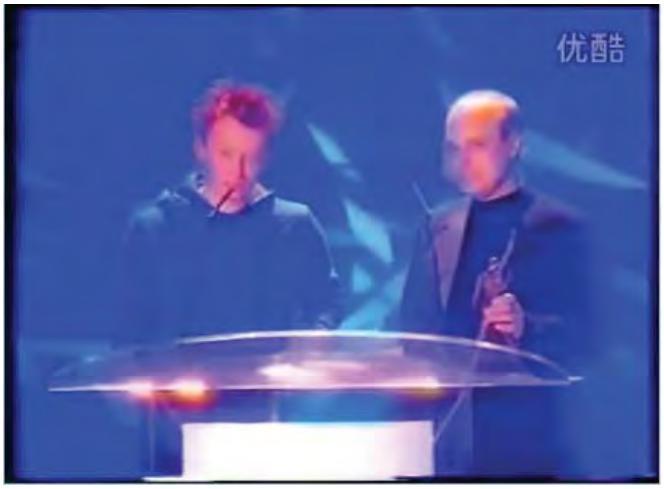

Figure 3: Brit Awards 1996.
https://www.youtube.com/watch?v=QgVbkjNmV1U

I am not sure if I can claim any direct infection of Yorke during his days as my project student on his Fine Art and English. Maybe had he stuck with Hypercard he might have made something of himself, but I am sure they say to each other as they leave the stage, "You know Mike Phillips/Roy Ascott?" Of course they didn't, but Yorke carries the virus, Eno carries the virus, it's evident and manifest in their work.

The contamination was not just of PhD researchers. I had contacted Eno in 1992, asking if would consider being the External Examiner on the BA/BSc MediaLab Arts course that I was running in the Computing Department at a young Plymouth University. He turned it down, saying he had just finished a stint with Roy Ascott at Gwent, and really needed a rest (I blame Paul Sermon - also infected - who was part of that cohort). He subsequently became a Virtual Advisor, taking part in European Satellite Broadcasts (Mediaspace) and online environment, and I was able to secure him an Honorary Doctorate. Roy Ascott joined us as the External and we latter secured him to cultivate STAR (Science Technology Arts Research), one half of the CAiiA-STAR consortium, and later the Planetary Collegium.

Figure 4: STAR, CAiiA-STAR, Planetary Collegium Logos.

The point is that, not only had he infected the Ontario College of Art (it tried to decontaminate), San Francisco Art Institute, Gwent College of Art and the Planetary Collegium, but secondary infection can be found in Plymouth. Now a carrier, the contagion can be seen in people like: Adam Montandon (who created the first Eyeborg for Neil Harbisson whilst on my MA/MSc Digital Futures Course); Nema Hart (Digital Economy for the Arts Council who worked at a national level defining Governmental digital policy under Gordon Brown), Ruairi Glynn (now directly infecting students as Director of the Interactive Architecture Lab at the Bartlett School of Architecture, UCL); Emmet Connolly (who left the MA/MSc Digital Art & Technology course for Google and created Android Wear – years before Apple imagined its Watch); Dan Effergan (Director of Aardman Digital Studio); and B Aga (doomed to forever work at i-DAT). Just a tiny sample of victims of a highly contagious transmissible infection, a short phrase, a string of DNA, a spell cast.

Routing Table

The first table top encounter would have been in Toulouse, a collaboration with Rob Pepperell (also seriously infected)

at the Slade School of Art, developing networking protocols on the UCL EUCLID mail server system, was played out in 1985.

Figure 5: Networking in Toulouse, 1985. [5]

Subsequent telematics network contaminations, such as *Aspects of Gaia* (Ars Electronica 1989), were played out remotely over modems transmitting Binhex files through Kermit via EUCLID. Once infected it is hard to shake, the sound of modems logging on still resonates like tinnitus.

More recently the Tabletop was recovered through the collaboration and co-curation between Plymouth Arts Centre (lead by Paula Orrel) and i-DAT (lead by B Aga) of *The Syncretic Sense - Roy Ascott*, from 4 April to the 24 May 2009 at Plymouth Arts Centre, England. The Syncretic Sense explored the influences of Ascott's early work on digital culture and the impact these experimental ideas and activities had on art education. The material framed for this exhibition formed the core of the show at Incheon International Digital Arts Festival, Incheon, South Korea in September 2010, and at SPACE (studios) in Hackney, London in 2011. Following this, Syncretic Cybernetics, a comprehensive exhibition of Ascott's work was featured in the 9th Shanghai Biennale 2012. The contagion spreads…

A preoccupation with inter/transactions across tabletops emerges, resonating with a blend of ludic strategies and the telematic protocols of the *Dowding System* (RAF Fighter Command Operations Room processes). Whilst on the vertical plane, recombinating transparent panels predate the gestural trends of Natural User Interface design. Ascott's *Tabletops* and *Change Paintings* leave a trace that can be experienced some fifty years later in this new century. Whilst Apple and Samsung wield clips of 2001 a Dave Bowman (Kubrick, 1968) caressing touch screens in war of attrition over the genetic origins of the multi-touch surface, prior art can be found in Ascott's Change Painting from some ten years earlier. [6] Leaving aside his influence within the telematics and educational spheres there is a rubric for participation through an interface that is now manifest in every multitouch screen. As we sit in cafés caressing, flicking and stroking our smartphones we should consider the heritage of this behaviour…

Now that this pandemic is truly embedded, the concern is that the patient is actually being killed off by something else. Academisation of Art may actual be the personification of death. The vitality of Ascott's requiem is that it is truly transformative, the telematics and technoetics are instrumental as a mechanism of transmission of disruptive behaviour, they transcend technology which conveniently illustrates the vision. Ascott is the router, wifi the carrier and the message, broadcasting a disruptive meme of creative practice…metaphorically and actually… The Art College would, after a short fever, reawaken, renewed and revived to dance on the tabletops. The bludgeoning of Art Practice by bureaucracy and indifference that we are witnessing across the University sector offers no redemption.

Paul Thomas: Reformatting Art Education Through Viral Transmissions

There are many reasons why we want to explore the future and how we as humans respond to the emerging and changing contexts within culture. One of the dominant changes that have taken place is the digital and technology, incursion via systems thinking in art education.

This talk looks at seepage and the effect of a visionary artist who through his intellectual and conceptual generosity inspired and transformed art education through a form of syncretic osmosis or instigating a network virus. Invisible to many students who exist within seemingly normative art institutional structures, the entitlements were part of a hard fought effort.

At the start of the network age of telecommunications I.P. Sharp provided artists with an electronic exchange network system (ARTEX). ARTEX enabled the beginnings of the first international artistic text and cursory graphic collaborations over the computer network. The telepresence on the network began with work such as a *Hole in Space* (1980) by Kit Galloway and Sherrie Rabinowitz, that demonstrated the slippage appearing in the way artistic discourse and practice could be carried out. Roy Ascott conceived the impact of a global network and this vision was pertinent to generating his first network projects. As Ascott stated:

More broadly, in my mind, the concept of a global creative network, a cybernetic art matrix, was clear but not until some fifteen years after I had first digested the significance of integrative systems did I come upon the technology which could effect these transformations of culture I had so eagerly anticipated.

The global creative network also had it opposite meaning invented simultaneously. For example, Paul

Virilio's observation that high-speed trains automatically generate the potential for high-speed rail disasters. The network effect was also a sharing of consciousness but, by default, the inception of a cognitive virus. Ascott's network was a conceptual and physical exchange of minds that enriched ideas in the world through the immediacy of a cyberspace that was unexplored, formative and still innocent. In the antipodes this enriching/viral communication was of great importance in staging a sense of connectedness. Ideas posited in art education were simultaneously (and instantly) arriving in Perth, the most isolated city in the world. The lapse in time was one that might also have been felt here in Vancouver as things developed.

In 1983 Eric Gidney invited Tom Klinkowstien to Australia 1983 (One of the outcomes of this event was that I first met Ascott telematically) as part of telecommunications project based on the topic of Australia 2003. The topic was to introduce students to

…new telecommunication technologies and the new "electronic living spaces" that [Ascott] believes will be an important creative environment for artists in the near future.

Australia 2003 was a telecommunication fax link-up project between students in Sydney, Adelaide, Newcastle and Perth. This project does not concern us here, but with Klinkowstiens visit to Perth came a phone-coupling device incorporated into a typewriter that was set up for a global telex communication with IP sharp. In the lounge room Tom (an artist in residence in Perth) demonstrated this piece of equipment which had me totally excited by its potential to banish the tyranny of distance I felt in Perth. The fax project was taking place in the same year.

At the same time Roy Ascott was instigating LA PLISSURE DU TEXTE and in a letter to his colleagues he laid out the plan.

…a computer networking art project designed by ROY ASCOTT for the major exhibition devoted to the historical and contemporary review of Electricity in Art organised by FRANK POPPER for the Musee d'Art Moderne de la Ville de Paris. The exhibition is called "ELECTRA I983" and will open at the beginning of December I983 and run for three months.
La Plissure du Texte is a collaborative story telling project using a computer timesharing network of artists located in Europe, North America and Australia. Artists using terminals in their own studios or at publicly accessible locations will be involved in a process of "distributed authorship". They will employ the ARTBOX network of I.P. Sharp 's APL system (who have donated free network time to the project). The video display and print-out of this collaborative oroject in the form of a "Planetary fairy tale" will constitute the contribution to ELECTRA.

Catherine Mason's book *A Computer in the Art Room* presents Ascott, in 1964, beginning his exploration of system thinking in art by making works where the viewer becomes a co-author. Painting was Ascott's chosen medium. Marks made on moveable pieces of glass made the viewer complicit in the creation of the artwork. Ascott would use painting as the lens by which he viewed the effects of emergent technologies on society, a significant redefinition of the contemporary role of the artist. The education of artists as to *whether technology was art* shifted when posed with the question of *how will technology change art*. It called for the conversion of the face-to-face program of the master and apprentice to a distributed network of global knowledge where the user could access from any node. This was seen as a cultural, physical and spiritual goal.

Ascott was the inspirational visionary of a future who not only lived this vision but gave the vision a reality in his practice and through education. On discovering in 1986 that Ascott was coming to Australia I invited him to detour via Perth. One of my own telematic artwork projects instigated in 1986 was *I You Send One* (1987, with Neil Hollis and Benno Poeder).

Ascott's ongoing visions for the future have been profound, creating aspirational perspectives for new understandings of life in which all aspects of being human are challenged and contextualized. These visions are generous, freely given gifts at the cutting edge of contemporary art practice and syncretic education. The spread of the ideas dominated my involvement with emerging technologies and the role of art education. The Artslab concept became part of the Centre for Advanced Inquiry in the Interactive Arts, (CAiiA) general educational format.

CAiiA introduction

There is a great need for art to play a cultural role when emerging technologies exponentially drive the economic framework. Ascott pointed out the potential of research into nanotechnology. Things were evolving to a point that

…molecular robotics, positional assembly, and self replication suggest exciting possibilities for moving atoms around, building new materials, manufacturing nano machines, and generally building the fundamental blocks of nature into any configuration we desire, there is a danger that the outcomes, even when beneficial in engineering, medical and social terms, could be spiritually hollow, and as such would exacerbate rather than relieve the excessive materialism of our time.

Ascott, 2004 [7]

Our quality of life depends in large measure on finding creative and constructive value in the new technologies

and in shaping them to human needs. Advanced telecommunications, digital multimedia, computer-mediated and post-biological systems are playing an increasingly important role in the transformation and globalisation of culture. Artists working in the space between art, science and technology are uniquely prepared to influence, shape and exploit these changes, and to radically rethink artistic and cultural strategies.

From Roy Ascott's CAiiA document

The context for the talks was to show the formative stages of ensuing work and how a new reality would come into being. In 1998 I used some of Roy's text in the development of a proposed digital research lab.

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Authors' Biographies

Elif Ayiter

Elif Ayiter Ph.D., aka. Alpha Auer, is a designer, educator and researcher whose creative interests are based in three-dimensional online virtual worlds and their avatars, as well as in developing and implementing hybrid educational methodologies between art & design and computer science. She teaches full time at Sabanci University in Istanbul and is also the Director of Studies of the I-Node of the Planetary Collegium in Greece. Her texts have been published in academic journals such as the *Leonardo Electronic Almanac, the Journal of Consciousness Studies,* and *Technoetic Arts,* and she has authored many book chapters in edited academic books. She has presented creative and research output at venues including the John Hansard Gallery, UK; ISEA2011, SIGGRAPH, Creativity and Cognition, SPIE, Computational Aesthetics and Cyberworlds. Elif Ayiter also is the Chief Editor of the academic journal *Metaverse Creativity* with Intellect Journals, UK.

Diane Gromala

Diane Gromala Ph.D. (born 24 February 1960) is a Canada Research Chair and a Professor in the Simon Fraser University School of Interactive Arts and Technology. Her research works at the confluence of computer science, media art and design, and has focused on the cultural, visceral, and embodied implications of digital technologies, particularly in the realm of chronic pain.

Dr. Gromala was one of the first artists to work with immersive virtual reality, beginning with *Dancing with the Virtual Dervish,* co-created with Yacov Sharir in 1990. From that time, she has co-founded transdisciplinary graduate and undergraduate programs four universities in North America, and two in New Zealand. Currently, she is the Founding Director of the Chronic Pain Research Institute, a transdisciplinary team of artists, designers, computer scientists, neuroscientists and medical doctors investigating how new technologies—ranging from virtual reality and wearables to robotics to social media—may be used as a technological form of analgesia and pain management. With Jay Bolter, Gromala is the co-author of *Windows and Mirrors: Interaction Design, Digital Art and the Myth of Transparency*. Her work is widely published in the domains of Computer and Health Science, Interactive Art and Design.

Mike Phillips

Mike Phillips is Professor of Interdisciplinary Arts, Plymouth University, School of Arts & Media,Faculty of Arts. He is the Director of Research at i-DAT, an Arts Council England National Portfolio Organisation, and a Principal Supervisor for the Planetary Collegium. His R&D orbits digital architectures and transmedia publishing, and is manifest in a series of 'Operating Systems' that dynamically manifest 'data' as experience to enhance perspectives on a complex world. He manages the FulDome Immersive Vision Theatre (IVT), a transdisciplinary instrument for the manifestation of material, immaterial and imaginary worlds and is co-editor of Ubiquity, The Journal of Pervasive Media: http://www.ubiquityjournal.net/

Paul Thomas

Paul Thomas Ph.D. is Associate Professor and Director of the Fine Arts program at, UNSW Art and Design. Thomas initiated and is the co-chair of the Transdisciplinary Imaging Conference series 2010, 2012 and 2014. In 2000 Paul instigated and was the founding Director of the Biennale of Electronic Arts Perth 2002, 2004.

Thomas is a pioneer of transdisciplinary practice. His work takes not only inspiration from nanoscience and quantum theory, but actually operates there. Thomas's current research 'Quantum Consciousness' is based on the research being conducted by Associate Professor Andrea Morello, Quantum Nanosystems, UNSW, looking at the visualizing and sonifying the electrons

superposition in the development of quantum computing. Thomas's previous projects investigated silver, the mirror and quantum theories of light and parallel universes in the work 'Multiverse'. Thomas's nanoart works include 'Nanoessence' which explored the space between life and death at a nano level and 'Midas' a study on what is transferred when skin touched gold. Thomas is the author of the book, *NanoArt: The immateriality of art*, published in 2014.

Peter Anders (Moderator)

Peter Anders Ph.D. is an architect, educator, and information design theorist. He has published widely on the architecture of cyberspace and is the author of "Envisioning Cyberspace", published by McGraw Hill, which presents design principles for on-line spatial environments.

Anders received his degrees from the University of Michigan (B.S.1976) and Columbia University (M.A.1982) and the University of Plymouth Planetary Collegium (Ph.D. 2004). He was a principal in Kiss, Cathcart, Anders, an architectural firm in New York City which designed facilities for the production of photovoltaic panels. He has received numerous design awards for his work and has taught graduate level design studios and computer-aided design at universities including the New Jersey Institute of Technology, University of Detroit-Mercy, and the University of Michigan. He is presently the chair of ISEA International and principal of Kayvala PLC, a design practice specializing in architecture and media/information environments.

His work has been featured in professional journals and he has presented his research on the architecture of cyberspace in several international venues including The New York Architectural League, Xerox PARC, ISEA, CAiiA, Cyberconf, ACADIA, AEC, ACM-Multimedia, InterSymp, SEGD and the World Future Society.

Digital Performance in Flesh and Bones

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Abstract

This artwork investigates the Brazilian urban body through performance. Unifying concepts of new rhythmic music and conceptual dance in performance, this article uses artistic movements in Brazil that are suffering marginalization by breaking with the established aesthetic. Discoursing about aesthetic axioms, the influence of technology in people's daily lives and connecting those elements with music and dance history pieces; this article aims to project questions around the value of popular culture. Small sketches of public dance interventions with live music are used in order to analyse the potential of daily movements and popular dance by digital media. Musical matrix connected to traditional rhythms involving everyday gestures, repetitions with the gradual introduction of electronic music in choreography after the performance, producing a videoart built by metacreation and performance concepts.

We present a kind of critique of the new mass phenomenon that becomes a fever and viral spreads music icons and, through performance, invite the public to think about society reality and the questions around contemporary music, dance and old paradigms.

Keywords

Popular culture; aesthetic of art; creation process; metacreation.

Introduction

Those responses, meanwhile, should not be presented as immutable or fixed, but should be flexible and capable of prospects for changing. "Flesh and Bone" aims to interpret and analyze a characteristic phenomenon in Brazilian cultural production: prejudice or discrimination, recurrent and frequent in various historical periods, putting the cultural production in a resilience paradigm. Particularly we can see this matter in cases of discrimination and even criminalization of facts passed in Brazil due to certain popular rhythms and dance like Maxixe (XIX century); Samba (XX century) and Funk music (XXI century).

But in order to investigate such issues, it was necessary to take some precautions about procedures or values that though widely recognized and theoretically accepted in the field of Aesthetics, they seemed to us insufficiently adequate to approach the phenomenon today.

Therefore, in this work we used two kinds of approaches to deal with those issues:

(i) creative research and
(ii) relational approach.

The Creative searching

As creative searching, we understand a configuration that organizes two branches of aesthetic search and language; interlinked and indissoluble. The theoretical search of the listed questions or subjects and the application of some conclusions or considerations in the real work of artistic production.

The most important, in this kind of approach, however, is the coming and going of information and expressions, be it in the translate of theory in artistic movement (sound, choreography, projection, etc), be it in the theorization of how the interaction with the performance and the public was passed effectivelly. The relation between the two fields we can, hardly, call Adorno dialetic, were the conflict and questions inherent to each ones can´t be solved in a possible media point, or mediation by center: it is solved by limits and extremes, not solving the problems, but opening perspectives and interpretation. That is, a choreographic questions can´t be solved theoretically, as a theoretical questions can´t be solved choreographically, but both of them was solved in interaction, exploring just the limits of their definition of fields, that is, the limits between theory and artistic pragmatically.

Relational Approach

The second point that origins that creative search is the relational consideration of aesthetic object. This work starts from the conception that the object of art can´t be understood as a given object, which was recognized by an essentiality around the beauty and fixed in their aesthetics values.

On the contrary, the object of art is given socially, produced by artists, metaartists or by interaction with the public, directly. It is an object that can be fixed as aesthetic or, indeed, as a work of art just through determinated relations in a licit form of life [1]. This means that to the creative search "Flesh and Bones" it is not like to persecute or try to reveal the essence that flows from work of art; but interpretate and understand the phenomenous and social relation that figures the aesthetic universe, so that the work can be understood as a work of art. That is, it´s suitable to investigate the game of language in a given society where it is

configured the universe of what is appreciated as a work of art [2].

Music and Math

Music and Mathematics have been traditionally closely connected. This relationship generated several notation systems, scales and different instruments manufactured. The seventeenth century was fundamental, while science was changing from theoretical to practical music was moving from science to art. The connections between music and science, in the nineteenth and twentieth centuries, to composition have been further extended.

From the perspective of physics, sound propagation obeys mathematics equations. There is a relationship between scales, tone, semi-tone and math conceptions such as ration, proportion, logarithm sequence and others. This relationship between music and math is very intense and ancient.

The oldest system of scale construction is much older than Pythagoras (c.550 BC), but is described as *Pythagorean scale*. It is associated with the theoretical justification, in mathematical terms, of its construction. Pythagoras noted the harmonious relationships of the sounds produced by the hammer in a blacksmith's forge.

In European music tradition, Pythagoras influences the theoretical basis. Ancient Greek instruments such as the lyre (a stringed instrument similar to a small harp) and the aulos (a reed instrument) finally led to the modern-day instruments of a classical orchestra [2].

In Oriental music tradition, the number of scale has more minimal interval between the pitches. Western ears are unusual to oriental scales causing them to have a unique sound not normally found in popular music. African music has a polyphony and the music system is focused on repetitive and rhythmic variation to achieve altered states of consciousness. [3]

Is the music Natural or Conventional?

The musical system can be called universes of ‘meaning construction inducers’ that work with building aspects of associations, a field boundary between consciousness and the unconscious expressions of given expression of the self; or of ideological configuration for the construction subjectivity, insensitive in daily life, but brutal in contrition of the bodies in your expression.

Wave sound can be represented by binary code, which is digital sound. This technology can be used to manipulate sound, recording, processing, reproducing, transmission, compression and storage it. Analog electrical signal can be convert into digital signal, like a microphone that use digital-to-analog converter (ADC), or it can be use to record in WAV, or MP3, for example. The opposite process, digital-to-analog converter (DAC), converts digital signal back into an analog signal, which could be a CD or MP3 player, for example. ADC conversion results in lost of data, for a simple problem of that poverty points doesn't make a completely curve. Nevertheless, there are extremely good softwares that converts in a good quality.

In 1989, German researchers from Moving Pictures Expert Group created the MPEG Layer3, which is known as MP3. This is a code form much more compressed than its predecessors, compact disc (CD) and long-playing (LP). So, to transform, song to mp3 file, it becomes a 10 times smaller, in average, than a file in a CD. And this process takes just a few seconds. It is based on psychoacoustics that studies how people realize sounds. Human being does not get frequencies low than 20 Hz and higher than 20.000 Hz. The frequency of human voice is, for example, between 60 and 1300 Hz. Besides, human audition is not able to notice some combinations of bass and treble. The MP3 encryption starts from this limitation. The mp3 file is smaller than other because it softwares using algorithms and some sophisticated mathematics equations to eliminate everything that psychoacoustic affirms that we don't realize. In theory, this reduction does not affect sound quality, like human ear listen the music. An agreement among speech and language therapist talks about the physical MP3 player danger in ear. The expression “deaf generation” is used by them all because everybody listen to music in headset louder and damaging to health.

In essence, technology has changing how art is made anhow the audience may experience it.

Art as support for non-art or is it otherwise?

Since the beginning of the twentieth century and to recent days, artists had provoked the critics, some were shocked and some amazed or even angry, we can mention some aesthetic experience that undermined completely what was settled once for all. That is, the designation of some particular types of objects, which are very common in the world, but should stand out as art objects. In that manner an urinal (Fontain) is displayed at an exhibition causing great impact; a pile of market boxes is exposed as an artwork; a cloak made of pieces of cloth and debris left by visitors in a mental hospital is now to be showed in a Biennial art exhibition; or a huge number of disposed bikes and watermelons should be seen as a artistical installation. [4]

Exposing these 'ready made” objects, commonly used in everyday life, such as a cycling or un urinal named by Duchamp as a Fontaine he notes that only the place of exhibition makes these objects to be seen as works of art. It is the place that gives the aesthetic value to a common object, the less aesthetic that should be [...] The value changed location: being now related to the place and time, defected from the object itself. [5]

One issue that seemed so very well settled for the traditional art in the early twentieth century presents itself as a new aesthetic and philosophical problem. We can go further in questioning on issues hitherto considered truths and

opening a flank until then not thought of objects of common use treated as artistic works.

In 1958 the art critic William Kennick encouraged his readers to imagine a huge warehouse filled with all kinds of things in the world.

> Now we will give instructions for someone to enter the warehouse and coming back, bringing with him all the works of art found there. Someone could do that successfully, however, as the very aesthetes admit, the person does not have a satisfactory definition of art as a possible common denominator. [6]

According to the philosopher and art historian Danto [7] perhaps the most profound impact that the twentieth century bequeathed to the arts is the disruption of what the tradition used to claim, as an essential fact about what should be considered or not an art object. Such questioning - he tells [8] (Danto 2009) as a kind of personal enlightenment that had to be faced first with the Brillo Box by Warhol [9] – could be put together in many favorable options philosophically and serve as art in several respects and prospects.

In general this question opens a very promising field for research that would approach philosophy of art as it begins to put under judgment something that hitherto was taken as a common sense: the art as having an essence that by itself should be define art as art.

If the aesthetics of the twentieth century inherited this tendency toward blurring the art object and the relational establishment of values; the contemporary trend towards meta-authorship points to the blurring between the author and the public, by referring to the public and a creative field of art itself build as an aesthetic discourse. And along with this, the lack of distinction between an art object and an object of ordinary life. At least one blurring field: one in which fragments of ordinary life, to be attached into aesthetically configured environments become aesthetic and artistic. Also otherwise, where the daily endeavor of a direct intervention of aestheticized movement, interacting with everyday life effectively.

Historical Aspects Through Music and Dance Prism

The musical diaspora forms a controversial mixture of persecution, discrimination and violence. The marginalization of rhythms is on several factors: the issue of race, religious and tonal accommodation. Samba is the famous Brazilian rhythm originating from the slums, invented by African descendants. Born on the Portuguese colonial farms where African slaves used dance to disguise the martial art called Capoeira. Later, the Samba rhythm hid at the top of hills in Rio's slums where today the police are trying to regain power.

After hiding in slum hills, the rhythmic moved down and approached the beaches, where it gained new clothes and a status with the label of. [10]

As Samba, another hybrid Brazilian rhythm called Maxixe borns in black guettos in XIX century. Slowly, this sensual music and dance attracts the attention the attention of a part of the population, where they started promoting small dance parties. In this century, this kind of meeting was represses and prohibited, even so they got notoriety among musicians and bohemians. Including – and perhaps – because it reproduction (scores and terminology) was censored and considered immoral. The books, when founded, were gathered. This is a fact, for example, that encouraged a composer called Ernesto Nazaré to rename the rhythm to “Brazilian Tango” and, the same music, could be distributed again.

> Judged and cursed as music and dance, survived under a constant war. Resisted bravely through all those enemies. It hadn’t founded safety among familiar groups, but Maxixe continued scandalizing, soberly, exciting others [11]

The musician and researcher Andre Rocha Haudenschild analyzed the influence of Samba weariness and American Jazz through the slow paced song of that turned more towards individualism, close to the sea leaving behind the modern city of Rio de Janeiro at the beginning of the 60´s:

> Would not be an coincidence that this ‘creative tension’ of Bossa Nova, also called "suspended animation" for Treece. Will be manifested in its many musical aspects - his slow and differentiated rhythmic movements, their harmonic cadences, his arrangements, his instrumentations and their vocal performances - which point to a seductive and comforting sound enjoyment, whose musical ethos always acts as an antidote to the rapid and hostile forces of modern everyday life. By the way, that would explain the unique character of their sound: this quiet *samba* rhythm, harmonized by dissonant jazz chords. Among the heritage of secular African-Brazilian rhythmic rituality (their ‘secular spirituality’) and musical influence of modern Western rationality (his "formal refinement"), Bossa Nova is inspired by a modern experience in transition, born of a natural sociability between the sand and the sidewalks of the buildings of the carioca metropolis of the late 1950s. [112]

Haudenschild explains that the growth and movement of the city's central locations for Rio's south zone was due to the new process of urbanization and the guitar was the passport of entry to Bohemian bars and private parties.

If the guitar was one tidy and intimate instrument that dictates and moderates the tone of Brazilian music, the entrance of electric guitars and percussion increases the volume of Popular Music, introducing a sensuality of fever and provocative body movements of the 70’s as was the introduction of the hippies mini skirt influenced by Beatle´s rock.

Firstly, as an outsider but gradually by being exported to Carnival, it took on different rhythms in the Blocks. *Samba, Frevo, Capoeira* are the first rhythms and dances that leverage musical and artistic movements such as Modern-

ism and Tropicalism, paving the way for Brazilian Popular Music such as Rock, Hip Hop and Funk.

> "In the case of Bahia´s African-pop, there was a standard negotiation with the phonographic industry that assimilated the carnival music and spread it internationally. The mestizos musical models' sound improve through research and start to be more sophisticated. The rhythmic and melodic brings the inclusion of harmonic instruments of samba-reggae bands, for example, it raises the status of percussion, often overlooked in the musical plan." [13]

Tribal relations are not only limited to rhythm. Dance elements, the gesture and possessive trance from the yard of the religions manifestations become collective in the parties, trios and bands everywhere and popularized the way people dressed and talked in Bahia, seeking strong colors, valuing traditional African clothing.

The African descendants of the northwest of Brazil realized their role in the blocks and in the success of the music exported globally. The *Lambada*, *Timbalada* and *Axe Music* becomes a new fever that contaminates the music scenario of in the 90´s.

The carnival music of the Lambada, the Timbaland and Axe music propagate outwards and gain space in the media. Stuart Hall described Diaspora a post-colonial behavior using the concept of Derrida's difference,

> The concept of diaspora closed leans over a binary conception of difference. This founded on the construction of an exclusion boundary and depends on construction of an "Other" and a rigid opposition between the inside and outside. However, the configurations of syncretized Caribbean cultural identity require the Derridian notion of a difference that does not work through the binaries, veiled borders that not finally separate, but they are also places of passage, and meanings that are and positional relational always slide along a spectrum without beginning or end. The difference, we know, and essentially the meaning and the meaning and crucial culture. [14]

The explosion of *Axe* music was characterized by a new diaspora for the pride and appreciation of African values and the body's sensuality. It can be stated in a new Musical Diaspora that pervades popular music with new rhythms. The new emerging classes of suburbs and slums in northeastern Bahia bring new rhythm to the ghettos, valuing the culture and carnival sensuality, and new instruments are incorporated such as the electric guitar and percussive drums. The wave of movement mixes with the Caribbean rhythms of the North generating new melodies and rhythms with strong influences of reggae.

In Brazil, swing and jazz influenced the white Rio´s middle class with *Bossa Nova* with the guitar as the main instrument. The reggae with samba generated the Axe Music, the mestizos in Northeast valuing the percussion. *Capoeira, Frevo, Forró* and *Maracatu* influenced the new hit of the swamp with the musician Chico Science that mixed Hip Hop bringing American orality and poetry to music.

The black American musicians first created funk music with a more smooth and danceable rhythm. The new pattern for the younger generations of musicians: a song with a slower, sexy, loose rhythm and oriented repeated musical phrases. Funk and Hip Hop brought popular Brazilian music from slums and ghettos because they combine the repeated hits, sung poetry, percussion and repeated phrases with exacerbated sensuality.

Aesthetic and Marginalization

According to Hall, popular culture is the relationship that face up to dominant culture. Common sense says that popular culture is everything that the mass consumes, ignoring the context and social aspects and positioning popular culture in passive consume place. In the other hand, the anthropological view describes aspects of popular culture but – as Hall endorses – it's not a wakeless theory.

Looking through music and dance history pieces, the cycle of consuming illustrate how people have been accepting popular culture and how media deals with it.

As we've seen, there is an axiom present in different times in our history, as model that is followed season after season. First, a rhythm (regardless if it's a dance or music rhythm) is created. Thus, it gets spread and people incorporate it as local culture. At this point, the persecution starts. Exemplifying, in they sent sympathizers to jail; in Brazilian funk the media manipulate the information connecting the image of dancers and MCs as invaluable and illegal. The history starts changing with an outside view. Maxixe was extremely respected in Parisians saloons as well as funk was pretty famous in US, including with Beyoncé using Brazilian funk samplers. The history had it twist that time. Those rhythms came back to Brazil coated as new products and the Cultural Industry exports it. The product – and it becomes as a product – is vulgarized and stereotyped.

Social issues, as drug traffic and violence, are frequently bonded with popular movements. "Police sections" on the news hosted the entrance of funk carioca in media scene. As Filho & Herschmann, scholars, say

> all the campaign and the encouragement to the fear around *carioca* funk – on TV News and mainstream media – contributed, in some ways, to that funk lifestyle and cultural production have fascinated other social groups beyond slums in Rio de Janeiro city. [15]

As popular movements are all balancing themselves in chord between a popular acclamation and danger sentences. Judging the sympathizers by values beyond art itself. Why, as any art movement, the values for popular art are different? Where our judgment of taste comes from?

To Pierre Bourdieu the ideology of natural taste

> owes its efficacy to the fact that, like all ideological strategies generated in the everyday class struggle, it

> naturalizes real differences, converting differences in the mode of acquisition of culture into differences of nature, it only recognizes as legitimate the relation to culture (or language) which least bears the visible marks of genesis, which has nothing academic, scholastic, bookish, affected, or studied about it. [16]

It's a fact there is a dialogue – that is a Brazilian cultural characteristic until currently days – between what is prohibited, what is moral and immoral; what is culture and what is tribal fetishism. This debate determines an intense cultural fusion, but, in the other side, establish a kind of aesthetic critique that coexist peacefully with a discrimination or criminalization of some types of cultural expressions. It brings to aesthetic campus a concept of "status evaluation" around what is erudite and popular.

The criticism of *Maxixe* wasn't exactly to a rhythm or dance, but to something – it wasn't socially well accepted – stronger than the method itself: the sensuality. There was a sensual language inherent to it, malice, cultural background and oppressed irony. Moreover, it faced up European an aristocracy that didn't allowed an enhancement of a Brazilian "black" image.

Nonetheless, this isn't happened just with *Maxixe*, we see it in *samba* and, nowadays, the same process with funk.

However, as a resistance culture, the artistic production of the bottom classes in Brazil, could be distinguished as part of a "group of attitudes, customs, beliefs, behaviour code of subordinate class in a historical period". An authentic culture that suffers constantly a disassembly and misappropriation process, that tends from a "popular culture" to a "culture imposed to subordinate class". [17]

Cultural Industry theory conceived a model of an aesthetic mercantilization that supported a method to manipulate the taste of people, in order to satisfy basics desires, symbolically poor.

That perspective points to a different direction, to be ruled the possibility of resistance face up to ideological imposition, endorsed by aesthetic. Under this point of view, it admits the possibility of transference and counter transference ideological; all the cultural imposition carries a resistance multiplicity impossible to map and with the time in favor by inhabit imposition.

The ideology, according to the French philosopher Louis Althusser "isn't a issue of 'false conscious', or misconception or epistemological limit". [18]

Ideology is a physical group of control apparatus direct and indirect, explicit or implicit, it means, implicit under a daily habit: controlling the time and movement. In aesthetic it isn't represent the cultural resistance, merely the movement of the bodies. The cultural struggle isn't the strengthening or the imposition of styles or types of culture, but the bodies expressions in dances, parties, ceremonies and everyday. Thus, this aspect, even the styles and the culture as concepts, being incorporated as products and returned as control rules over the taste, the multiplicity of ways of life guarantees a resistance. And this is a human capacity to reproduce and, invariantly, express and impose itself on it own control, in a cyclical way of submission and subsumption, of antipersonification and subjetivation.

Pondering about it, the performance presented on ISEA2015 mixed popular culture – funk, gestures and simple movements – in different daily situations, with contrasting styles and intensities to extract real reactions in real world. What's an old lady expression when she see funk dancers in a street market? Or contemporary dancers? As if those labels really exist.

Figure 1: Performance at Vale do Anhangabaú, São Paulo, Brazil. © Jefferson Alves

Technology and daily lives

The evolution of small communication devices in our day-to-day lives, connected with the Internet, with the growth and spread of the rhythms of Brazilian music and dance, create a jump in disruption; a leap in quantity and a disruption in quality. Choreography digitally recorded and intentionally posted to spread virally is measured by the amount of 'Likes'. Usage of repetitive motions associated with musical phrases that induce trace, force a spatial and temporal detachment using "points" from African religious beats. Also the generation that mixed mantras with electronic music of Eastern cultures forming the Rave Culture in the 90´s.

> worth the relationship and body aesthetic that the musical harmony implies, because it helps us understand the Brazilian adjustments and differences of scale and musical dissonance between the Brazilian south and northeast. A significant portion of our musical heritage comes from the European Southern region, which suffered the Arab influence with the Moorish invasions. Another of our musical influences come from Africa - pentatonic having a musical system composed by polyphony and the dissonance - and mixed with Brazilian indigenous musicality from the colonial period. [19]

Brazilian music and their atonal instruments with all their mixtures of influences directly affect day-to-day life. Entering bass and treble tones developed through its history, with repetition and changing rhythm become addictive because they induce the production of dopamine, creating other state of minds. Thus, it explains how performances of small clips become viral. But this has been going on for a long time in electronic games, carnival, and electronic music festivals or tribal raves.

Digital Performance in Flesh and Bones

The performance, the experiment using theoretical concepts unfolded in actions to experience and enlarge the studies around this subject, is based on Rudolf Laban researches, meta-creation process and digital media.

The choreographer, dancer and intellectual Laban, changed how we see the dance movements. Expanding the dancer body, including and accepting the natural movements as dance. He put the focus on what the person makes and what it could possibly inspires on others.

Filming simple scenes, extracted from Brazilian everyday, these micro sketches are seen and reproduced in a choreographic posterior dance scene. The way that images are composed in edition shows all the process, since the naturalness of first shot until the choreography ready.

Gesture, the daily and the artistic

The elected theme was "daily gesture", included the large characterization of "gesture"; not only the individual gesture is considered, but the collective gesture, whose substance comes from popular expressions, being it in cultural manifestation or ceremonial, being it in the daily gesture, regulated in the routine, duties and relationships.

Figure 2: Performance at Santa Cecília street market, São Paulo, Brazil. © Jefferson Alves

In that way, it was represented by expressions of personal and collective gesture. Besides, it may be said that the gesture holds a duplicity in itself, from one side it is spontaneous, for it appears spontaneously, many times without rational control; but it appeared too, just dressing more usual clothes, and, from this point of view, it obeyed to a behavior predefined patterns, in great part of the cases called "spontaneous".

Creation Processs

The movements and actions produced in this performance are based on daily movements and funk steps.
Observing the routine and extracting some gestures from people on the streets, the dance borns with the repetition of these gestures and, thenceforward, it becomes a dance improvise.

The blend of intentions and places change the choreography forms and the creation process interacts with the dance that happens between theses signs, playing with intention, velocity, costumes and our own dance repertoire.

These interventions were filmed in several historical points of São Paulo, without rehearsal or direction. All those places – Vale do Anhangabaú, Santa Cecília street market and Fundação Nacional das Artes-FUNARTE (National Foundation of Arts) – are public and localized in downtown. The group chose them, because there are a wide number of diversity audiences.

Laban considered space what the body occupies to execute movements. His studies embraced the relations that human movement produces in the space, but how the space influence in movement as well.

> his idea of 'choreutics', or the practical study of space harmony, is based on a distinction between general space, in the way geometry or topology might define space, and space as a field of relations produced by the moving body. [20]

Encouraged by the Krauss' expanded fields concepts – that embraces the fusion of different issues of art to built a piece that floats among these ones – the music was created. After the performance images, the musicians worked on a musical arrangement to translate de movements in notes. As a meta-score, the body and the intentions, they have created a similar reasoning to compose the music.

The meta-creation process uses the material used as inductors or as guides to compositional procedure: true scores constituted bodies, scenes and movements. The captured images are reinterpreted by musicians, who put together noises and environmental sounds, and developing new layers of creation, by observing the projection on the screens.

These qualities – expanded fields, Laban's studies, metcreation – have a characteristic in common: the hybridism. Krauss considers the intersection among the fields, Laban explore de space and body as a single piece and metacreation goes beyond synesthesia and put the components of ambience and dance as a conductor for the music harmony. Looking at funk history, the scholars say about plurality:

> The hybridization process intrinsic to funk when it embraces several contents from various musicals branches allows that the empathy [with the music] happens in different socials environment. [21]

Disruption

What stands out in this creative research process is that theoretical production is constant and recurrent, subsided in different contexts, which are extending the original scope for another creative set. As a kind of stagecraft, dance or musical where what is considered to be the object of art is produced in real time, through various stages.

In this process, before setting the fixed content on rigid schemes the authors stablish optical fields, syntax or grammar, which induce the production of the final object, but not to be fixed it in an authoring way. These creators can be called meta-authors, because while producing, along the creation cycle, they don't deal with objects as such but situations, procedures and senses that drive the effective interaction between artist, audience and communication, producing in factual and real time the utmost artistic object. [22]

An experimental field that expands the boundaries between traditional artistic expressions (dance, music, videoart) and where the digital and the apparatus of the body reconfigure a virtualized space-time that expresses the inherent contradictions and co-existence: rhythm x arrhythmia; communication x noise; planning x randomness or even probable x improbable.

The point of this study is not just theorize the questions about art and digital universe, but create a product that blend the questions practically, unifying the past and the present in art (by digital and live performances) transposing that one piece without the other couldn't be possible without losing the layers that compose it.

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Disrupting the City: Using Urban Screens to Remediate Public Space

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Abstract

For over a decade, human-computer interaction (HCI) research placed a great deal of emphasis on studying interaction, engagement, and appropriative practices in online technology-mediated social environments. Moving forward, however, we see computing systems increasingly designed to support digitally-augmented face-to-face interactions in public settings. As far back as the nineteen seventies, new media artists anticipated this interactive potential of digital public displays to foster new forms of situated interactions in urban space, quite distinct from mobile computing in that they altogether exclude online connections or exchanges. Drawing on examples of practice, this paper discusses and showcases some of the key creative strategies, which panelists deploy in order to remediate interactive screen technology into a platform that has the power to disrupt the ordinary course of our everyday experience within increasingly media saturated cities.

Keywords

Urban screens media fa ades large dynamic digital displays screen technology interactive public space installations urban interventions design strategies situated interaction remediation.

Artists, Digital Screens, and Public Space

Large digital displays are becoming ubiquitous in public space, but their potential for interactivity remains largely unrealized as they are mostly used to deliver content. This typically takes the form of a one-way process where information is simply transferred from one person (sender) to another (receiver), thus following the elementary transmission model of communication theorized by Shannon. 1

While industry and the public sector are poised to design new systems and applications that will make interactive digital public displays reminiscent of what we have come to expect of the World Wide Web, new media artists have been developing participatory models to support interaction with screen technology for the past fifty years.

For instance, in the 1970s, artist Peter Campus conducted a series of experiments with very large displays to produce a disjuncture between visual perception and proprioception. He did this by showing viewers images of themselves that drew attention to delays, disruptions, and oppositions between their situated body movements and how these are represented on screen. These early electronic art installations were concerned with exploring the degree to which a viewer's sense of bodily awareness intervenes in the relationship between vision and embodiment. 2

Since Campus's ground-breaking work in the field of electronic arts, new media artists from all over the world have imagined and deployed their own arsenal of creative strategies to transform passive screens into participatory platforms. In doing so, they have also considered the physical environment around these screens. In semi-public and public settings, this means disrupting the way people would usually perceive urban furniture, lighting, ambient media, architecture, and the presence of other people.

Accordingly, this panel presentation was articulated around the idea that taking an artistic approach to digital displays deployed in urban settings implies remediating public space into a platform used to stage new encounters and situated interactions *with* and *through* technology.

Each panelist was invited to showcase their unique approach to making interactive screen-based public art installations and accordingly explain how these creative strategies work to disrupt the ordinary course of our everyday experience within increasingly media saturated cities.

Urban Screens as a Disruptive Platform

In Europe and Australia, the term *Urban Screens* has been used since early 2000s to describe an emerging curatorial network that promotes the appropriation of media fa ades and dynamic digital displays in urban space for the purpose of community building and artistic creation. In this sense, the *Urban Screens* movement firmly pushes back against the commodification of screen technology in public settings. 3 Now known as the *Connected Cities* global network, this initiative supports the production of cultural content for screen-based platforms, and coordinates exchanges between cities around the world who wish to reclaim public space. Of particular interest is that both the *Urban Screens* and *Connected Cities* projects highlight an infrastructural model that does not focus on profit:

> *The Urban Screen project was initiated in Amsterdam in 2005 with the conference "Discovering the Potential of Outdoor Screens for Urban Society". One of its aims, further explored by the following two Urban Screens events held in Manchester and Melbourne in 2007 and 2008 respectively, was to explore the opportunities of employing the growing infrastructure of large digital*

displays in public space, currently used mainly as a tool to influence consumer behaviour through advertising, and expand them by displaying cultural and artistic content with the purpose of revitalising public space, and generating public engagement and interaction. 4

The *MediaCity* biennial academic conference is another similar forum. It is concerned with looking at "citizen driven approaches based around ad-hoc practices and prototyping of counter-culture scenarios". 5 Held in Plymouth in the U , the theme of the 2015 conference was: *Reflecting on Social Smart Cities*. Academics, architects, designers, and new media artists from all over the world presented papers and artworks that critically challenged the role and use of technology being proposed in the dominant – profit-driven – paradigm currently driving the underlying technological infrastructures of smart city agendas. The *MediaCity5* conference program describes this paradigm as "the data-centred optimisation of urban systems". [6

Many social sciences and humanities scholars critique the fact that today's infrastructures tend to "over-regulate people and their actions". [7 But the Urban Screen project reminds us that, in the best of worlds, they can and should also be sites of negotiation and compromise to envision possible futures. After all, infrastructures are the context for the design and use of technology as a public good. 8

With this in mind, for the purpose of this panel, the authors chose to expand the use of the term urban screens to more broadly describe an actual setting in the built environment that includes one or more public media fa ades, dynamic displays, or screen-based art installations, under the assumption that an urban screen can be any public platforms used as a screen to remediate the city. This is done to propose future potentialities for, as some scholars have suggested, there may be as many instantiations of public space as there are citizens in modern urban society. 9 Accordingly, this panel aimed to engage the audience on how some creative strategies might better support a two-way model of communication that is relational, rather than merely informational. This paper provides a summary of the highlights of this public forum on urban screens.

Questions, Challenges and Opportunities

Transforming urban screens into interactive public platforms present both challenges and opportunities. uestions raised by the moderator and panelists included:

- *What happens when such platforms enable a two-way flow of interactions rather than a one-way flow of information?*
- *How can artists use them to remediate urban space?*
- *How can they change our way of thinking, seeing, and doing? How might this affect people's sense of aesthetics?*
- *How do the different spatial elements influence one another?*
- *What happens when the observer is set in motion inside a space with one or more urban screens?*
- *What are the digital practices that these platforms afford?*
- *How could they be used to facilitate new forms of social, cultural, and political interaction in real public space?*
- *What content is possible? Could urban screens allow us to untap new potentials for content creation?*
- *How does the material blend with the digital to enhance the interactive experience of urban screens?*

uestions raised by the audience included:

- *Do urban screens really disrupt the city when they, in fact, make use of existing infrastructures and thus blend into the mêlée of existing mass media?*
- *What means and tactics might best support disruption in such contexts of production and deployment?*
- *Are such platforms truly open to free speech or must we assume that because they are deployed in public space, they are subject to surveillance, data mining, control, and possibly censorship?*
- *Can they be designed to support appropriation?*
- *To what extent do digital public displays serve some of the needs and support the speech acts of the marginalized and the disenfranchised?*
- *Can we imagine ways that people can be directly involved in making and controlling their own large-scale public displays?*

Engaging Audiences by Using a Research-Creation Approach to Urban Screens

Panelists explained their approach before they showed several exhibited examples of practice. Interestingly, the presentations made by the authors of this paper served to raise more questions than they answered. This is yet another advantage of using a research-creation approach to study and develop urban screen projects: theory and intentions are grounded by illustrative case studies. The following subsections summarize each of the presentations made during the panel session by highlighting salient concepts and arguments brought forth by the panelists. This paper then concludes on the implications of these approaches.

Using Massive Media to Remediate Public Space (Dave Colangelo)

What can happen when buildings become screens?

The new sites of conversation, contestation, and commerce in public culture that emerge from the confluence of building and screen-based technologies have two key characteristics. Firstly, they are big – they are *massive*. As a

Figure 1. ***In The Air, Tonight*****, 2014, Dave Colangelo and Patricio Davila, video projected art installation, ©2014_DaveColangelo.**

result of their scale they are highly visible and loaded with significance and thus culturally and economically valuable. They *take* space, that is, they take up a significant amount of prime real estate and demand to be considered as public and communal. Secondly, they are communicative and technical– they are *media*. They use their scale, visibility, ephemerality, centrality, and communicative capacities, from data visualizations enabled by programmable LED fa ades, interaction through sensors and mobile ubiquitous media, moving images, sound, and networked communication, to broadcast their messages and engage on- and offline publics. They *make* space and produce it through interactions both proximal and distal: they mediate. All together, they are *massive media*.

So, when a building becomes a screen via the addition of expressive, programmable lighting (such as LED lighting panels), or large-scale digital projection, the logic of the monument and the logic of the screen are mixed. The solidity and history of a structure, with its attendant hold on the spatial and cultural imaginary of a place (think of the Empire State Building, for example), gets mixed with the attractive ephemerality (and sometimes reactivity or interactivity) of the screen.

The resulting architectonic forms, while situated within a history of architectural lighting and projection, mark a significant shift in scale, expressivity, and malleability of the urban surface. Instances of expressive architectural displays are bigger, more dynamic, and more readily altered and appropriated than ever before due to technologies of encoding and transmission available to the hosts and cultural producers, and the technologies of decoding (and re-transmission) available to the peripatetic audience surfing urban, virtual space, and increasingly hybrid space.

While there are many aspects of this phenomenon worth noting, I focus on three major areas, answering the question “what can happen when buildings become screens?” in three distinct ways:

Firstly, with large-scale public projection, concepts of montage, superimposition, and apparatus can be used to address and recenter a peripatetic, [10] transversal [11] subject and audience, while newer tactics such as interactivity and constructing a composite *dispositif* [12] flesh out the expanded cinema practice of massive media, unlocking narrative and associative potentials for the moving image and the city. The cinema and public space are transformed when buildings become screens.

Secondly, large-scale public data visualizations made possible with expressive architectural surfaces such as LED fa ades, data, and ubiquitous social and mobile media, enable artists to create new telepresent and telematics rituals and opportunities for urban activism and identification by combining screen-based information, communication networks, and monumental architecture. Buildings become dense transfer points for a highly contingent relationality, [13] as well as sites for public data visualizations, [14] when they become screens, again, unlocking narrative and associative potentials.

Finally, the continued presence of curatorial groups and strategies are required to open these new scenarios of massive media to creative and critical use by artists and citizens in contrast to commercial monopolization. This requires networked coordination of sites, negotiation with corporate infrastructure owners, politicians, and city governments, and the conscious development of audiences for the work. When buildings become screens they must be treated as exhibition spaces, and the surrounding city as an urban gallery to enrich mass culture and the public sphere.

Overall, when buildings become screens, that is, when they become massive media, expanded cinema and big data become something that we can, and should, comprehend and contest in new ways on and offline publics can engage at once with social networked information and images mediated at highly visible and attractive architectural scales. This can be harnessed for commercial purposes, of course, but our focus should be on how and why these spaces should be reserved and developed for art and directed towards larger societal issues such as social justice and climate change.

One such example of creation-as-research in which I have attempted to address this directly is through a project entitled *In The Air, Tonight* [15] completed with my collaborator Patricio Davila. For one month, during one of the coldest winters on record in Toronto, the LED fa ade of the Ryerson Image Arts Building was animated with a blue wave representing wind speed and direction while an intermittent red pulse was triggered by fluctuations in the use of the hashtag homelessness on Twitter. By visiting intheairtonight.org people could read and retweet messages from our Twitter feed (@itat2014) or compose their own messages. Every message with the hashtag homelessness amplified the issue online and contributed to a colour change on the building. Our goal with this project was to foreground a pressing social and civic issue through networks and architecture, negotiating access to both, and providing an interface that allowed people to engage with and contribute to amplifying an area of common concern – to create a participatory public sphere around a specific issue through massive media.

Air(e) Libre: From Individual Bubbles to Full-Blown Public Sphere (Jean Dubois)

Before the twenty-first century, modern conceptions of public space were intimately shaped by everyday life and encounters experienced at street level and in city squares. Today, it may be that the majority of our interactions collectively take place through online social media and this shift may well have radically redefined our understanding of what constitutes public space. The street continues to exist but it is no longer the locus of public life, the place where we share ideas and views. Digital networks now host virtual public spaces rendering them intangible. While online environments support new ways of being together, they also change the stakes and present unprecedented challenges and opportunities. et, it is still not completely clear exactly what these are. We have a sense that the public sphere has become a liminal space for public life somewhere between the streets and the complex web of media networks we use, an indeterminate discursive space produced by the interdependency of one and the other.

At each node of these networks are technological devices. Among those, large digital public displays started to become ubiquitous in big cities around the world at the same time as urbanites began to routinely carry with them mobile phones embedded with miniature displays. Notwithstanding their screens, they have little in common since they are of entirely different scale and fulfill competing purposes. While the former serve the function of placards that broadcast the spectacle of advertising, the latter are used as reading tools, which like a book, lend themselves particularly well to cocooning. Still, one wonders whether a new ontology of public space might emerge from the interplay between the two. Could it engender unpremeditated encounters or spontaneously elicit the spirit of community and a sense of solidarity among strangers? How might it induce embodied experiences that are equally as stimulating to the senses as they are to the mind? Might it channel a harmonized voice distinct from the usual hubbub or the communal sound of the choir?

The main objective of the *Air(e) Libre* research-creation program was to consider these questions through the production of a new kind of public artwork that would strive to forge new relationships between the urban landscape, telecommunications, and intimate space. 16 The approach developed in the context of this creative process is best exemplified by three artworks. Each of these invites passersby to first dial a special telephone number, and then blow into the microphone component of their personal devices. By doing so, people in the city can animate the giant images on digital public displays fortuitously encountered in the city. This mode of interaction aims to support a direct, embodied connection between the intimacy of the body and the monumentality of architecture.

À Portée de souffle (By Means of a Sigh) represents a tight close-up framing a lateral view of a man and a woman's face gazing into one another's eyes as they symbiotically breathe the same air from the single bubble they blew from chewing-gum. Passersby are invited to enter into the

Figure 2. *À portée de souffle*, 2012, Jean Dubois and Chloé Lefebvre, interactive art installation. ©2012_MartineDoyon.

couple's intimate bubble by blowing out air right into the microphone component of a portable phone connected to the screen. From the bubble's incipient formation to the different stages of its expansion and retraction, the spectator actively engages with the artwork by gradually bringing the bubble to its breaking point. This puts an end to the telephone call linking the interactant with the large public display, and by extension, to the encounter with the couple.

By contrast, the spectator's exhalation becomes consonant with a gust of wind in *Tourmente (Turbulence)*. In this work displayed on a large digital screen, we first see a series of portraits of people who appear to be in distress. A message invites passersby to find out more about why the sitters have this air of torment by calling a special telephone number. Once the phone is connected to the screen, a second message explains that the atmosphere in the picture can now be changed if the interactant blows into the portable device's microphone. When this happens, a soft breeze immediately kisses the face of the sitter displayed on the screen. But then, the wind rapidly changes into a blast that dishevels the sitter's hair and deforms their face. Once the interactant runs out of breath, the telephone connection is automatically interrupted, thus suggesting to spectators that such interactions are what had caused the

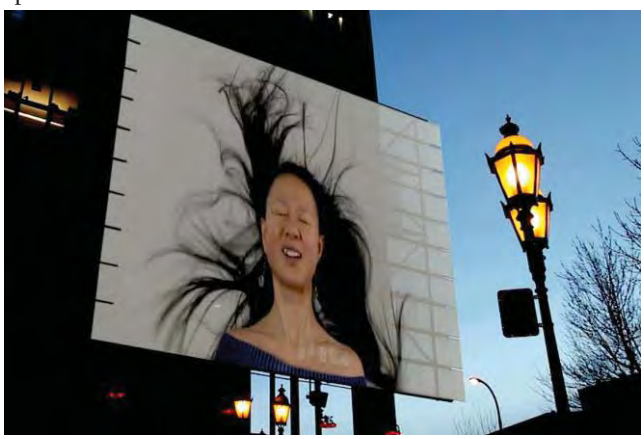

Figure 3. *Tourmente*, 2015, Jean Dubois, interactive art installation. ©2015_JeanDubois.

sitters to appear troubled at first. Here, it is a personal device that gives one access to the public realm within which private space is defined by the boundary of a large urban screen this artistic strategy effectively inverts conventions of what currently constitutes public space vs. private space.

In *Le Circuit de Bachelard (Bachelard's Circuit)*, public displays come in the shape of a series of luminous translucent tubes set up all along an underground passageway, which offers pedestrian access between two campus buildings. The light installation visually references the electrical and hydraulic pipes and fittings typically found running along the ceilings and walls of building basements. In this interactive artwork, the interactant's exhalation causes fluctuations in the motion of the light flow along the tubes of the installation. During the *White Night Festival* that took place in Montr al in 2015, the design team organized a series of "tug of war" type of competitions: the collective breathing effort of one team competed against another's to modulate ambient lighting inside the underground tunnel.

It is not without significance that breathing was the strategy used to interact with urban screens of commanding scale, especially considering that the input interface – personal mobile devices that have become increasingly part of our everyday – are of miniature size in comparison. Indeed, this interaction modality makes manifest an invisible, but vital connection between individuals and the civic infrastructures that surround them. Breathing is probably one of the most inconspicuous acts that all of us do day and night. Although the reach of one's breathing spans no more than a few centimeters, it nevertheless circumscribes the boundaries of our physical privacy. Giving one person's breathing architectural magnitude works to challenge preconceived ideas about how authority and agency conventionally play out between individuals and institutions.

Figure 4. *Le Circuit de Bachelard*, 2014, interactive art installation. Photo credit: Maxime Boisvert. ©2014_JeanDubois.

Beyond creating a user-friendly context for playful interactions, the three artworks described above also aim to suggest that we, as individuals, need not only be the spectators of monumental public art. By interacting with these works, we are meant to become aware that their overpowering presence in public space carries a great deal of political weight. Breathing as an interaction modality is proposed here as a means to reclaim the dignity and nobility of the subject's body in the city by temporarily reversing the power imbalance between its modest scale in reference to the imposing stateliness of the *polis*.

Ancient Insights on Interactivity: Using a Media Archaeological Approach to Study Urban Screens (Claude Fortin)

Huhtamo argues that, as elements of visual media culture, public displays have been a common fixture of the *polis* since ancient times 17 . Applying his media archaeological approach to urban screens also reveals that large screen surfaces in private, semi-public, and public space have an equally far-reaching history of being *interactive*.

A case in point are the dialogical wall writings found in Pompeii. Since the eighteenth century, archaeologists have been excavating the Ancient Roman town-city that lay buried in pumice stone after the eruption of Mount Vesuvius in 79 A.D.. In these ruins, they found that the interior and exterior fa ades of public buildings, stores, and private homes were often marked with *graffiti* and *dipinti*. A *graffito* is an inscription – a writing or a drawing – produced by scratching into a painted or plastered surface that hides a different coloured ground a *dipinto* is a similar inscription painted over this surface with ink, paint or charcoal. 18

Figure 5, for instance, shows such graffiti in context. Here the excavation site is a city street with a small commercial building known as Asellina's Tavern. Some of the cursive dipinti seen on the frontal fa ade are painted notices that have been identified as electorial slogans and advertisements serving as political placards. Along with similar *programmata*, it would not be unusual to find in Pompeii announcements for beast-hunts or gladiatorial games. 19

Further, archaeologists found that in the ancient Roman world, graffiti was a respected form of writing which existed on the fa ade of most buildings, including inside people's homes. For instance, one luxurious home in the Bay of Naples had greetings from friends, carefully incised around the edges of frescoes in the home's finest room and a stairwell in which people took turns quoting popular po-

Figure 5. *Thermopolium of Asellina* in Pompeii, Italy, c. 79 CE, Ancient Roman Empire. Reproduced from ArtStor.

Figure 6. Frescoes inside the *Casa degli Amorini Dorati* in Pompeii, Italy, c. 3rd century CE to the 1st century AD, Ancient Roman Empire. Reproduced from ArtStor.

ems and adding their own clever twists. In other areas of that home, the graffiti included drawings: a boat, a peacock, and a leaping deer. 20 According to Rebecca Benefiel, the clustering of graffiti in this house showed that this practice was not the domain of the individual they were typically social and interactive in nature, often the work of many people responding to each other. 21

The results were a motley collection of asynchronous conversation threads and images. Figure 6 shows the interior of another home in Pompeii. Here formal decorative frescoes executed in the First and Third Pompeian styles co-exist with personal inscriptions. With these graffiti and drawings, the walls inside Pompeii homes and on Ancient public fa ades could be construed as media platforms for free speech, creative expression, and more specifically, for people to engage in dialogue in public space. Aside from graffiti and street art, obvious examples of such interactive writings today are found on the virtual public spaces of chat rooms, blogs, and social media sites (i.e. Facebook™).

Perhaps more interestingly, onsite observations in the town-city of Pompeii shows that the practice of graffiti was actually widespread among all social classes and in all types of buildings, including basilica walls, which were found to have collections of poetry and prose as well as "extended conversations about the nature of love, scratched by a variety of different hands", while in other pedestrian sites, one could read graffiti of "legal and commercial rhetoric, improvised and crafted poetics compositions, dramatic performances and public readings". 22

What this research suggests is that the town-cities and city-states of the Ancient world may have been interactive public spaces in their own right. As the first *res publica*, Rome in particular offers an early example of a participatory city in which the public realm is made to appear and disappear through public displays of speech and action. Indeed, one could even say that since the dawn of civilization, cave walls and building fa ades have more often than not been transformed into media sites. The question here is in what way are such private and public sites interactive?

This, in turn, raises the problem of what exactly constitutes an interactive public display? Looking at stencil-like proto-graffiti made with human hand prints on cave walls, as seen on Figure 7, for instance, one might ask in what way could this have been interactive? Contemplating this question can open up new ways of thinking about the design of urban screens because it forces us to think of interactivity in ways that we might not be accustomed to. In fact, this historical approach invites us to interrogate the relationship between form and content that supports interactivity as a process. For example, one could argue that there may be a biochemical interactivity happening over time on the cave wall, for surely, the colors, shapes, and textures of this palaeolithic artwork must have been subject to constant transformations over the years. Such a conception of interactivity is in fact closely aligned with Nicholas Negroponte's recent claim that "bio is the new digital" 23

By linking a form from the past to one from the present, we create a *topos*, which Huhtamo, in the context of the media archaeological approach, defines as:

> *…a persistent cultural formula that appears, disappears, and reappears, gaining ever-new meanings in the process…Topoi are building blocks of cultural traditions; they manifest both communities and transformations in the transmission of ideas. [24]*

Huhtamo situates this scholarly practice well within the tradition of the humanities, that is, its purpose is mainly philosophical and discursive. But one could argue that, for many artists, designers, and practitioners, it is also intrinsic to research-creation. Have artists not always referred to visual sources as a source of inspiration and as a tribute to the legacy of culture itself for as long as we remember? Further, by using historical sources to challenge current conventions of what constitutes an interactive digital public display, we can also evoke ways of reimagining them.

Another case in point is the observation that the electronic billboard aesthetic, which emerged at the turn-of-the-century in cities such as Seoul, Hong ong, Tokyo, and Times Square, is actually nothing new. As Mc uire argues, its origin is the electrical sublime. 25 Indeed, in reference to public displays, it is especially a remediation

Figure 7. Stenciled hand prints in the Cosquer Cave, France, Palaeolithic Period. Reproduced from ArtStor.

of how architectural lighting started to be used in metropolitan urban space in the 1920s when very large advertising billboards were being designed with light embedded in them as a design material, to then be integrated as media architecture in big cities. Neumann, who examines lighting as a design art, refers to this visual practice as the twentieth century tradition of designing "nocturnal modernity… whose roots could be traced back to the theatre". 26 Figure 8 illustrates this urban phenomenon. It is a diptych showing, on the left, a view of Times Square in 2006, and on the right, the same street view taken circa 1930.

More importantly, this last visual argument suggests an essential idea. One could say that digital public displays and media fa ades might draw on all three of these historical examples, with the exception of one key factor, substantiated only by Figure 8: the medium-specific material that defines the form and content of digital public displays is light. Above and beyond that technical requirement, artists and designers arguably have a great deal of freedom in exploring the different forms that they can take, and by extension, the modes of interactions that they can support.

For this reason, a media archaeological approach to the study and design of urban screens can provide a grounded context for the research-creation process in that it reminds us that what makes the city come to life is human activity, not technology. Technology can enhance, extend, and augment our communicative powers or our senses, but it is civic life, and thus people and their actions, that constitute the pumping heart of a participatory city. It offers evidence which suggests that cities were already smart before big data and the digital revolution. It further shows that the exchange of information is not enough creativity, social intelligence, and embodied intelligence are also needed.

Figure 8. Diptych of Times Square in New York City, NY. *Left*: 30 September 2006. Photo credit: Willem van Bergen. ©2006_ WillemvanBergen Reproduced from Wikimedia (creative commons license). *Right*: circa 1930, Neumann [26], 13.

Conclusion

For the benefit of ISEA 2015 audiences, the three panel presentations described in this paper each highlighted a different approach to the design of urban screens. While Colangelo's research-creation approach placed the emphasis on the formal character of public displays as elements of media architecture, Dubois' explored the artistic possibilities afforded by one peculiar mode of interaction to blur the boundaries of what separates private and public space. By doing so, their work called into question conventional notions of spectatorship, intimacy, agency, and power differentials between the individual vs. the collective, the citizen vs. the state. In keeping with a humanities-based research tradition, Fortin took a philosophical stance by adopting a media archaeological approach, which aims to show that such conventions mainly exist as cultural and discursive constructions a focus on materials and processes further suggests that the potential to reimagine public displays in computational media still remains wide open.

All three, however, somehow echo key aspects of what shaped the *post-photographic condition* brought on by the digital revolution. As Fontcuberta writes, we are now in:

> *an era characterized by the mass production of images, endless accessibility, immateriality, and vertiginous dissemination…an era in which the image has become promiscuous and the gaze infinite…concerned with how our relationship with images have changed…* 27

In comparing past and present, it is noteworthy to see how some of these phenomena echo one another across the ages: the proliferation of signs of variable scale in public space is not necessarily specific to the digital age. Indeed, a historical approach to the study of public media displays suggests that cityscapes have always been sites of representation, inherently generative of all kinds of discursive forms of expression and interactivity. Further, their materiality has never been entirely fixed, except perhaps in their photographic representations (see Figure 7). It may be that that public spaces are fated to be disruptive palimpsests.

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Panel Participants and Author Biographies

Jean Dubois — panelist

Jean Dubois creates installations that, both poetically and critically, tackle interpersonal relationships, combinative textuality, and reflexive situations through media interfaces that incorporate the spectator's body. He teaches at Université du Québec à Montréal's School of Visual Arts and Media Arts. His creations have been presented in a number of countries, including Canada, Poland, China, the United States, Brazil, Japan, and Luxembourg.

Dave Colangelo — panelist

Based in Toronto, *Dave Colangelo* is an artist, academic, researcher, and consultant. His research investigates and engages massive media (urban screens, reactive architecture, and public projection) as a means to support critical and creative engagements with the city, public space, and information. Colangelo has exhibited his work at a number of galleries and sites in Toronto. His writing has appeared in *C Magazine* and *Street Signs*. His work with collaborator Patricio Davila has been exhibited and published in Toronto and internationally at 2014 Media Architecture Biennale, the International Symposium for Electronic Art (ISEA) 2011 in Istanbul, ISEA 2013 in Sydney, the 2013-14 Biennale of Architecture and Urbanism in Shenzhen/ Hong ong, and in the *Leonardo Electronic Almanac*. Colangelo holds an MA in Cultural Studies and Interactive Media from Goldsmiths College, University of London. He recently completed a PhD in the ork-Ryerson Graduate Programme in Communication and Culture.

Claude Fortin — moderator

An interdisciplinary scholar, Claude Fortin is a doctoral candidate and researcher at the Making Culture Lab, an applied design research lab affiliated with Simon Fraser University's School of Interactive Arts & Technology (SIAT). Her engagement with public interaction through technology builds on academic studies in the humanities, social sciences, and fine arts. Claude is interested in finding new ways to unleash the interactive potential of screen-based systems at the scale of the built environment. Trained in multi-sited ethnography, her research agenda aims to bridge the gap between the top-down prescriptive design approach of experts and the bottom-up appropriative digital practices that shape usages of urban technology.

EMDL European Mobile Dome Lab for Artistic Research.

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Abstract

This paper comprises the E/M/D/L [European Mobile Dome Lab] panel presentations which the activities and outcomes of the artistic research carried out during the international collaboration funded by the European Culture Programme (Strand 1.3.5). E/M/D/L built an international network for the exchange of artistic and technological expertise, with the goal of researching and documenting a language and grammar unique to the fulldome medium. Bringing together four European and three Canadian institutions and cultural partners, all leaders in the fulldome field, the project aimed to share and expand skills, methodologies, strategies and content under this creative and highly productive umbrella. Between February 2014 and September 2015, the participants took part in eight residencies and public presentations offered in five countries, clustered around domic architectural structures equipped with cutting-edge technologies. This culminated a series of works presented at the world's most sophisticated virtual theatre, the *Satosphere* in Montreal, Canada.

Keywords

Fulldome, media art, artistic research, cultural exchange, immersive, interactive, transdisciplinary, performance, mobile labs.

Introduction

E/M/D/L was coordinated by and under the project Direction of Martin Kusch and Ruth Schnell of the Digital Art Department, University of Applied Arts Vienna [Austria] the international network of partners and collaborators included i-DAT, Plymouth University [England], Trans-Media-Akademie Hellerau, CYNETART festival, Dresden [Germany], Laboratory of New Technologies in Communication, Education and the Mass Media (UoA NTLab), National and Kapodistrian University of Athens [Greece], Society for Arts and Technology [SAT] Montréal [Canada], kondition pluriel Montréal [Canada] and LANTISS University of Laval, Quebec City [Canada]. This partnership brought together, through a series of commissions, an international transdisciplinary group of artists to develop an international network for exchange of artistic and technological competencies, with the goal of developing and documenting new artistic languages and grammars and to explore modes of expression for the fulldome medium.

The European Mobile Dome Lab supported an interdisciplinary collaborative process, which foregrounds embodied immersive experiences. The project lies within the research and development area of new digital applications for 360º dome shaped projections and aims to generate a diversity of artistic dramaturgies for this media. E/M/D/L was tailored around the process of collaboratively creating immersive artworks and experiences for a dome environment. These immersive mediated environments involved real-time visualization (and sonification) software, ubiquitous computing, sensor networks, tracking technologies, pre-rendered material, mobile or locative technologies.

The community itself drew on practices from artists, scientists and theoreticians from Canada and EU who are active in creating media art or pursuing innovative interdisciplinary research and wish to collaborate in order to create (interactive) fulldome media artworks. This included members of the performance, software art, VJ, installation, video, audio and computing communities.

Figure 1. EMDL, Liminal Spaces at Satosphere © Sebastien Roy.

On Fulldomes

The word "fulldome" refers to immersive dome-based projection environments. The dome, horizontal or tilted, is filled with real-time (interactive) or pre-rendered (linear) computer animation, live captured images, or composited environments. Although the current technology emerged in the early-to-mid 1990s, fulldome environments have evolved from numerous influences, including immersive art and storytelling, with technological roots in domed architecture, planetariums, multi-projector film environments, flight simulation, and virtual reality.

The fulldome experience is one of the most immersive and engaging ways of supporting the interactive (or passive) synchro-nous presentation of 3D graphical environmental representations to relatively large groups of people, with a limitless scope of applications, including education, arts, games and wellness.

E/M/D/L took as a premise that in the context of an immersive dome environment, the impact of immersion can be described as a physical, sensorial and emotional experience, through which the participants experience the very vivid illusion of playing an integral part in the image. The project researched the phenomenon of perception in an immersive 360º environment, exploring vision without being objected to one singular focal point of view, directed in generating multi-sensory and kinaesthetic feedback for the spectators. One of the specificities of this medium is to offer an environment in which the spectator's senses are engaged in manifold ways.

From this perspective, E/M/D/L built on the exploration of the narrative and dramaturgical possibilities and the aesthetic potential, to attempt to define certain rules and guidelines for creating such an audio-visual and multi-sensory fulldome artistic experience.

Figure 2. EMDL, Liminal Spaces at Satosphere © Jean Ranger.

Liberating the Fulldome

The power of the fulldome environment has been successfully exploited by the scientific community for decades, however, digital projection technologies are liberating immersive fulldome experiences from cosmological visualisation and enabling the evolution of a broad range of disciplinary content to be presented in the context of this medium. Transdisciplinary collaborations between media artists and scientific disciplines have produced rich immersive media content to support the public understanding of science and can be seen as influencing huge audiences around the globe through the rapid expansion of science centres equipped with 'planetariums'.

However, the rapid evolution of the fulldome as a 'form' of artistic expression has been contained by the formalities of these edutainment/infotainment models and the 'planetarium' style shows. Equally the evolution of the digital technologies underpinning the fulldome platform have been contained by the scale and repeatability required for the 'planetarium' format. Technological platforms emerging through parallel creative media communities, such as VJ and projection mapping practitioners, offer greater flexibility, accessibility and economical routes to production.

E/M/D/L explored the protocols and artistic potential offered by an immersive situation, a kinaesthetic, poly-sensorial and emotional experience in which the spectators are plunged. For this purpose, E/M/D/L provided a number of selected European and Canadian media artists, coming from different cultural, technical and artistic backgrounds, with the opportunity to collaborate with other European and Canadian artists in order to explore and create immersive projection-based artworks, through a process that allowed for intercultural and interdisciplinary dialogue. The extensive list of collaborators can be found on the www.emdl.eu website.

The project produced, via the creation of a series of immersive media artworks, new aesthetics and technological paradigms. In particular three highly interactive and experimental productions screened /performed at the Society for Arts and Technology [SAT] in May and June 2015 (http://sat.qc.ca/fr/emdl):

Liminal Spaces explored the dome as an intermediary membrane between inside and outside, sheltering human performance, interactivity, image, sound and text layers;
Murmuration fostered public interaction with digital particle swarms and real-time manipulation of virtual/physical audio-visual objects; and

Figure 3. EMDL, Murmuration at Satosphere © Sebastien Roy.

Dream Collider highlighted the place of the user as a living actor of a multi-perspective narrative, unfolding between physical and virtual spaces.

Dome Workshops

The backbone of E/M/D/L project were the series of research and production residencies in each of the partner institutions. These workshops explored technical and aesthetic considerations through a collaborative and highly

participatory creative practical process. At each of the workshops, members of the E/M/D/L project were joined by local artists, to explore specific aspects of the research process.

Workshop #1: Society for Arts and Technology [SAT] in Montreal, Canada, February 2014
This first residency at SAT aimed to unify and standardize the initial knowledge, expertise and vocabulary of the fulldome medium. Participants from several different fields of artistic research took part in master classes and workshop sessions that focused on spherical imagery production, real-time generated immersive visual content and 3D spatial sound. The residency further elaborated the global intentions for the project and defined the participants' vision for the collaboration over the following year. This first gathering encouraged the discovery of each other's practice, expertise and interests. The workshop introduced the exemplary work of SAT, providing key insights into its unique fulldome, sound system and game-engine based systems, and provided a catalyst for the subsequent innovations.

Workshop #2: NTLab, Athens, Greece, April 2014.
The NTLab E/M/D/L workshop provided a platform to exploring the early phases of the research process, being more exploratory in nature and comprised of 5 days of brainstorming and design sessions. The analysis of the research performed in the Athens residency, resulted in the identification of themes which informed subsequent residencies as malleable concepts and points of reference. Many of the ideas manifest in the final productions can be traced back to these early brainstorming processes, whilst others emerged in the gaps between themes.

The workshop also included a public open-studio at the National Museum of Contemporary Art (EMST), consisting of an inflatable mobile fulldome and peripheral technologies, for the real-time testing of creative ideas. In addition a symposium, "Artistic creation in immersive environments, using large-scale display technologies" (April 15, 2014) was held, organized by UoA NTLab and the National Museum of Contemporary Art (EMST) in cooperation with the University Research Institute of Applied Communication.

Workshop #3: i-DAT, Plymouth, UK, July 2014.
The Plymouth workshop, following on from the design workshops in Athens, was oriented around rapid prototyping processes. The Plymouth workshops took advantage of i-DAT's Digital Studios (including the IBM Smarter Planet Lab). The Immersive Vision Theatre (IVT) was also used for audio production and performances and provided a 'micro-Satosphere' for the presentation of the various media artefacts together.

The E/M/D/L team, working with local artist/researchers, collaborated on the development of a range of technologies to support the fulldome research agenda. These included explorations of: generative audio audio compositions (incorporating the weird acoustics of the IVT solid plaster 'whispering gallery' dome); dynamic data feeds and navigation techniques for Unity 3D environments, including swarm behaviour, mobile app feeds using smart phone sensors; wearables, iBeacon proximity sensing and camera/kinect tracking; scaling and recursive spatial experiments. The products of these endeavours were demonstrated and critiqued, culminating in a rubric and prototypes which were carried forward to the August Montreal session.

Workshop #4 and #5 : Society for Arts and Technology [SAT], Montreal, Canada, August 2014.
This fourth residency at SAT was a longer mid-project endeavour, marking the end of the exploration phase and leading to a more elaborate definition of the research/creation project. The workshop was structured to maintain a highly experimental approach through a critical practice and prototyping of concepts. Iterative brainstorming sessions refined and validated the continuity of the creative research process. Combined with specific project developments, the workshop lead to workflow pairings and to the identification of integrated solutions. This culminated in the participants defining processes for expanding the medium's language of expression, and identified the need for more structured experiments on perception and for converging the different research interests towards united creation, laying the foundation for the Dresden residency.

Workshop #5: CYNETART festival in the Festspielhaus Hellerau, Dresden, Germany, November 2014.
An important part of CYNETART festival 2014 was dedicated to the support of the E/M/D/L project. A bespoke fulldome was constructed for the experimental productions and public interactions conceived of in Montreal.

Figure 4. EMDL at CYNETART © David Pinzer.

The goal of the Dresden workshop was to conduct artistic research, exploring interactive parameters with live movement (performer and public) in the fulldome environment. After the preliminary workshops conducting basic interactivity tests, the research explored the impact of live-movement that is mapped in real-time to different interac-

tive media parameters, inside of a circular fulldome reactive media space. The Workshop consisted of day time research and production work generating artistic prototypes that were then played out to groups of the public over four evenings. The experience gained from the public prototyping at the CYNETART festival, was nurtured by working groups leading up to the Vienna workshop. The mission was to scrutinize the different research strands, refine the existing artistic concepts and to form working production groups that would continue developing issues and concepts as well as practical solutions to the realisation of themes, such as body architecture, multi narration, etc. as part of an artistic syntax for 360 degree environments.

Workshop #6: Digital Art Department, University of Applied Arts, Vienna, Austria February 2015.
The Vienna workshop also marked the inauguration of the new digital fulldome lab at the Department for Digital Arts. During the Vienna residency the 20 participants were able to conduct specific tests and artistic experiments in the new domic architecture of the Department of Digital Art.

Figure 5. Fulldome-lab at Digital Art Dept. © Mike Phillips.

This immersive projection environment (diameter: 5.75 meters, height 3.70 meters) is equipped with state-of-the-art hardware and software thus offering a wide range of possible applications. The workshop consolidated artistic research undertaken to date. These reflections and the outcome of the practical working sessions led to a more coherent definition of the formats and the dramaturgical mise-en-scène for the final Montreal workshop, a process that was continued until the final showcase. At the end of the residency some of the artistic experiments were shown to invited experts during a presentation.

Workshop #6: Society for Arts and Technology [SAT], Montreal, Canada, May 2015.
The final workshop consisted of a frenzy of production, bringing a broad range of research experiments into a form that could be shown to a public. The research was articulated through the fulldome environment as an instrument to explore transdisciplinary forms of artistic expression. These experiments oscillate between performance, interactive installation and immersive event. Many research experiments were not included in these productions for practical reasons and decisions were made to pragmatically address the performative aspects of the final productions.

Public Presentations

The project culminated with a series of ten evening presentations of three experimental artistic dome-works, showed in the Satosphere Society for Arts and Technology (SAT), in Montreal, Canada: Liminal Spaces explored the dome as a intermediary membrane between inside and outside, sheltering human performance, interactivity, image, sound and text layers; Murmuration fostered public interaction with digital particle swarms and real-time manipulation of virtual/physical audio-visual objects; and Dream Collider highlighted the place of the user as a living actor of a multi-perspective narrative, unfolding between physical and virtual spaces.

Liminal Spaces

We are made up of layers: the physical ones of skin and tissues, but also the intangible ones of history, tradition, images, and words. In the strata of sensations and accumulations of meanings, what strategies can be used to subjectivate such heterogeneous materials and find coherence among them? Where should borders be porous and where should they be strengthened? How can we let them breathe and allow them to change their contours? How to inhabit the threshold between two states, conditions, or regions – the transitory, the indeterminate?

Figure 6. EMDL, Liminal Spaces at Satosphere © Sebastien Roy.

Sheltering layers of performance, interactivity and image, sound and text, the dome becomes the intermediary membrane between inside and outside, as it is explored and pierced through at the limit of palpable space.

Dream Collider

Through an interactive journey in the narrated dreamland of crystallized daily scenes, Dream Collider questions the intertwined states of diverging oneiric ideas, the rise and collapse of these subconscious mind constructions, and the iterative processes leading the exploration of self-generated worlds. Initially created with the intent of expressing

grammatical results issued from artistic research in the field of immersion, this dome installation highlights the relation and cohesion of physical and virtual spaces, and the place of the user as a living presence in between the layers of this multi-perspective narrative.

Figure 7. EMDL, Dream Collider at Satosphere © Sebastien Roy.

Abstract collisions, premonitory visions or interneuronal recovery fluctuations; dreams have always been intriguing and are haunting our nights' and days' perceptions.

Murmuration

Murmuration [muttering of low, indistinct, whispers / abnormal heart sounds / mass cloud like flocking] is a series of trans-scalar and recursive transitions from the imaginary to infinity: i∞. Constructed from bio-imaging technologies and modeled fractured architectures, the low-poly-aesthetic of murmuration navigates its audience through playful interaction with particle swarms of digital detritus and real-time manipulation of virtual/physical audio-visual objects and the environmental experiences afforded by their continuously transforming arrangement. Algorithms of repulsion and attraction maintain the cohesion of nano / molecular landscapes harvested by atomic force. Bio-forms, like artificial organs, and boney architectures, temporarily seem to come to life, create cavities and cavernous voids, conjuring uncanny atmospheres of elation, intrigue and awe.

Figure 8. EMDL, Murmuration at Satosphere © Sebastien Roy

Dome-Technic

The overall E/M/D/L fulldome research benefitted from the sharing and development of the latest tools for capturing, synthesizing, and re-visioning the world by the imaging and sonification methods of sampling, IR analysis, MRI, Atomic Force Microscopy, 3-D scanning, photogrammetry and point cloud visualization. These works capture the multiple, heterogeneous forms of presences generated by a digital culture but also critique the intrinsic homogeneity that emerge through processes of surveillance and control. This transdisciplinary research interrogates the language of the new creative environment of the fulldome, creating the possibility of a rich experience of audience participation: a world of multi-user interactions, navigating through trans-scalar, recursive imaginary territories, harnessing both physical and synthetic worlds.

European Mobile Dome Lab for Artistic Research

E/M/D/L filled the empty infinite space of the fulldome with a creative nucleosynthesis - the closest we came to talking about astronomy was the reflection on the artistic nuclear fusion that drove the collaboration. The highly transdisciplinary approach, productions, technical innovations and artistic research methodologies will be articulated in a forthcoming publication.

On reflection, one way of defining artistic research would be to regard it as being composed of highly specific and singular projects that require multiple competencies and within which different individual investigations might combine for shorter or longer periods of time. The nature of such prospect is that the form of presentation, just like the research methodology, must be invented. The rules of such activity always come afterwards, they do not precede practice, and they cannot be formulated as a system or a "methodology" (and in this particular feature, Jean Francois Lyotard, among others, has seen an essential similarity between artistic and philosophical activity, which he posits

as the opposite of “normal scientific” practice, whose rules of validity and forms are regarded as self-evident).
Artistic research as a “disruption” to scientific research. The methodology of artistic research has to be continually invented, something dynamic and unfixable
The rules of such activity always come afterwards, they do not precede practice!

Figure 9. EMDL, Liminal Spaces at Satosphere © Sebastien Roy

Notes:

Liminal Spaces: Organizations: Digital Art Department, Vienna, Austria / kondition pluriel, Montreal, Canada / Trans-Media Akademie, Dresden, Germany
Participants/Collaborators: David Campbell, Carla Chan, Matthias Härtig, Johannes Hucek, Martin Kusch, Marilou Lépine, Armando Menicacci, Marie-Claude Poulin, Audrey Rochette, Ruth Schnell, Alexandre St-Onge, Nikola Tasic

Dream Collider: Organizations: Society for Arts and Technology [SAT], Montreal, Canada.
Participants/Collaborators: Derek deBlois, Bruno Colpron, Sébastien Gravel, Jean Ranger, Olivier Rhéaume, Dominic St-Amant, Louis-Philippe St-Arnault
Murmuration: Organizations: Laboratory of New Technologies in Communication, Education and the Mass Media (UoA NTLab), Athens, Greece / i-DAT (Institute of Digital Art and Technology), Plymouth, U.K.
Participants/Collaborators: Dimitris Charitos, Luke Christison, Phil Mayer, Cameron Micallef, Lee Nutbean, Alexandre St-Onge, Mike Phillips, Olivier Rhéaume, Haris Rizopoulos, Ben Stern, Iouliani Theona, Penny Papageorgopoulou

Authors Biographies

Dimitris Charitos is an Associate Professor in the Department of Communication and Media Studies at the National and Kapodistrian University of Athens, where he teaches human-machine communication, interactive design, digital art and visual communication. He studied Architecture at the National Technical University of Athens, and C.A.A.D. in the Department of Architecture, University of Strathclyde (Glasgow). He holds a PhD in interactive and virtual environments design. His artistic practice includes electronic music, audiovisual and interactive installations and virtual environments. He has participated in exhibitions in Greece, the UK and Cyprus. As a researcher or coordinator, he has participated in research projects (funded by Greek and European programs) on the subjects of virtual reality, locative media, digital art and multimedia.
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Martin Kusch studied art history, philosophy and painting in Berlin, and media arts with Peter Weibel at the University of Applied Arts in Vienna, where he has also been teaching since 1997. Founder and artistic co-director of the Media performance group kondition pluriel, he is particularly interested in the transformation processes of the electronic media inside performative contexts, and on how digital technologies influence our perception of the body and space. His works have been presented at numerous festivals and institutions, such as: Ars Electronica (Linz), ISEA, ZKM (Karlsruhe), Transmediale (Berlin), CYNE-Tart (Dresden), EMPAC (Troy), Le Centre des arts d'Enghien les bains (Enghien), the Mois Multi (Quebec City) and the Museumsquartier Wien (Vienna).
http://www.konditionpluriel.org/

Mike Phillips, is Professor of Interdisciplinary Arts at Plymouth University, the Director of Research at i-DAT.org and a Principal Supervisor for the Planetary Collegium. His R&D orbits a portfolio of projects that explore the ubiquity of data ‘harvested’ from an instrumentalised world and its potential as a material for revealing things that lie outside our normal frames of reference - things so far away, so close, so massive, so small and so ad infinitum. He manages the Fulldome Immersive Vision Theatre, a transdisciplinary instrument for manifesting (im)material and imaginary worlds and is co-editor of Ubiquity, The Journal of Pervasive Media.
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Marie-Claude Poulin is trained in dance and kinanthropology at the Université du Québec à Montréal and holds an MA in Choreography at the Inter-University Center for Dance in Berlin. Between 1985 and 2000, she has taught in the field of somatic education and has worked as a performer, notably with choreographers Benoît Lachambre and Meg Stuart. In 2000, she co-founded the digital performance group kondition pluriel. Her works have been presented at numerous festivals and institutions, such as: ISEA, ZKM (Karlsruhe), Transmediale (Berlin), CYNE-Tart (Dresden), EMPAC (Troy), Le Centre des arts d'Enghien les bains (Enghien), the Mois Multi (Quebec City) and the Museumsquartier Wien (Vienna). Since 2013, she is a lecturer at the University of Applied Arts in Vienna.
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Ruth Schnell lives in Vienna. Her corpus of work, which includes video installations, interactive video environments, and light installations, explores the nature of human perception and the relationship between human perception and the human body. Ruth Schnell has been teaching at the University of Applied Arts Vienna since 1987; since 2010 she has been head of Digital Arts Department. Solo and group exhibitions include: Fourth Moscow Biennale of Contemporary Art (2011), Bienal Internacional de Arte Contemporáneo de Sevilla/Biacs 3 (2009), ZKM/Center for Art and Media Karlsruhe (2010 and 2008), Akademie der Künste Berlin (2004/05), California Science Center, Los Angeles (2004), Kunsthaus Bregenz (2002), mumok – museum moderner kunst stiftung Ludwig wien (2000), 46. Biennale di Venezia / Austrian Pavillon (1995).
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Poetic Disruption in a Time of Surveillance

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Abstract

This paper explores artistic practices that reappropriate released and "leaked" United States governmental documents. The steady trickle of documents from Edward Snowden's cache, alongside the massive disclosures from Wikileaks, are only a small part of the regular release of documents via the Freedom of Information Act. This trove of material provides much fodder for artistic investigations into open culture, surveillance, counter-surveillance, drone warfare, and torture, among other topics. Nevertheless, the historical and contemporary artistic approaches discussed will focus more on poetic responses that upset a purely instrumental, objective analysis of the material. *Art for Spooks* and the *Crowd-Sourced Intelligence Agency (CSIA)* will serve as the main catalysts for exploring the efficacy of the poetic in a time of objectification and quantification.

Keywords

Poetic, disruption, surveillance, counter-surveillance, art, appropriation, federal, documents, visualization, augmented reality.

Introduction

The focus of this paper is the concept of poetic disruption, proposed among others by the poet Hakim Bey [2], and prior to him, Salvador Dalí (paranoiac criticism) [9] . A host of countercultural figures and artists have used this term in reference to the interruption of strictly rationalist perspectives through poetic strategies. Our context for the term comes from the panelists' engagement with governmental documents, either leaked by people such as Edward Snowden or Chelsea Manning, or released through Freedom of Information Act (FOIA) requests. These projects disrupt the conventional rationalist approach taken towards the analysis of such documents by mainstream and alternative media alike. Rather than using the documents as simply evidence of governmental misconduct, the panelists will discuss works, both their own as well as those of others, that poetically disrupt the understanding and discourse surrounding the documents.

The rhetoric of "transparency" through so-called "open" access to governmental data has implied that citizens can now "watch the watchers", and thus engage in a form of counter-surveillance. However, to do so is to accept the logic of the "watchers", and thus to potentially fall into a trap that admits no position of resistance. Instead, the works under discussion in this paper will suggest poetic disruption as one means of response that rejects the objectivist logic of transparency.

Art for Spooks

Art for Spooks (2014-ongoing) is an augmented book that takes a poetic angle to electronic surveillance. It combines texts and images from "leaked" NSA documents. Texts in the book draw on posts in "Ask Zelda", the NSA's internal advice column, and analogous to the popular "Dear Abby" column in the United States. Images are compiled from various PowerPoint presentations that appear to concern psychological operations. Altogether these documents evince mundane concerns of NSA employees with grooming etiquette, gossip and surveillance at the workplace; the development of encryption and psychological profiling tools modeled on alleged historical links between magicians and the military; and a delirious imaginary steeped in the world of modern folklore, populated as is with UFOs, popular media archetypes of evil and good, as well as (apparently) a taste for buffalo meat, high art, and Orientalist and gendered themes (Figure 1).

These materials are juxtaposed with graphics read through a tablet interface. The act of reading generates randomized data in the forms of new images and texts which are concurrently uploaded to various social media platforms, including Twitter and Flickr. The traces of these data are refracted through algorithmic manipulation. As visitors to *Art for Spooks* share images of their augmentations, other information—texts about surveillance, alternative GPS coordinates, and text generated from NSA/GCHQ materials—can be found in the metadata of these images. (Metadata is different from content; it is "data about data". In the case of images, it is mostly embedded in the photo's EXIF information, which includes "hidden" information about camera shutter setting details, the camera's model, as well as location, date and time of capture, etc. For another project that utilizes this kind of metadata, see *I Know Where Your Cat Lives* [19].) So for instance, on close inspection, it becomes apparent that the GPS coordinates specifying the upload location of the images are systematically changed to documented locations of United States drone strikes, such as in the Federally Administered Tribal Areas of Pakistan (Figure 2)[1]. One can click on

[1]Data on locations of drone strikes is collected by

Figure 1: Examples of leaked images used in *Art for Spooks*

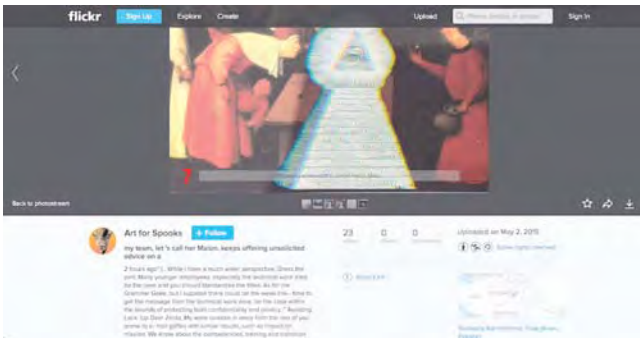

Figure 2: Example of mutated geo-location information for image uploaded to Flickr by *Art for Spooks*

these locations to see more images on Flickr from these defined locations. Because of this aggregation, the images from *Art for Spooks* appear alongside photos uploaded by people in the area. As a result, the viewer is treated to a shifting tapestry of NSA appropriated images alongside local photos including those of babies, school children, teenagers, and local people looking into the camera, as well as landscapes, animals, jewelry, mosques, everyday life scenes, market shots, improvised memorials, and documentation of rituals, and even a postcard with a quote from the president of Afghanistan, Ashraf Ghani, addressed to a Taliban leader stating that the "killing of innocent children is contrary to Islam" (Figure 3)[2].

As visual condensations of the battlefield, these composite images foreground the asymmetry between the cryptic abstractions of systems of espionage, political assassinations, surveillance, infiltration, and destabilization, and their targets' perceptions and documentation of life on the ground,

Figure 3: Image uploaded to Flickr by user fstop186

which are all routinely invisible in Western media. The eerie tone of these images is amplified as one considers the stakes of metadata in current surveillance at home and abroad and its implication in drone wars overseas. Metadata is not only central to domestic wiretapping and other surveillance activities, but according to the former NSA-chief General Michael Hayden, "We kill people based on metadata"[3]. *Art for Spooks* demonstrates that the manipulation of this data is a relatively trivial undertaking, thereby questioning the legitimacy of metadata as a component of surveillance targeting.

With this in mind, our project departs from heuristic models of addressing current forms of electronic surveillance. An example is the project by American photographer Trevor Paglen, *I Could Tell You But Then You Would Have To Be Destroyed By Me* (2010). The work, in the form of a book, collects patches allegedly worn by military personnel involved in covert surveillance operations. Each patch testifies to a similar bizarre fascination with images and themes as documented in *Art for Spooks*, ranging from a plethora of cryptic symbols (lightning bolts, Greek letters, and star and trident shapes) to images of a spy holding the planet on his fingertip,

The Bureau of Investigative Journalism, `https://www.thebureauinvestigates.com/category/projects/drones/drones-graphs/`.

[2]This postcard, posted by Flickr user fstop186, is in reference to the Peshawar school massacre on 16 December, 2014, where 145 people, including 132 school children, were killed by fighters linked to the Tehrik-i-Taliban, a Pakistan-based group that is philosophically and operationally distinct from the better-known Afghan Taliban. For more information, see `https://en.wikipedia.org/wiki/2014_Peshawar_school_massacre`.

[3]See `http://www.nybooks.com/blogs/nyrblog/2014/may/10/we-kill-people-based-metadata/`.

and an alien in chains with a Klingon inscription underneath reading: "Dont Ask". In the book, Paglen attempts to get to the meaning of these images by way of visual analysis. In contrast, because monitoring and killing based on metadata constitutes a system of surveillance that bypasses evidentiary methods, we suggest that the intense categorization and cataloging of facts, phenomena, and life under current modes of surveillance demands the invention of new methods that resist the stultifying effects of this kind of instrumentalization.

With *Art for Spooks*, we propose that electronic surveillance can be best understood along the lines of the critical paranoiac method as outlined by the surrealist painter Salvador Dalí in the 1930s [7]. An extension of the Surrealists' overall interest in the unconscious, this method melds Dalí's interests in psychology and art by way of exploring associative process typical of paranoia. Schizophrenia is clinically described as a cognitive disease that develops from a mental state of superposition that psychologists call "ambivalence" [3]. Works created by Dalí following this method, including paintings, sculptures, and installations, closely resemble said definition. Dalí's signature style of life-like compositions created by juxtaposing anthropomorphized objects, objectified bodies and body parts, optical illusions, and even biological and innate elements, mimic the paranoiac's ability to combine disparate and otherwise unrelated materials through an illogical (that is, non-rational or Cartesian) associative process based on resemblance. Similarly, in his discussion of schizophrenia, the psychologist Mark Garrison argues that when treating schizophrenics, psychologists should keep in mind the many points of correlation between the thought processes employed in this pathology and those that function in poetically inflected language and art [14].

Contrary to Garrison's pathologizing of schizophrenia as a mental disorder arising from the schizophrenic's inability to resolve ambiguity of interpretation (which he opposes to "normal" people's ability to do so), Dalí celebrated it as a catalyst to challenge the valorization of rationality and rational methods. According to Dalí, exposure to paranoiac-critical images and works would induce this same state in viewers, as the equivocality of such works would challenge rationalist (linear) interpretations of reality, themselves premised on the separation between the "subjective and objective" (he called this "conflicts of interpretation"). Thus, Dalí's works, sardonic parodies of the truth-claim or evidentiary status of photographs based on the belief that they capture reality, showed that "reality" and "being" can be best thought as associative, ambiguous, fragmentary, and fluid concepts, much like representations of the self and the world. By extension, he inverted the idea that normative rationalist (empirical) conceptions of reality are "normal", arguing that consensus reality is a paranoiac delusion of the worst kind, given its ubiquitous stultifying effects [8, pg. 90]. In *Art for Spooks*, we contend that the belief underlying NSA's electronic surveillance and drone strikes, namely that metadata corresponds to "reality", is an extension of the rationalist/empiricist mode of viewing the world, which Paul N. Edwards describes as a "closed world discourse" [10].

As a holdover of the Cold War, when computers and informational concepts (cybernetics, cognitive psychology, and artificial intelligence) became central to military operations, the "closed world discourse" is synonymous with global surveillance and control through high-technology military power. Indeed, one of the most startling comments to come out of the Snowden documents is evidence of the NSA's desire to "collect it all" [4]. Edwards typifies the reductionist logic of this system in relation to the computer's use as a metaphor and ideological construct, used to make war appear to be both controllable and rational, "a radically bounded scene of conflict, an inescapably self-referential space where every thought, word, and action is ultimately directed back towards a central struggle. It is a world radically divided against itself. Turned inexorably inward, without frontiers or escape, a closed world threatens to annihilate itself, to implode" [10, pg. 12]. As he shows through several examples, including Operation Igloo White, conducted from 1967 to 1972 in Vietnam, this "closed system" with its internal logic, is itself impenetrable from the outside, a realm of quantification (body counts) and simulation that serves only as a construct, as an illusion of control on the battlefield. Operation Igloo White is prototypical of present surveillance and wars at remote. Designed to create an impenetrable barrier between North and South Vietnam, the operation was directed from Washington DC using data provided in "real-time" by computers. Electronic sensors on the ground registered the presence of any North Vietnamese troops or vehicles that attempted to cross, and this data would then be represented on computer screens, which would in turn control the release of bombs from patrolling aircraft. The system proved ineffective, as the sensors were easily fooled. Paradoxically, however, the system was hailed as a success, because the criteria for success or failure was dictated by the computer itself: a convoy was registered as destroyed, not because this was verified on the ground in Vietnam, but because the computer would no longer detect it.

As descendants of these systems, contemporary forms of surveillance and warfare operating on metadata engage a similar logic. Consider for instance, a kindred project, Bangladeshi-American artist Hassan Elahi's *Tracking Transience* (2006-ongoing) [5]. Profiled by Wired as a "perfect alibi" or "an audacious art project", Tracking Transience is a website created and maintained by the artist since 2006, when Elahi began documenting his everyday activities and whereabouts daily. To date, the site, a database, contains a growing amount of data including posts of the artists copies of debit card transitions, photographs of meals consumed and toilets visited, airport terminals, food courts, and his real-time physical location on google maps. The impetus of the project dates to 2002, when Elahi, who travels by plane extensively for international art exhibitions and conferences, was detained at the Detroit airport returning to the United States on a flight from the Netherlands. According to Elahi, FBI agents later told him they that they had been tipped off that he was hoard-

[4] See https://www.washingtonpost.com/opinions/no-place-to-hide-by-glenn-greenwald-on-the-nsas-sweeping-efforts-to-know-it-all/2014/05/12/dfa45dee-d628-11e3-8a78-8fe50322a72c_story.html.

[5] See http://elahi.umd.edu/track.

ing explosives in a Florida storage unit. To prove his whereabouts (coordinates), the artist showed them his Palm PDA, a device containing enough information—calendar notes of appointments and classes he teaches—to convince his interrogators of his innocence. Elahi passed subsequent lie detector tests and interviews, but his paranoia grew as given his frequent traveling he thought it only a matter of time for another such episode to occur.

As the artist jokingly observes, *Tracking Transience* is designed to allow for his permanent tracking by surveillance agencies. As an alibi, the project has thus far worked, as according to Elahi, his invitation to surveillance was taken up by federal agencies, which he was able to identify as visitors to his site based on the records of IP addresses. As an art project, *Tracking Transience* is a sardonic satire of federal Intelligence gathering. Along the lines of an artistic tradition concerned with the ambiguity of representation initiated by the Surrealists, among them Dalí, on the site and in exhibitions of the project, Elahi persistently addresses the questionable authenticity of images. As a manipulated archive, (for instance, the artist arranges photographs in mosaics according to parameters such as color and shape rather than based on particular chains of events or itinerary; few of the images here are presented with time or date tags or any identifying information and even those that have such as the videoscreen flashing one satellite image per day of the whereabouts of the artist invite doubts), *Tracking Transience* mocks the surveillers' belief in the authenticity of images. How are we to know that Elahi is where he is shown to be? Is it indeed his phone that registers those coordinates? In his interview on the satirical television program *The Colbert Report*, (May 7, 2008) Elahi said that his website uses market forces to render information worthless. By flooding (and manipulating) the world with information, personal information becomes worthless to investigators.

Similarly, *Art for Spooks* uses social media sites, regularly monitored by surveillance agents and market forces alike (in our case Twitter and Flickr), to intervene is this conjunction of surveillance and consumerism. In this regard, we should note that Elahi's and our project converge in that both are directed at a very defined audience. Alongside disrupting the use of personal information by marketers, *Art for Spooks* is designed to augment the paranoia of NSA employers and those that, because of their involvement with surveillance-related activities, are legally barred from accessing and reading leaked NSA documents. To date, we know about such an instance, when a visitor to an exhibition showcasing *Art for Spooks* messaged her friend with a link to the projects website, upon which the recipient, who works on developing drone technology, sent a message back admonishing her that "now" he "had to clear his cache" and not to send any information about the project to his phone. The perplexed visitor approached one of us as to inquire why her friend would be so concerned, stating that given his line of work, she thought he would "be very interested in *Art for Spooks*". Nevertheless, if one has taken an oath to protect classified information, one is still prohibited from accessing publicly available information that is still not formally declassified—exactly the situation with the Snowden and Wikileaks releases. Thus this friend's response is understandable. This incident reflects the underlying aim of the project, which both conceived as an invitation and a provocation, seeks to employ poetics—the ambiguous processes of the paranoiac-critical method—to create conflicts of interpretation ideally leading to seeing the world in a different light.

These characteristics of *Art for Spooks* could additionally be understood as a form of *parrhesia*. Most prominently explored by Michel Foucault, *parrhesia* is a form of "free" or "fearless" speech. Coming out of his studies of ancient Greek and Roman texts, *parrhesia* is a form of speech that: 1) is directed at someone with more power or authority than you; 2) could place you in some form of danger; and 3) is a moral truth not necessarily based on Cartesian or rational forms of evidence [12]. While Foucault mostly based his comments on an analysis of ancient texts, he later extended the idea of *parrhesia* into the present by suggesting that the "modern" artist could enact a form of *parrhesia* today [13]. Indeed, *parrhesia* is key to the work of an artist such as Krzysztof Wodiczko, who draws on Foucault's understanding of fearless speech in his projects and prostheses that enable immigrants, marginalized women workers, and victims of violence to express themselves in public space [18]. While Snowden himself could certainly be understood as engaging in *parrhesia*, especially given the risk he has faced and continues to face, we should not presume that everyone has the capability to act in such a manner. Instead, artists and activists can engage in *parrhesia* with the surveillance state in a variety of ways, from the activists who barricade access to military bases such as the Upstate New York Coalition to Ground the Drones and End the Wars [6] to our own practices in *Art for Spooks*. Each is a form of *parrhesia* tailored to each individual or group's tolerance for reprisal, and using the means congruent with their philosophical outlook. As artists, we understand *parrhesia* in a poetic sense, a means by which to "speak" with the surveillance state using their language in order to interfere with their own paranoia.

The Crowd-Sourced Intelligence Agency

The Crowd-Sourced Intelligence Agency (CSIA) (Figures 4, 5, and 6) is an interactive artwork and research project that allows users to perform the role of an intelligence analyst through an online interface. Anyone can use their Twitter account to login and evaluate Twitter posts, or comment on other agents' evaluations. The second phase of *CSIA*, *Agent Bayes*, allows participants to review fully automated algorithmic evaluations of Twitter posts. *Agent Bayes* is named after the Bayes theorem, the most common formula used by intelligence agencies for establishing the probability of an event. The machine-learning algorithm evaluates Twitter posts and labels them as either suspicious or not suspicious in regards to national security threats. *CSIA* agents can compare the algorithm's decision to the original tweet and it's associated metadata, and can agree or disagree with the algorithm's decision. Eventually, this feedback will be integrated into the algorithm to improve its accuracy. Both phases of the project are built to replicate secretive social media surveillance techniques used

[6] See `http://upstatedroneaction.org/`.

Figure 4: *CSIA* Logo

Figure 5: *CSIA* Interface

Figure 6: Digital Sketch of *CSIA* Analyst Workstation for Science Gallery Installation

by various intelligence agencies as revealed in FOIA files, leaked documents, ethnographic and technical reports. In the *CSIA*, however, analysis takes place in the open. *CSIA* agents get first-hand experience with the decision-making processes faced by intelligence analysts who monitor social media.

The Poetics of Surveillance

The provocation for making the *CSIA* was stories of spectacular misjudgments by intelligence agencies in identifying threats to national security. Notably, two British students were detained by the US Department of Homeland Security and denied entry to the United States in 2012 for posts they made on Twitter. And during the trial of Dzhokhar Tsarnaev for the 2013 bombing of the Boston Marathon, the social media evidence presented by the FBI was exceptionally flawed. A photograph of a mosque in Grozny used for the background of Tsarnaev's Twitter page was incorrectly identified as Mecca, and jokes from television shows and song lyrics were incorrectly marked as evidence of terrorist activity. Tsarnaev was convicted due to ample physical evidence linking him to the crime, drawing a stark contrast between traditional evidence gathering techniques and more recent methods for gathering digital evidence.

Considering the plethora of stories and leaked documents about the aforementioned "collect it all" strategy now used by the NSA and intelligence agencies around the world, there must be hundreds of less spectacular incidents of misidentifications. This raises the question: what are the decision-making criteria for intelligence agencies when evaluating data collected from social media? Despite occasional news stories or ethnographic reports discussing the erroneous judgments of federal agents, leaked schematics illustrating the process of data collection, and photographic documentation of vast data collection centers, little is known about how the data is processed once it has been collected.

During the planning stages for the *CSIA*, we needed a word to describe the type of aesthetic experience that comes from this kind of judgment making process. The term we began using is "qualculative poetics". Qualculation is the system for making qualitative rational judgments; it is the material process and set of practices that allow people to make those judgments. Qualculation includes the spatiotemporal arrangements and metrics needed for making value based decisions. The term was coined by Franck Cochoy when he was researching how shopping carts in supermarkets alter the decision-making process by transforming shopping decisions into a question of volume [5]. Later, Michelle Callon and John Law linked qualculation with agency, realizing that there is a social and material basis for any system of judgment, whether it is a legal system or scientific process. Qualculation is related to discourses surrounding accountability, while the antithesis of qualculation, nonqualculation, is related to postmodernism, or certain religious traditions that

withhold making judgments [4].

A "qualculative poetics" is the creative rearrangement of these elements for aesthetic ends, often resulting in the questioning, or disruption, of a dominant, rationalist logic. In the *CSIA*, the qualculative poetics would be the experience that emanates from the display and arrangement of information on the screen and the sequence in which it is presented. Because a *CSIA* account is obtained through Twitter's API, every *CSIA* agent is familiar with tweets in their original context—Twitter's interface. In presenting tweets in the format seen by intelligence agents, the *CSIA* interface detaches the tweet from its original context and transforms into something to be judged based on how threatening it is to national security. The microblog post is no longer part of a larger system for communication; it is an individual piece of data presented along with its associated metadata. For example, if the author of the tweet has supplied Twitter with a description of themselves or their location, this information will be displayed and may affect the agents decision. The individual users of the app (the *CSIA* agents) must also contend with the human element of the decision-making process, and depending on their individual socialization, biases, and educationthis may vary widely.

Whenever possible, our design decisions for the application were based on known techniques used by intelligence agencies for monitoring social media. Through the design process, we became aware of how choices made about what information to present and how it is presented will directly affect the decision making process of the agents, and the agency they have in making those choices. Within several minutes of use, every user of the *CSIA* will be encountered with a tweet that will be difficult to evaluate based on the information presented. Yet, by all available accounts, this is the same information presented to real intelligence analysts. This difficulty is the aesthetic experience of the *CSIA*, its qualculative poetics. Bruce Nauman once said that where language ceases to be a useful tool for communication is the edge where poetry or art happen [21, pg. 44]. We are looking for that same edge in social media surveillance systems.

Socio-technical Assumptions

As an artistic research project, the *CSIA* aims to analyze intelligence agencies' socio-technical assumptions. From our direct engagement with the technical apparatuses known to be used by intelligence agencies interested in total information awareness, we are testing some of the theories that have been developed about intelligence gathering. We will briefly discuss five socio-technical assumptions that media theorists, philosophers and ethnographers have explored and compare them with our tentative findings to date.

In "Signal-to-Noise Ratio", media theorist Friedrich Kittler writes, "Ever since noise, through the interception of enemy signals, has not been evaluated by interpreting articulated discourses or sounds.... An unoccupied space has emerged, where one might substitute the practice of interception for the theory of reception, and polemics for hermeneutics" [16, pg. 177]. Kittler's passage indicates that the analyst's subjective interpretation of any given message is less essential to understanding the production of intelligence than the overall orientation of an agency or programthe basic assumptions underpinning the technological and social apparatus. We can also derive from it one of the basic assumptions behind signals intelligence: that an analyst is there to intercept and decode enemy signals from noise.

Seeing the surveilled as the enemy is tied to the tacit assumption of guilt within automated intelligence agency surveillance strategies. Media theorist Timothy Jordan argues in Information Politics that algorithmic profiling treats everyone whose data is collected as guilty, and people are only determined to be innocent after their records have been analyzed and found not to resemble the criminal profile. This technique, which is used in commercial profiling and other big data analytics, has been called "topic-agnostic", to characterize the function creep wherein data collected for one purpose can be used for another using the same procedures [15, pg. 115]. But the presumption of guilt is unique to security agencies, who use technologies developed in marketing and used in finance for very different purposes.

Philosopher Colin Koopman traces the intertwined histories of personality psychology and information theory, arguing that "informational persons" have developed since the late 1800s in personality psychology, privacy law, bureaucratic paperwork, communications theories, and elsewhere. From the Tabulating Machine of the census of 1890 to the notion that privacy is based on the "right to an inviolate personality" modern and contemporary forms of surveillance assume that your data at least partially constitutes you and therefore surveilling your data is surveilling you [17]. The belief that captured data is an accurate and indexical trace of a person and their actions is equivalent to the belief that a photograph is an indexical trace of reality with an empirical claim to truth—yet this has been called into question since the birth of photographic technology. The first daguerreotype of a street scene, Louis-Jacques-Mandé Daguerre's Boulevard du Temple from 1838, did not register any of the moving figures, and therefore failed to accurately represent the bustling streets of Paris. Like the wandering figures that evaded detection in early photographs, language used on social media is constantly shifting, and there is no reason to conclude that what is captured transparently represents the world. To believe otherwise is to neglect the significance of interpretation.

An ethnographic account of a Swedish intelligence agency, *The Raw is Cooked: Data in Intelligence Practice*, by Minna Räsänen and James Nyce, that corroborates with ethnographic accounts of US intelligence agencies, reveals that the notion of "raw data" is used regularly by intelligence agents to mean data received from sensors, signals and individuals. Agents assume that intelligence work begins with raw data, and that it is "through their own interpretive labor" that data is cooked, if you will. But, Räsänen and Nyce argue that this data has already been "processed by the work practices", such as the forms that agents have to enter data into, as well as "political, practical and other decisions even before data collection occurs" [23, pg. 655]. Räsänen and Nyce argue that the interpretive labor of an intelligence agency begins before an analyst ever sifts through the information. Furthermore, from an analysis of the FBI's own model of the "intelligence cycle", which is defined as the "process of developing unrefined data into polished intelligence" it is clear that there is

no distinction between, or clear definition of, the terms data and information: in fact, they are used interchangeably, and both are described as, and understood to be, "raw" [11].

In *Infoglut*, Mark Andrejivic writes that the belief that processing a database could predict (or prevent) crime assumes that the only limit on our ability to predict is the "ability to effectively organize all of the information" [1]. Leaked documents and ethnographic reports show that intelligence agents are afraid that they may not be sharing enough information with one another, and yet they simultaneously feel that they are drowning in too much information, and struggling to make meaning out of noise [22, 6]. In a leaked intranet column called the SIGINT Philosopher, an NSA agent stated, "We are drowning in information. And yet we know nothing. For sure." [20] This "collect it all" and "share it all" approach has resulted in the accumulation of more information than can be processed by human agentscreating a need for automated processing, or "next generation information access" (NGIA) systems, to algorithmically process the massive troves of data they have collected, with the belief that software will find patterns that human analysts cannot perceive.

Through the development of the first two phases of the *CSIA*, we have found that dataveillance techniques, as currently practiced by intelligence agencies, do seem to operate on the premise that they produce transparent representations of "the enemy's" behavior as unprocessed data that can be processed into intelligence. Additionally, the intelligence community seems to be taken in by some of the promises of Big Data, such as the assumption that processing more information will allow for more accurate prediction and prevention. This is the role of their NGIA systems, which algorithmically analyze and classify hundreds of data streams from diverse sources, both open source and private. The belief that processing more information will allow for more accurate prediction contradicts the fact that they still find themselves struggling to make meaning out of a sea of random noise.

Artistic Research and Disruption

Culturally, we are in the early phases of understanding contemporary forms of dataveillance and the appropriate tactics of resistance to them. We take the position that a critical, practice-based understanding of how contemporary dataveillance functions is the first step towards any kind of resistance. By crowd-sourcing the decision-making process used to create intelligence, the *CSIA* opens up a window into the technical practices that frame intelligence gathering, revealing the assumptions that lie in the technological and algorithmic designs that intelligence agencies deploy. By replicating known data processing techniques, *CSIA* allows for a practice-based awareness of dataveillance techniques, and exposes potential problems or oversights inherent in the process. But the *CSIA* does not only replicate what intelligence agencies do in order to study them. By opening up these processes for all to participate in and see, it also changes the relationship between intelligence agents and their targets. Intelligence agents are typically unaccountable to the people they judge, and people who are profiled cannot usually see the processes behind how they are categorized.

The *CSIA* contributes to a more informed debate on the problems associated with secret, automated, "collect it all" surveillance. It fosters the potential for disruption and resistance through a practice-based awareness of social media surveillance techniques: by giving users first-hand experience with how social media surveillance works, it provides them with the means to navigate the security apparatus, allowing users to choose if they want to evade algorithmic capture, jam the system with too much information, or find another mode of engagement. The *CSIA* not only opens a debate about the effectiveness of surveillance techniques, but it also enables users to reflect on how they want to engage with it.

Conclusion

At the core of both *Art for Spooks* and the *CSIA* is a desire to directly engage with the rationalist, objectivist logic that guides the contemporary surveillance state. In both projects, documents that were leaked or released through FOIA requests play an integral part in the creation of the work and are part of the aesthetic experience. This is not to say the material itself is aestheticized, but rather, an incorporation of the rationality revealed by those documents provides an opportunity for the viewer to playfully partake in that logic. One example is the use of metadata within each project in a manner that adds an element of horror to Michael Hayden's admission that people are killed based on metadata. *Art for Spooks* demonstrates how easily and automatically this metadata can be manipulated. Likewise, the *CSIA* challenges viewers to make decisions based on the limited understandings that can be gleaned from metadata—the same decisions that have potentially life changing consequences when made by actual intelligence analysts. It could be said that these projects provide the viewer with a sandbox for a protected interaction with the logic of the system that allows them to viscerally experience the limitations and assumptions deeply-rooted within the rationalist perspectives outlined by the released documents. This sandbox is the space for both a playful engagement and poetic disruption.

Author Biographies

Derek Curry's artistic practice engages questions of agency and knowledge production through a variety of mediums from video games and data analytics, to participatory performance and sculptural data visualizations, and his research focuses on algorithmic modes of control, particularly in the electronic stock exchanges. Jennifer Gradecki's artistic practice and research focuses on the relationship between information and power, particularly in intelligence agencies, and aims to make specialized knowledge and technical information more accessible. Curry and Gradecki are both currently PhD candidates at SUNY Buffalo, in Media Study and Visual Studies, respectively. They earned their MFAs in New Genres from UCLAs Department of Art in 2010 and have participated in numerous international exhibitions and conferences, including the New Media Gallery in Zadar, the AC Institute in New York, the Science Gallery in Dublin, Critical Finance Studies in Amsterdam, the International Symposium on Electronic Art in Vancouver, and Radical Networks at NYU Polytechnic–Eyebeam.

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The Visual Politics of Play: On the Signifying Practices of Digital Games

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Abstract

Digital games are so pervasive that they increasingly shape how people ascribe meaning to their world; in short, games are now culture. Similarly to music, literature, television, fashion and film, games as culture constitute "networks of meaningness which individuals and groups use to make sense of and communicate with one another" (Hall). Games expand the ways that we image our own possibilities, create empathetic connection, and seed ethical engagement with lived-world challenges and problems. Recent games 'culture wars', notably, Gamergate definitively confirmed that games traffic in the politics of representation, just as any other form of mass media. This panel examines the social functions of playable media as powerful forms of visual culture and ideological world making, especially as they relate to notions of difference.

This panel includes contributions in critical games research that model intersectional approaches foregrounding the politics of representation, and signifying practices of video games as new media and visual culture. Brought together are three important voices, who—each in their own field—utilize intersectional approaches foregrounding more nuanced or inclusive forms of representation, and therefore more sophisticated signifying practices of video games as electronic media and visual culture. Each panelist (Everett, Harrell, Jenson) presented their work for twenty minutes, with an informal question and answer session that included the audience, speakers and moderator (Murray).

Keywords

Games, representation, signification, Gamergate, identity, social identity, race, gender, sexuality, feminism, cultural studies.

Introduction

To play video games is to engage with the myths and value systems of a constituency whose access, agency and ability to wield the technology allows them to communicate their wishes, fears, fantasies—and even identity politics—through a form of interactive entertainment. Although games are not the same as films or popular television narrative, they do operate as expressions of myths, the "dream life" of culture, whose depths are only beginning to be plumbed (Hall). Among these "dreams" are the roles of differenced bodies, gendered bodies, and racialized bodies, within the technological spaces of game play. The powerful representations in games are extensions of the visual cultures from which they arise, the political and cultural contexts, and can be mined for their significative potentials.

There is a burgeoning and exciting discussion of game content, which includes textual studies of games as forms of cultural expression (Dovey, Jones, Galloway, Wolf and Perron, Dyer-Witheford and de Peuter). And there are texts that investigate from various perspectives the potential for games to affect positive social transformation or make ethical interventions on the level of design (Harrell, McGonigal, Flanagan, Sicart, Frasca). Lastly, there are few—but nevertheless seminal—interventions into broader issues of digital media and representation, most prominently race and gender, but recently sexuality as well (Nakamura, Shaw, Anthropy, Nakamura and Chow-White, Cassell and Jenkins, Kafai et. al, Laurel). This panel is designed to build upon and enhance current scholarship in relation to issues of representation and practices of signification, as they specifically relate to games.

Gaming Matters: Playing with Black Womyn MPCs (Everett)

A paradigm shift of sorts has occurred in the procedural rhetorics and gameplay structures of videogames over the last two decades where race and gender in games intersect, though the changes are not nearly enough. Gamers now negotiate and amplify the joy and pain of their videogame fandom quite publicly and enthusiastically as game characters of color are gaining some new visibility as optional play (OP) and must play characters (MPC). As powerful narrative agents in action-adventure, open-world and first- and third-person-shooter genres in mainstream, casual and online gaming spaces (including networked games on

Xbox Live), black women as MPCs in successful mainstream gaming franchises and action-adventure game brands are redefining the gaming experience in terms of 21st-century multicultural, multiracial heroic/sheroic character ideals. This work explores some benefits and drawbacks of gaming's tepid embrace of black women and girls as sheroes of video game play in popular game titles. Online fora /fansites/ blogs, etc. devoted to gaming, video games journalism, and recent scholarship on intersectional politics in gaming industry theory and praxis are at the center of this study. My motivation for interrogating the discourse function of both Aveline de Grandpré as the baaddass protagonist of *Assassin's Creed III: Liberation* and Sheva Alomar as the powerful female buddy/protagonist in *Resident Evil 5* coupled with acknowledging the vocal gamer girl-citizen journalists agitating for more black female MPCs is not intended to tamp down excitement for this development (See Figure 1 and Figure 2). Rather, it is meant to amplify those voices of black girl gamers and fangirls savoring this long-overdue moment of gaming diversity and inclusion. Nonetheless, a cautionary imperative at the heart of this study warns: "be careful what you ask for!"

Figure 1. *Assassin's Creed III: Liberation's* Aveline de Grandpré.

Clearly, it is a promising as well as exciting phenomenon that the *Assassin's Creed* and *Resident Evil* franchises have expanded their gaming storyworlds to make room for black women, as well as other women of color, into the ranks of must-play characters (MPCs); optional characters (Ops) and playable characters (PCs) for the first time. At the same time it is curious that Capcom's 2008 release of *Resident Evil 5* features a lead MPC of African descent, Sheva Alomar, whose scant attire beyond the expected hypersexualization, is sedimented with questionable signifiers of primitive, nativist African mythology (figure with Sheva in bone necklace and body paint). Similarly, Ubisoft's decision to situate Aveline de Grandpré at a great historical remove, in the colonial period of slavery seems overdetermined in both its willingness to address this ignoble past and, arguably, its unwillingness to craft a powerful contemporary black shero tackling racial justice issues in the 21st century. That said, it is important to acknowledge and encourage game developers and designers to go even further in their economically sound decisions to up the percentages of women of color (WoC), and women from dominant groups for that matter, in their future game sequels and franchises. Better still would be for games companies to develop and put the marketing and publicity resources behind new games titles centered on non-white MPCs. As games developers are coming to realize, diversity and inclusiveness in the industry makes good business sense and it addresses the reality that older women and underrepresented racial groups now make up the largest demographics of their consumer base.

Figure 2. *Resident Evil 5*, Sheva Alomar is Capcom's Hypersexualized Black Woman MPC in Primativist Garb and Wardrobe Malfunction (if you look closely enough).

What I am calling the gaming industrial complex (GIC) is also attuned to heated debates, conversations, and controversies on and offline about the confluence of race and gender in gaming. Primarily, most controversies revolve around refusals of many male gamers to share what JaySmooth calls their "privileged gender spectrum" with black and other women/girls of color as narrative and ludic agents in action-adventure, fighting, and other lucrative gaming genres. This work also took cognizance of the increasing presence of black and other women of color (WoC) in networked gaming spaces, especially in discourses on Xbox Live, in Indy games, and elsewhere in the gaming ecology, all of which have exacerbated the culture's retrenched gender wars, as the 2014 #Gamergate controversy underscored. Nonetheless, indices of gaming's slowly changing gender dynamics can be found in the proliferation of social media buzz, special websites, blogs, wikis, YouTube channels, and Vimeo videos, Instagram, among other discursive online platforms that engender powerful participatory gaming cultures of play and critique. Moreover, one cannot consider adequately the growing push for more gender and racial diversity in contemporary gaming culture outside the heightened racial framework of American civil society at large, a society still adjusting to having elected the nation's first bi-racial President, Barack H. Obama who self-identifies, proudly, as black or African American. Also, there is the industry framework driven by the enlarged roles of global audiences

and market shares to which game developers cater with strategies and tactics unparalleled even during the golden age of the business' expansion in the Bushnell and Miyamoto eras of the mid to late 1970s through the mid 1980s. Then, there is the digitized race and ethnicity framework promulgated by the *Grand Theft Auto* (GTA) franchise that introduced mainstream gaming's most high-profile, if not first ever, central black protagonist C. J. as a must-play character (MPC). Fourth, there is the gender framework following the girl games movement that gave rise to the highly successful *Lara Croft* game brand at the end of the twentieth century. Finally, there is gaming's networked online framework that has taken the industry by storm and to new heights of social, cultural, global and financial influence and significance. A through-line transecting each of these frameworks is the often disavowed problematic of sanctioned racial otherness in gaming's historic narratives. My concern, then, with exploring the beneficial (I hope) industry move of developing black women MPCs, is the huge, often unspoken stakes involved in the seriousness of gameplay. As game theorist Jos de Mul put it in 2005:

> Just as narratives, computer games are expressions that, among other things, play a function in the formation of our identity . . . [W]e could say that the (computer) games we play are nothing but a remote imitation of the infinite play of the world.

Modeling and Expressing Social Identity in Games (Harrell)

Overview

Avatars and player characters in games offer us new ways to see ourselves. They also impact us in the "real" physical world. Studies show that avatars can have a range of effects on users such as performance and engagement (Kao and Harrell 2015b, a). Avatars can have other impacts on user behaviors, it has been shown that users conform to expected behaviors and attitudes associated with an avatar's appearance (Yee and Bailenson 2007). Avatars can also trigger stereotype threat (Steele and Aronson 1995), the phenomenon of being at risk of confirming a stereotype about one's group, and even impact future aspirations (Good, Rattan, and Dweck 2012). Since avatars can impact physical world experiences even including oppression and violence, it is important to look closely at the effects of avatars on users. This section argues for the importance of analyzing identities and how computational modeling can be used to better design expressive identity representations in videogames.

Back End Representations

While clearly graphics are important for analyzing sociocultural aspects of avatars, there has been little analysis of how culture impacts back end representations such as data structures. It is imperative to look "under the hood", however, because analyzing back-end technical aspects of systems can reveal how they implement particular worldviews. For example, Harrell and his collaborators have revealed that racial stereotypes and gender biases have been built into character attributes in games[1] (Harrell 2010, Lim and Harrell 2015a).

However, the argument for analyzing back end representations of virtual identities extends beyond analysis of attributes. For instance, in the bestselling computer role-playing game (RPG) *Neverwinter Nights*[2] while the graphical gendered and racial features of player characters are superficial and do not impact gameplay, the back end data structures for race, phenotype, and gender are defined in surprising ways with subtly interacting effects. E.g., the genders of non-player characters (NPCs) can be set to "Male," "Female," "Both," "Other," or "None." If the creature appearance is of one of these standard NPC racial types, setting the gender to "Male," "Both," "Other", or "None" will assign the male appearance to the character. So there are five genders possible for NPCs, 80% of which are apparently male by default!

Such observations are not intended to single out the excellent RPG *Neverwinter Nights* as having deficits compared to other games. The implementations of gender, race, and ethnicity in games reflect broader social worldviews many developers (and many players) share in, along with long held RPG conventions. Yet, the results of such implementations influence how real world phenomena of race and gender play out in game worlds including detrimental effects such biases, stereotyping, and other forms of inequity.

Computational Modeling of Social Identity in Games

The work presented here for modeling identity phenomena including, but not limited to biases, stereotyping, and other forms of inequity in games is pursued in two main ways:

- Computational analysis: Developing theory and build systems to *analyze computational identity phenomena*.
- Computational expression: This analysis informs new ways to *model social identity experiences*.

The next subsections overviews several efforts towards these ends.

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[1] These analyses include both humanities-based and computational AI analyses of *The Elder Scrolls IV: Oblivion*. In that game, player character abilities grow based upon user actions in, so that these attribute differences can largely be overridden. However, this is still a significant phenomenon for many players, in particular those who optimize their characters as much as possible, because racial or gender attribute differences still result in different maximal possibilities for player characters.

[2] In this game back end data structures are easily accessible since the game enables user created content such as creatures and non-player characters (NPCs) using the Aurora Toolset.

Computational Analysis

AIRvatar (Lim and Harrell 2015b) is a data-mining AI application that collects data on user behaviors as they create customize their avatars (See Figure 3).

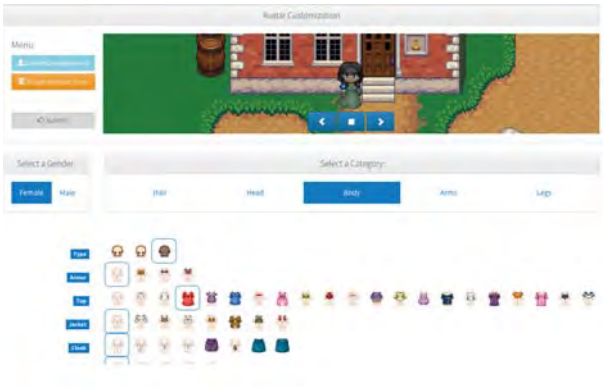

Figure 3. Screenshots of the *AIRvatar* interface.

Lim and Harrell have discovered a number of results relating to gender stereotyping and cross-gender play using AIRvatar (ibid). E.g., in a study of 191 participants, female players tended to construct male characters that correspond to gender stereotypes of high physical ability attributes, but low attributes for mental attributes and charisma (See Figure 4). Revealing users' gender stereotypes is a quite telling discovery because it empirically demonstrates that stereotyping is not just a matter of developer biases or user biases alone, but rather these worldviews and their associated imagery are socially widespread and only semi-visible, in other words they are *cultural phantasms* (Harrell 2013).

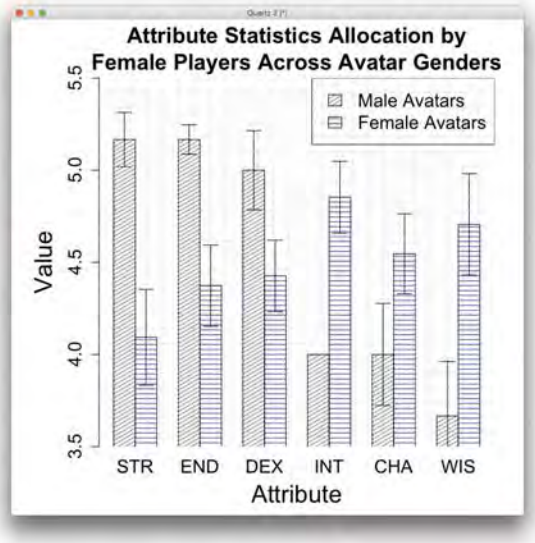

Figure 4. The allocation of attribute points by female users for male player characters reveals gender stereotyping.

Design and Expression

Computing can also be used to model social identity phenomena in expressive works. E.g., *Chimeria* (Harrell et al. 2014a) models how users' identities change over time – an engine for implementing dynamic virtual identities.

Gatekeeper (See Figure 5) is a game made using *Chimeria* in which a player character is prompted to try to gain access to a castle through a trajectory of actions enabling "fitting in" to a privileged social category or its highlight membership in a stigmatized category (Harrell et al. 2014b).

Figure 5. Screenshots from the game *Chimeria: Gatekeeper*.

Conclusion

We must be critically aware of the effects of avatars on users. Computational modeling can be deployed toward this end through both analysis and creation of expressive tools and systems. To avoid introducing detrimental social identity phenomena into systems, and to support users in critically engaging with their own biases, developers must consider that avatars are technical, cultural, and cognitive co-constructions between systems, developers, and users. This means that we must be cognizant that users' and developers' social stereotypes alike persist as phantasms prompted by systems. This situation provides a special responsibility for developers: games hold great expressive power in designing and deploying avatars, yet we must take care as this power can be used alternately to fulfill, subvert, invoke, or reveal social identity phantasms and their resultant clichés and stereotypes.

Acknowledgments

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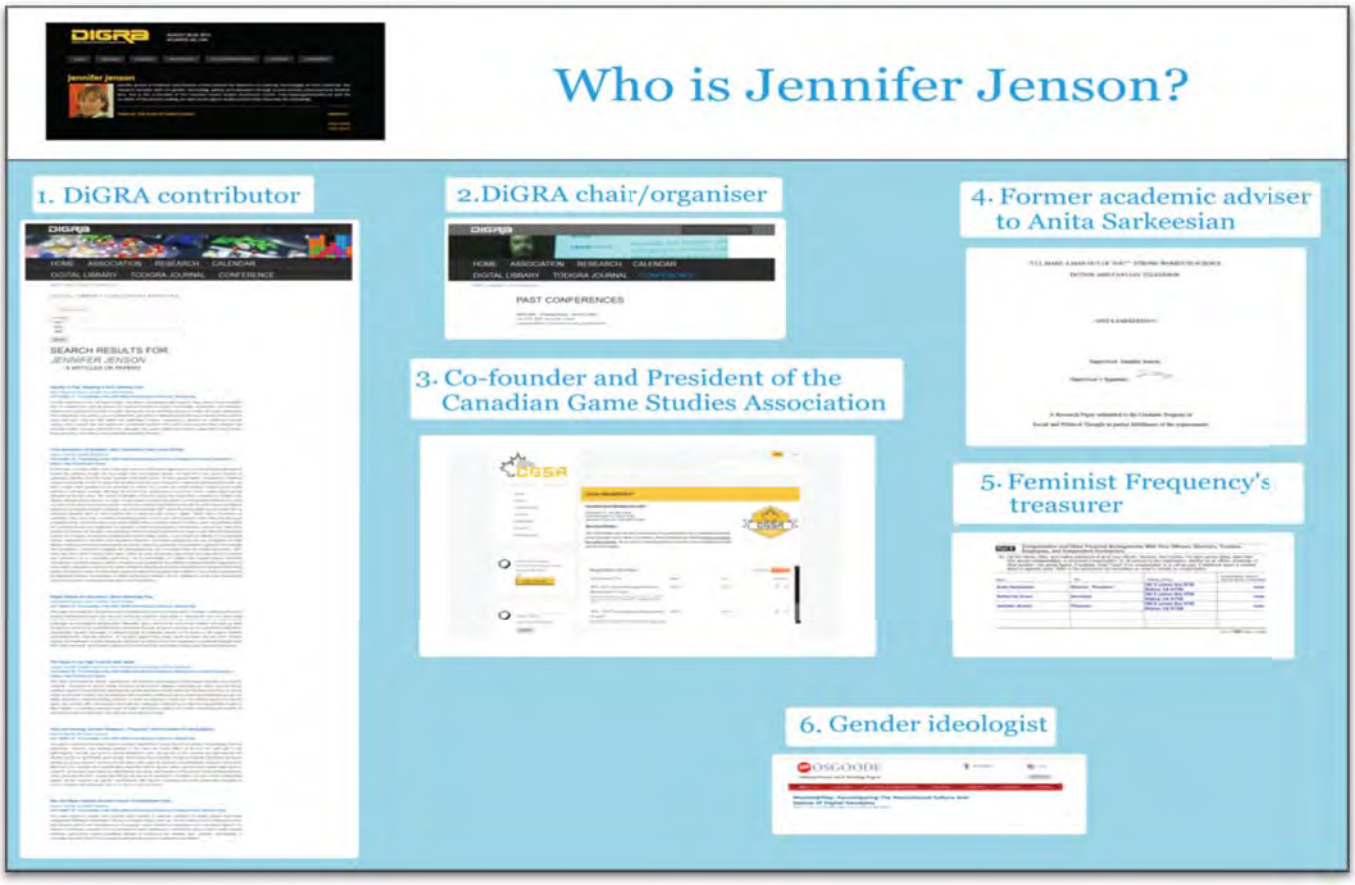

Figure 6. "Facts" about Jen Jenson.

Fighting Gamehate: A Feminist Project (Jenson)

In mid-August 2014, Twitter, Reddit, YouTube, gaming websites and 4chan exploded with allegations of "corruption" in games journalism, naming the phenomenon "Gamergate" (see Twitter hashtag #Gamergate). Since that time, nearly every major English news outlet and game-related journalistic website has reported on Gamergate. Women (critics, game players, game makers and journalists) are at the center of the controversy, and many have received threats that, as games journalist David Auerbach put it, are "so egregious" that a prominent female journalist (Jenn Frank) publically announced that she would no longer be writing on games (Auerbach 2014a, 2014b). This situation further escalated into a public threat of a "massacre," forcing games critic Anita Sarkeesian (Executive Director, Feminist Frequency) to cancel a public address at the University of Utah, and even the author of this notation has been targeted (See Figure 6).

To better understand what feminist/s frameworks and approaches might offer games scholars and game makers under these conditions is my explicit focus. I here describe the origins and development of an explicitly feminist project, Feminists in Games (FiG), which brought together makers, players and researchers to work on the 'gender troubles' of digital games industry and culture – and give a brief overview of the opportunities that project created.

Most of what Gamergate has been doing is precisely a kind of boundary policing – reacting against women speaking in public. And it is precisely that public speech that comes under fire, not just in games but also in many other aspects of a now public social media. Feminist in Games (FiG) was first imagined, funded by the Social Sciences and Humanities Research Council of Canada, completed in 2014, then became the foundation of a 5-year funded cross-sectoral partnership to work to transform the games industry and gamer culture. "FiG" (See Figure 7) is described here as one concrete example of how it's possible to 'speak up' against the pervasively misogynist games industry and culture – and from there, how to help build political and practical tools to achieve diversity in games.

Figure 7. Feminists in Games.

The challenge, then, is not only to better understand what is supporting the ongoing inequities in digital game design and play, but to work to transform these conditions. The FiG project, taking up that challenge, was designed to develop not just a research partnership, but also a feminist alliance. In the face of widespread cultural, academic and political repudiation of the term 'feminist', seen as a divisive and indeed aversive label more likely to lose than engender support, we explicitly embraced both the terminology and the historical, theoretical and methodological resources feminism offers. The FiG project brought together social science and humanities researchers from a variety of disciplines, community organizers and activists and games industry employees (both from large/mainstream companies and Indie developers) to build meaningful research, but also to build an activist alliance, around what has been and remains today a hugely resistant problem. Our aim was to help create the conditions for more equitable participation of women, both as consumers and as producers, in an industry that has gained increasing social, cultural and economic importance for 21st century work, education, communication and play, not only in Canada, but globally. In the service of that work, we invited researchers and others interested and invested in games industry, community, education and culture to begin a conversation about what feminism could offer the above 'problems' of and for women in games.

There are two primary points to emphasize by way of a conclusion: 1) Gamergate is part of a larger, systemic problem in the games industry and culture; and 2) Feminist approaches and practices can and do provide a means initiate a broad-based, grassroots transformation, with a powerful cross-sectoral infrastructure.

What is new with Gamergate and the ongoing sexism and misogyny that characterizes game cultures and industries is that *nothing is new*. What matters most in the deployment of tropes of 'surprise, dismay, shock and awe' round and about Gamergate is that extreme angst makes it look like this has not always happened and that something new and really different is going on. The real shock should be that it's same ol', same ol', and we need to name that significant fact. Otherwise it's as if we had no understanding of how social situations are made and can be re-made, as if we had no power to change this somehow 'natural' order of things, as if, to borrow from the law of the conservation of matter, violence against women is neither created nor destroyed—it just changes its shape. Violently silencing women, whether in *The Odyssey* or in *Call of Duty,* is as old as the hills.

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Professor Soraya Murray holds a Ph.D. in art history and visual studies from Cornell University, and an MFA in Studio Art from the University of California, Irvine. An Assistant Professor in Film & Digital Media at the University of California, Santa Cruz, she is also principal faculty in the Digital Arts & New Media MFA Program, and affiliated with the History of Art & Visual Culture Department, as well as the Center for Games and Playable Media. Murray is an interdisciplinary scholar who focuses on contemporary visual culture, with particular interest in contemporary art, cultural studies and games. Her writings are published in *Art Journal*, *Nka: Journal of Contemporary African Art*, *CTheory*, *Public Art Review*, *Third Text*, *Gamesbeat* and *PAJ: A Journal of Performance and Art*.
Dr. Murray is the convener and moderator of this panel.

Institutional Presentations

CogNovo: Cognitive Innovation for Technological, Artistic, and Social Domains

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Abstract

CogNovo is a multi-national doctoral training programme offering a research network for cognitive innovation, both as a new field of artistic and scientific investigation, and as a strategy for research and innovation. We summarize the programme's goals, themes, members, partners, projects, and activities in this paper.

Keywords

Cognitive neuroscience, computational modelling, humanities, experimental psychology, creative industries, cognitive robotics, game design, PhD programmes, cognitive innovation, interactive arts

Programme overview

Why is novelty creation and selection so important for cognitive functioning? Is it necessary for autonomous knowledge acquisition in artificial systems? What is the relationship between novelty, usefulness, and creativity? Can a deeper understanding of perception and the generation of ideas help forge new links between cognitive science, technology, the arts, and the humanities, thus creating new opportunities for innovation?

CogNovo[1] is a multi-national doctoral training programme that addresses such questions. Based in the Cognition Institute at the University of Plymouth (UK), CogNovo focuses on interdisciplinary research in cognition, novelty, and creativity. The programme aims to disrupt single-field research and to establish a rigorous basis for cognitive innovation and a research training programme in which new researchers learn to adopt the self-aware, multi-faceted process of cognitive innovation (exploration / speculation, explanation / synthesis, and exploitation / implication), applicable both to their research activities as well as their professional and personal development.

Programme themes

CogNovo is characterized by a wide-ranging interdisciplinary approach, formed by combining the following complementary streams:

The **experimental psychology** stream involves studying perceptual, developmental, and cognitive aspects of creativity as well as developing innovative solutions to problems in alarm design, medical communications, decision-making, and cinema technologies, thus providing new insights into the basis for sustainable social innovation.

The **interactive and creative arts** stream explores the role of and effects on cognition in the creative process within a range of artistic disciplines including digital games, music, interactive sound, and dance. This stream also explores the dynamics of social creativity within interacting groups through direct engagement with creative practices.

The **cognitive neuroscience** stream explores the neural and physiological basis for cognitive innovation and the relationship between cognition, novelty and creativity. CogNovo fellows will apply neuroimaging technologies to investigate creativity in imagery and deception, and how novelty detection helps to shape cognition and inspire creative responses and outputs.

The **humanities** stream takes a transdisciplinary approach to broadening the scientific ear of CogNovo fellows by offering new ways of thinking about problems not normally considered within the scientific community. A particular focus is on the human values important for sustainable innovation in technological applications.

The **computational modelling** stream develops bio-inspired models that provide testable explanations for creative cognitive processes. Computational modelling provides important links between cognitive neuroscience and experimental psychology and a basis for developing novel intelligent cognitive technologies.

The **cognitive robotics** stream tackles the problem of developing human-like cognition in artificial robotic systems. It examines the role of artificial creativity in the development of artificial cognition.

Programme Members and Partners

There are currently 25 doctoral students from 15 countries in the programme. They are supervised by a team of over 45 University faculty members from across a range of disciplines, and by over 25 external academic and private industry partners from Europe, Asia, and North America. Fourteen of the research fellows are funded through the European Commission's Marie Skłodowska-Curie Actions programme, the other eleven directly by the University. The Marie Skłodowska-Curie Actions programme provides generous research funding

[1] Programme website: `http://cognovo.eu`; accessed: 22-OCT-2015

to students alongside ample opportunity to gain experience abroad and in the private sector during the course of their studies.

Example Projects

Each of the 25 fellows works on a distinct project related to novelty, creativity, and cognition. This section describes a selection of the projects to demonstrate the range of concerns tackled within CogNovo.

Shared creativity in dance (Project 7) focuses on group improvisation as a unique way to understand how people collaborate and how new ideas appear from social interaction. It explores the interdependency of individual cognitive strategies and group processes, investigating the role of shared flow experience in improvisation.

Bodyshaping the Mind (Project 8) aims to develop theories, tools, and techniques for exploring how the body shapes the mind. It investigates how physiological states such as muscular tension, range of motion, and quality of movement shapes cognition and affect, and how technology-mediated interventions could facilitate somatosensory sensitivity.

Designing Playful Systems in Mixed Reality (Project 9) investigates notions of play through a series of experimental games and playful interactions that take place in mixed reality environments. The project involves artistic research into aspects of complex systems such as neural network models and social systems theory.

Early Cinema and Cognitive Creativity (Project 10) investigates the temporal resolution and inter-frame nature of analogue and digital film projection and its effect on the cognition of the cinema spectator. It explores whether the cognitive experience of cinema has changed as a result of the transition from analogue to digital cinema projection.

Signs of Alarm Fatigue (Project 12) aims to provide evidence of the pheno-physical correlates of the subjective experience of "alarm fatigue", as well as to outline a framework for a cognitive-methodological innovation in the study of the phenomenon.

Creative technologies for behaviour change (Project 13) translates insights from Elaborated Intrusion theory into novel treatments for unhealthy lifestyles, with a specific focus on social robotics and mobile apps to stimulate imagination and suggest mental imagery to users.

Predicting creativity from spatial ability and personality (Project 15) investigates the qualities of creative people by exploring how individual differences at a fundamental level in terms of temperament can affect cognition and creativity.

Unconscious Creativity: The Eureka moment (Project 16) focuses on the process of creative problem solving by understanding how to overcome impasses and the role of restructuring problems. The methodology includes behavioural experiments using established and newly developed tasks to collect empirical evidence undermining findings from qualitative analysis of interviews with real life problem-solvers. The project will look closely at neural activity in order to develop a model of the emergence of novel insights.

Neural Concept Sampler (Project 17) computes and represents concepts found in musical patterns using neural networks in order to generate innovative pieces of music using neural networks' conceptual representations of musical fragments.

Moral cognition: An interdisciplinary investigation of judgment versus action (Project 19) brings together experimental psychology and state-of-the-art technologies in order to examine 'moral hypocrisy' or the dissociation between moral judgments and moral behaviours. Virtual reality methods utilising virtual headset systems as well as haptic feedback devices are incorporated to allow realistic simulations of moral actions. Both pro-social and anti-social predictors are assessed in order to understand and model real life moral decisions.

Attention and learning about irrelevant cues (project 20) investigates the acquisition of associations for stimuli based on their predictiveness with a particular focus on the paradigm of blocking. In blocking, reduced learning is seen for a novel stimulus (blocked cue) that is paired together with a stimulus within a previously established stimulus-outcome association (blocking cue). This project uses experimental research with human participants and eye-tracking to examine gaze location patterns in order to gain further insights into the process of learning to ignore irrelevant cues.

Creating a voice for engagement and trust (Project 21) aims at creating an artificial voice for a robot that sounds trustworthy, based on phonetic and prosodic characteristics of English accents. A specifically-designed trust game is used to analyse more trustworthy voices and their characteristics in detail.

Understanding the Human Object (Project 24) questions the idea of establishing a working consensus between different disciplines and their views and on the rhetoric within scientific modelling, through the creation of a class of provocative objects that may reconcile or conflate opposing sentiments.

A Framework for Intuitive Remote Robotic Control (Project 25) takes inspiration from human robot interaction, ergonomic principles, and autonomous robotics to proposes a human-centric framework for robot control. Drawing on the current advancements in machine learning, artificial intelligence and autonomous robotics, the project aims to design a flexible, intuitive, and largely reconfigurable telerobotic interface. The interface is realised as a software agent connecting the two end points of the system: human and robot, providing an adaptive and intelligent interface for robot control.

Programme Activities

A variety of activities are programmed in CogNovo not only to support the research training of the fellows, but also to engage both the wider research community as well as the public at large on the programme's streams.

Interdisciplinary training for fellows

One approach that is taken in CogNovo to disrupt single-fields research is the implementation of combined workshops and the creation of designated spaces and times to discuss knowledge transfer between disciplines and evaluate preliminary results in the light of other streams. Five week-long workshops allowed intensive and focused training on selected topics during

the first 18 month of the program. A **Research Methods Workshop** in May 2014 introduced methodologies from the different research areas involved in CogNovo. During the **Experimental Methods Workshop** in June 2014 all CogNovo Research Fellows and participants who joined for the week learned about paradigms, advantages, and potential pitfalls of running and analysing experiments. The **Computational Modelling Workshop** in September 2014 instead focused on simulation and gave the participants access to computational and robotic tools. The **Public Outreach and Social Innovation Workshop** in January 2015 trained fellows on how to engage with broadcast media and deliver public presentations to create compelling and understandable accounts of research processes and outcomes. Finally an **Entrepreneurship Workshop** in April 2015 gave some insight into the interplay of science, business, and the law.

Another two workshops are planned for January and April 2016: the **Social Creativity Workshop** will explore the influence of group structures on the creative output while **The Brain Basis for Cognitive Innovation** will focus on the brain as the source of creativity.

Engagement with the wider research community

CogNovo engages with the research community through a number of events. The **Off the Lip** conference[2] held in Plymouth in September 2015 focused on humanities perspectives on Cognitive Innovation. Keynote speakers included Roger Malina[3], Sundar Sarukkai[4], and Amy Ione[5]. Presented papers and posters offered perspectives from a wide range of the humanities on Cognitive Innovation and touched on philosophy, literature, sound design, quantum creativity, psychoactive substances, decision-making during high-stress situations, and many more. Currently CogNovo aims at publishing the proceedings in collaboration with **Transtechnology Research**[6]. Due to its great success and impact on the CogNovo projects as well as in response to the feedback from involved researchers, CogNovo will hold another **Off the Lip** conference in 2016.

CogNovo fellows will be hosting a **Cognitive Innovation Summer School** in 2016. The Summer School will be open to research students outside the consortium. CogNovo Fellows will plan the programme, invite speakers, and develop advertising and fundraising campaigns.

Engagement with the public at large

From the beginning on the CogNovo workshop included at least one event to interact with the local community. This series of events, entitled **CogJam**, emphasises the artistic engagement of the research fellows and their practical approach to artistic creativity and Cognitive Innovation.

As part of the Public Outreach and Social Innovation Workshop, led by former BBC senior producer Malcolm Love and professional science communicator Emily Grossmann, the CogNovo research fellows put together a **Public Science Cabaret Show** which they performed live in downtown Plymouth while it was simultaneously transmitted to the local FM radio station. Podcasts created during the evening are still accessible to a wider audience through the website of **Radio CogNovia**, a digital radio broadcast initiative that was launched during the workshop.

Besides classic ways of scientific publication CogNovo research fellows experiment with different ways of communicating their findings: podcasts have been published to a wide audience on the **new leonardos** channel at Creative Disturbances[7], an international, multi-lingual online platform that publishes conversations, art exhibitions were used present results, and contributions to public events such as the **British Science Week** and the **ESRC Festival of Social Sciences** have been made. While films produced by CogNovo research fellows have been shown at festivals in the past, the upcoming **Workshop on Social Creativity** is expected to create more movies that can be used to communicate joint findings from the streams involved in CogNovo.

Summary

CogNovo aims to develop a ground-breaking training programme in cognitive research for technological, artistic, and social innovation. Our experience from activities that we have already completed provides us with some confidence towards meeting these aims. We look forward to further CogNovo training workshops in social creativity (January 2016) and the brain basis for Cognitive Innovation (April 2016). We expect that these sessions – in addition to the Cognitive Innovation Summer School (July 2016) – not only will develop among CogNovo fellows the advanced expertise and transferable skills that will prepare them for successful careers in academia and industry, but will also strengthen the worldwide network of leading research labs and innovative industries within which CogNovo is embedded.

Acknowledgement

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[4] Professor and Director of the Manipal Centre for Philosophy and Humanities, Manipal, India

[5] Director of the Diatrope Institute, Berkeley, California, USA

[6] Group website: `http://www.trans-techresearch.net`; accessed: 22-OCT-2015

[7] Network website: `http://creativedisturbance.org/channel/new-leonardos/`; accessed: 22-OCT-2015

Institutional Presentation - The Banff Centre

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Abstract

The Banff Centre adds to Canada s and the world s cultural repertoire by commissioning, supporting, and producing new creative works. We develop multidimensional artists for the international stage in an artistically rich learning environment. Arts programs at the Centre expand the work and perspective of artists and practitioners in Canada and internationally. By fostering interdisciplinarity, experimentation and engagement with technology, for the production and dissemination of original work, The Banff Centre supports artists at the forefront of contemporary culture. Moving forward, the Centre will disseminate the art and ideas developed in Banff using new initiatives in digital, web, radio, and broadcast media.

Keywords

Residencies, Exhibitions, Digital Media, Culture, Banff, Canada

Institution Profile

Founded in 1933, The Banff Centre is a public Arts and Culture Institution located in Banff National Park. With thousands of artists, leaders, and researchers participating in our programs annually, we are the largest arts and creativity incubator in the world. The Banff Centre has become a key contributor to Canadian culture, influencing the careers of tens of thousands of artists over the past eight decades. The Institution draws participants from Alberta, across Canada and around the world to multidisciplinary programs that support the creation, production and presentation of work in Indigenous arts, digital media, audio, video, writing, painting, sculpture, printmaking, ceramics, photography, opera, music, theatre and dance.

All of our programs have a dynamic and innovative approach, with a flexible learning and creative development environment unlike typical academic structures. The Banff Centre also conducts applied research and fosters innovation in a variety of program areas, both independently and in partnership with other institutions and the private sector.

There are many types of programs offered at The Banff Centre – from residencies to workshops, summits, and practicum learning programs. Arts programs are at the core of The Banff Centre. Programming supports the commissioning and creation of new work by individual artists and arts collectives, and provides resources for individual artistic exploration, collaboration, and applied research. Training and professional development is offered at the post-graduate level across all of the art forms supported. Work is showcased in public performance, events, and exhibitions throughout the year, and disseminated beyond Banff through the Banff Centre Press and Content Capture Unit. The Centre also partners with national and international arts institutions to bring art incubated in Banff to galleries, stages and concert halls around the world.

Visual + Digital Art residency programs at The Banff Centre offer opportunities for artists to engage with world-renowned faculty and peers, and gain new insights into the development of their work. Access to extensive facilities in photography, sculpture, printmaking, papermaking, ceramics, fibre, painting, digital media, video and audio is available. These programs are designed for professional artists with an exhibition record who have had formal training in visual arts, or equivalent experience and recognition from their peers as well as cultural researchers in curatorial and critical studies.

In a setting that creates community and collaboration, program participants are respected for their important role as artists. Aside from the activities of their program, artists can participate in the larger community of the Centre, mingling with artists in all disciplines attending world-class concerts, performances, readings, exhibitions, and other events in the inspiring setting of Banff National Park.

Types of Programs

Residencies can be structured and a fixed length, or self-directed and a variable length. Artists may explore their medium in collaboration with other residency participants and leading faculty artists in the field, work with discipline specific studio facilitators for technical or conceptual guidance, or they may work independently in the development of a specific project.

Workshops are short, intensive programs that delve into a specific topic, skill, or discipline. Usually ranging from a few days to a week long, they offer the full experience of The Banff Centre including ac-cess to facilities and faculty. Workshops may include group sessions, master classes, one-on-one mentoring, critiques, guest speakers, and other activities.

Our Practicum learning program offers a training and mentorship opportunity that is ideal for emerging artists,

technical practitioners, and arts administrators. Participants work with an experienced mentor in the field to develop knowledge and skills for a specific career in the arts. The practicum program is usually several months to a year in length and offers participants fully scholarshiped tuition, a stipend living allowance, and subsidized housing.

Technology Specific Programming

With support from the Canada Council for the Arts the Banff Centre held a 3-day summit from the 27th to the 30th of November 2014. Convergence was designed to bring together artists and technology experts to explore how different art forms intersect with emerging technologies.

Art and technology play a major part of The Banff Centre's continued dedication to supporting the contemporary needs of artists. Banff Centre is also leading the way for interdisciplinary artistic practice not only in Canada but internationally. With Convergence, we created an opportunity where we could exhibit the work of artists who operate in the frontiers of the arts, where disciplines and technologies are evolving. There were two main components to the Summit: Convergence Speakers Series and Convergence exhibitions and performances. These events allowed The Banff Centre to lead a conversation about future possibilities for interdisciplinary practice and to look at where technology can help bridge the transition between disciplines.

We also hosted Convergence Lab, an interdisciplinary residency in creative technologies. Fully supported by The Banff Centre, this was an opportunity for artists to put the ideas explored in the summit into practice, by creating a collaborative technology-driven work of art that harnessed interdisciplinary expertise.

Media and Production

Fundamental to Media Production at The Banff Centre is the belief that the creative sector flourishes through collaboration, and that the links and tensions across art, technology, and applied research have a critical role to play in describing and viewing contemporary cultures, and shaping the future. Media Production extends collaborative, creative and technical expertise in media and interactive production to artists and other Banff Centre participants within a professional, well-equipped environment. Media Production leads and supports all Banff Centre programs, including a variety of artist residencies, and programs across the Banff Centre that intersect with technology. As a multi-disciplinary department Media Production responds to The Banff Centre's strategic priority of providing seamless engagement across and between disciplines.

ISEA International

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ISEA International Board
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Abstract

Founded in the Netherlands in 1990, ISEA International is an international non-profit organisation fostering interdisciplinary academic discourse and exchange among culturally diverse organisations and individuals working with art, science and technology. The main activity of ISEA International is the continuation of the annual International Symposium on Electronic Art (ISEA).

Keywords

ISEA, international, art, science, technology, interdisciplinary, organisation, symposium, nomadic, electronic art, innovative.

History

The series of symposia known as the International Symposium on Electronic Art was initiated in 1988 in order to support the founding and maintenance of an international network of organisations and individuals active in the field of the electronic arts. This network took the shape of an association, founded in 1990 in The Netherlands, called the Inter-Society for the Electronic Arts. The Board and membership of ISEA has always been international. From the founding of ISEA until 1996, the organisation was based in the Netherlands. From 1996 to 2001, ISEA headquarters (HQ) was based in Montréal, Canada. After a period of a provisional HQ again in the Netherlands, in 2008 a new headquarters was established at the University of Brighton, United Kingdom. The Inter-Society existed for over 15 years as a membership organisation and in 2009 it was changed from the association to a foundation called **"ISEA International."**

Administration

The organisation is managed by the ISEA International foundation Board, whose main role is to select and work with the host city of each symposium, manage an archive of past symposium materials, and maintain communication with the ISEA community via a website and listserv. The Board also plans and oversees special projects and initiatives to further ISEA International's mission.

The ISEA International Advisory Committee consists of select members of the ISEA community who have been supportive of ISEA's mission. This group of experts in the field of electronic art, science and technology advise the ISEA International Board on a variety of matters.

Symposia

Historically the symposia were held as both biennial and annual events. As of 2009, the symposium has been held annually. ISEA symposia differ from most conferences in that they typically include art exhibitions and public events that take place throughout the host city. The symposium sometimes takes place in multiple cities within the 4-10 day-long event. Being nomadic has enabled the symposium series to incorporate local and regional culture and themes.

List of ISEA Symposia

- 1988 Utrecht, The Netherlands
- 1990 Groningen, The Netherlands
- 1992 Sydney, Australia
- 1993 Minneapolis, United States
- 1994 Helsinki, Finland
- 1995 Montreal, Canada
- 1996 Rotterdam, The Netherlands
- 1997 Chicago, United States
- 1998 Liverpool/Manchester, United Kingdom
- 2000 Paris, France
- 2002 Nagoya, Japan
- 2004 Helsinki/Tallinn/Baltic Sea, Finland/Estonia
- 2006 San Jose, United States
- 2008 Singapore
- 2009 Belfast, Northern Ireland
- 2010 Dortmund/Essen/Duisburg, Germany
- 2011 Istanbul, Turkey
- 2012 Albuquerque/Santa Fe/Taos, United States
- 2013 Sydney, Australia
- 2014 Dubai/Abu Dhabi/Sharjah, UAE
- 2015 Vancouver, Canada
- 2016 Hong Kong
- 2017 Manizales, Colombia

Future

ISEA International is working on future initiatives to improve communication with constituents, ease the migration of symposium content into the archives, and address integration of current technologies and social media trends into the organisation and future symposia. The board has been working on a new concept called "ISEA Central" which will manage data flow and provide innovative options for symposium hosts. Finally, ISEA2016 will be held in Asia for the first time in 14 years and ISEA2017 will be hosted in South America for the very first time. ISEA2017 will be bilingual with translations in both English and Spanish.

Kadenze: An Interactive MOOC Platform for Arts & Technology

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Name of Institution

Kadenze, Inc. ("Kadenze")

Description of Institution

Kadenze is a new interactive Massive Open Online Course (MOOC) platform that brings together educators, artists, and engineers to provide an online education that is unparalleled in the field of arts and technology. [1]

Mission

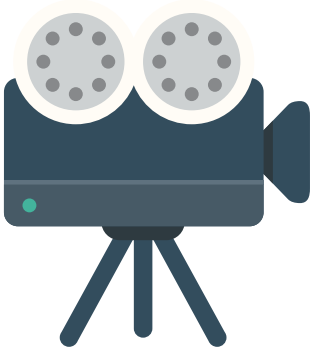
Our mission is to build a global coalition of universities and institutions that is dedicated to providing world-class education in the arts and creative technology, to students everywhere. We seek to empower professors from partner universities with the tools to accelerate facets of their existing pedagogy and to explore unprecedented educational opportunities.

[1] http://kadenze.com

Academic Catalog

Our catalog draws from the teachings of world-class universities and institutions, and is continuously expanding to include the latest content and advances in arts and technology. All content on the Kadenze platform is professionally produced to the highest standard, and undergoes a rigorous academic review. Each course is designed to meet university accreditation requirements.

Kadenze Members are eligible to receive college credit on select courses offered by Kadenze's leading institutional partners. Once completed, students can display their credits, completed courses, and accomplishments directly on their profile or they can choose to share them with potential employers and admissions officers.

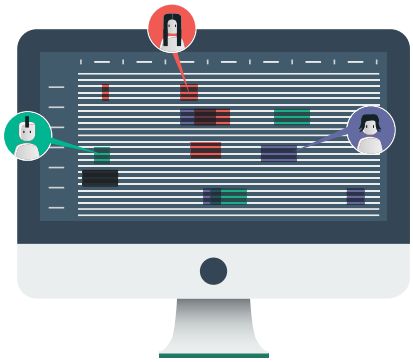


Production & Instructional Design

The Kadenze Production team works with instructors and institutions to convert in-person classes into professionally produced courses featuring video lessons and dynamic media. All infrastructure for production comes from Kadenze, so institutions and educators can avoid the complications of producing, filming, and editing, and instead can concentrate on doing what they do best. Kadenze produced courses are revisable to allow for future changes, and because courses are presented by faculty from within their own facilities, learners are connected directly to the school or institution.

Each instructor works closely with a course director and producer to control clarity and style while adhering to high academic standards. Course content is carefully formatted for efficient presentation, and lectures are enhanced through visuals, sound and animation. In addition to a director and producer, each course is assigned a writer, an editor, a designer, an animator, and a musician. These artists all work together to create content for the course at the highest level possible.

The final result is a dynamic online class presented at the highest quality on a platform which makes learning more effective, efficient, and accessible affording entirely new possibilities for education.



Interactive Classroom Experience

The Kadenze classroom provides a rich interactive experience featuring professionally produced video lectures, animations, demonstrations, and interviews. We make it easy for students to work together, to share valuable feedback, and to showcase their progress and accomplishments.

It is our goal to make arts education as accessible to students as possible, which is why we have kept it completely free for students to audit any of the courses in the Kadenze catalog. If a student wishes to become a member, they can do so for a nominal monthly fee.

Membership to Kadenze includes unlimited access to our complete catalog as well as full student privileges, such as a personal grade book, professional portfolio building tools, and the ability to ask questions and participate in forum discussions. Peer interaction and assessment is an important part of the Kadenze platform. Our *Connect* and *Course Gallery* tools help educators facilitate group collaboration and encourage a positive learning environment in which assignments are shared and feedback is given.

Conclusion

Kadenze is a dynamic online learning community full of discussion and collaboration, where students from all across the globe inspire one another to learn and grow collectively.

Currently, Kadenze is the only MOOC platform that is entirely dedicated to arts and creative technology education. We bring together artists and educators from the world's leading universities and institutions, to provide an online education that is engaging, relevant, creatively inspiring, and accessible to students everywhere.

Figure 1. The workshop participants share their performative prototypes with peers. © HKU MAPLAB 2014

Media and Performance Laboratory: Learning by doing, making by playing, sharing by performing

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Abstract

The Media and Performance Laboratory (MAPLAB) at the HKU University of the Arts Utrecht is an innovative learning and research environment, focusing on creative processes involving performativity and interactive technology. The MAPLAB projects engage art students and educators, professional artists, and various external partners in disciplines such as theater, dance, puppetry, music, and visual arts. These projects typically combine the MAPLAB core activities of education, research, and technological development, stimulating students and professional practitioners through rapid prototyping and agile development learning modes. In addition, MAPLAB trains educators to guide creative processes in technologically enhanced environments.

Keywords

Creative process, art education, interdisciplinarity, interface, mixed reality, performance, rapid prototyping.

Introduction

The Media and Performance Laboratory (MAPLAB) at the HKU University of the Arts Utrecht was founded in 2012 by Joris Weijdom as an interfacultary learning and research environment, in close collaboration with the Research Centre Performative Processes (RECPEP). During its initial years, the MAPLAB team has established methods to merge education, teacher training, professional artists' projects, and technological development trajectories. The need for platforms such as MAPLAB emerges from an educational and professional landscape in which interactive technologies are often too complex, inflexible, and expensive for use in creative stage productions and hands-on learning. MAPLAB is constructed in a modular and open-source fashion to enable the rapid prototyping and improvisational ways of working typically inherent in performative arts. Within the organization, MAPLAB is positioned as an interfacultary research environment for collaborations between HKU's different schools and research groups. It also functions as an important meeting point between arts education and research and external partners from the cultural domain and creative industries.

Rapid prototyping 'onstage'

One of the core methods employed in MAPLAB's teaching and research activities emerges from the idea of rapid prototyping. This means that training or workshop participants, divided into small interdisciplinary groups, explore the artistic possibilities of the technological tools by creating interactive 'sketches.' These sketches are subsequently presented to peers either through a brief group performance or by inviting a peer to navigate the sketch in a performative user-testing situation (Figure 1). This is followed by a short feedback session with the whole group, reflecting on the elements of the given mixed reality space, the temporal aspect of the experience, and the design of its interactivity. The feedback session focuses on the dramaturgy of the participant or audience experience, rather than on details of its technological solution. The iterative process of creating a new sketch and then sharing and evaluating it is often

compressed into a very short timeframe: two complete cycles are typically realized in four hours. Through this 'pressure cooker' type of learning, participants are encouraged to not overthink their concepts beforehand, playfully explore possibilities, allow mistakes to be part of the process, and dare to share and evaluate a 'work in progress.'

Research trajectories

In the context of longer research projects, with either students or professional artists, similar onstage improvisations and sketching are performed at selected moments of the process, stretching over a period of time. Such a research trajectory begins with the design and preparation of the modular lab environment to support the given research question and aims. Analogue and digital 'raw materials,' such as physical décor, video clips, and various interfaces, are also prepared and embedded in the space. The following phase is typically a four-day lab session, wherein the prepared materials and setups are explored to create an initial prototype of the performance or installation. On the final day of the lab session, the prototype and its progress are demonstrated to a live audience. Additionally, a wide range of media is used to document and reflect upon the findings during such a process. This three-step cycle may be iterated several times within a longer research project, whereby the first iteration is more explorative and follow-ups become more focused on testing and refining a given performance, interactive installation, or mixed reality experience.

Bringing students and professionals together

The MAPLAB training and research activities are divided equally between educational programs within the HKU and collaboration with external professional partners. Outcomes of all these projects flow back into the educational activities in the form of inspirational practice cases, new technological tools, and know-how of practice-based research strategies. Conversely, students participate in professional research activities as trainees supporting the preparation and execution of the lab sessions, and conducting their own associated research projects through an excellent junior researcher program. Finally, MAPLAB provides several trajectories for teachers to develop their expertise in the context of using interactive mixed-reality technology in both their teaching and their own professional practice.

Team and facilities

MAPLAB is an integrated concept involving people, resources, and methodology. The professional functions within the MAPLAB team manifest in three distinct aspects: management and public relations, research and development (R&D) of the facility and tools, and research coaching and lab assistance to support education, research, and training. The management team consists of the head of MAPLAB, a coordinator, and a lab manager. The R&D team, largely consisting of freelance specialists, research existing technological innovations and develop an infrastructure in which these tools can be dynamically connected. The coaches and lab assistants include senior teachers who lead the training and research activities, and junior assistants, often art school alumni, who help to facilitate these activities while being trained to become coaches themselves.

MAPLAB has two main lab spaces: a large theatre studio for full-scale setups and a small studio for brainstorming, preparation, and small-scale experiments. The infrastructure of both the lab spaces and technical tools are designed to be modular, user-friendly, and immediate. The modularity of the spaces means that their functions vary to accommodate a broad range of uses, and dedicated setups can be built in a relatively short time span. The technical tools are designed to be used by creative people without programming skills, and can be dynamically connected to each other with relative ease. MAPLAB implements both high- and low-technology, enabling research possibilities on a professional level while maintaining student and artist access to low-cost equipment for use in their own practice.

More information: http://www.maplab.nl

Authors' biographies

Joris Weijdom is the founder and director of MAPLAB. Joris' background is 3D computer animation, and he obtained his MA in Interactive Multimedia from the HKU University of the Arts Utrecht in 1998. Joris is deeply involved with education and curriculum development; he is a core team member, senior lecturer and advisor of individual student projects in the bachelor program Interactive Performance Design since 1999. Between 2008 and 2012, Joris led the research group Virtual Theatre of HKU, within which he initiated and supervised a number of research projects exploring the mix of real and virtual spaces in the context of performing arts. Joris is currently the leader of the research group Performativity and Media in the HKU Research Centre Performative Processes (RECPEP).

Kaisu Koski graduated from the Faculty of Art and Design at the University of Lapland and the Amsterdam School of the Arts, where she studied media and performance arts. In 2007, Kaisu earned her doctoral degree by defending her dissertation on interactive performances at the University of Lapland. Her art practice is intertwined with academic research, focusing on the dialogue between art and medicine and the methodology of arts-based research. Kaisu is currently affiliated as a research fellow with the HKU Research Center Performative Processes (RECPEP).

Repurposing Urban Space: Arts as the Catalyst for Change

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Abstract

Parks throughout the City of Vancouver, British Columbia, have "field-houses" where on-site caretakers formerly resided and over time, have become vacated. Having a surplus of these unused facilities, the Vancouver Park Board explored options to re-purpose these spaces. As part of the Cultural Plan, the City and Park Board sought to provide artists free space, in exchange for 350 hours of their time engaging the community and having opportunities to develop artistic practices.

The Field House Studio Program places artists with community-engaged and social practices into neighbourhoods to create work *in and with* community. The program brings the arts as an integral part of everyday life, into Vancouver neighbourhoods. It creates space to invite community, colleagues and curious visitors to share in intimate creative processes with artists through daily, shared arts experiences that are social, cooperative and collaborative.

This paper seeks to demonstrate the importance of building arts communities, while emphasising its importance in emerging multi-disciplinary discourse related to urban futures.

Keywords

Vancouver Park Board, Artist Field House Studio Residency, community-engaged art, urban space.

Introduction

Even today the realm of public space in the City has been considered to be the "physical connection that binds it together," because "parks and open spaces do not only adapt to forces of change, but also have the power to guide, shape, and curate the evolution of cities as the most effective catalysts for urban transformation" [1]. Engaged public art in urban spaces is one such example of a catalyst and a means of building social constructs since it involves "shaping the space or providing a powerful backdrop" thereby creating space as subtle, elusive, and capable of sustaining return visits to discover more about them [2].

Since public space "is always in the process of being made [3], the "recycling" of space is "not an incidental process, but rather, a deliberate and creative act. In regard to the efficacy of such programs and the importance of such partnerships, there are mutually beneficial relationships, in that, a non-profit or arts group can gain "legitimacy and clout by aligning forces with a government agency, while an over-stretched municipality is revitalized by the influx of energy from a public-minded private sector," especially since "in an age when vision is unlimited but funds are tight, such public-private partnerships may be among the most feasible ways to commission, maintain and restore works of public art" [4].

Recycling Space

The unused field houses scattered throughout the City of Vancouver, have been repurposed for the artist studio program. By creating these art zones, the implementation of an affective model of emphasizing the building of a community of shared identities and interests emerges. We are reminded of Joseph Beuys' influences of "social sculpture" and by borrowing the words of urban planning to bring further insight of the importance that 'livability', along side 'identity and control'; access to opportunity, imagination, and joys; authenticity and meaning; open communities and public life; including 'self-reliance and justice' are goals for future urban environments [5].

The Process

Several hundred artists and artists groups were interested in the residency program and undertook an extensive application and review process. Twenty-seven personnel, including arts programmers, supervisors, board members of community centres and professional artists, reviewed each application and then short-listed several artists for in-person interview presentations. From that short list the finalists were awarded residencies that run from eighteen months to three years to carry out their proposed projects. Such projects ranged from dance, music, theatre, visual arts, digital arts, sound, film and interdisciplinary projects.

The Vancouver Park Boards, Arts, Culture and Environment (ACE) team, which manages the Field House Studio Program, considers art as a social process, and sought to construct imaginative spaces of cultural diversity. ACE sees artists as collaborators with community members-who may not see themselves as artists. In working together as

creators, producers, performers, the artists and their projects activate audiences. Through a creative process consisting of workshops, discussion groups, open houses, events and exhibitions, they make and present artwork exploring issues and concerns that respond to the community. The work promotes diversity, innovation and collaboration. Because community art projects are often interdisciplinary and ephemeral they don't necessarily fit easily into traditional gallery or theatre settings, and access to community, recreation and park spaces is essential. At the end of the day, ACE is redefining and converging old models of public art with new models, which seek to be inclusive of community and the non-artist's sense of creative expression.

The Vancouver Board of Parks and Recreation, confirms its mandate in recognizing that the arts are an essential element in a vital, creative and balanced city and seeks to actively facilitate participation in and access to the arts for all. The Park Board holds a vision of a city where the arts are an integral part of everyday life; where community cultural development processes strengthen civil society, where parks and community centres reflect the cultural vitality of the community and where people are able to learn and express creativity in ways that build healthy communities. By widening the multi-disciplinary urban discourse of community centered planning, by infusing art in "everyday," the Artists in Field House Studio program advances Park Boards art policy that considers public space in terms of urban futures. [6] [7].

The Artists and Studios

Over 50 artists have participated in the program since the 2011 pilot program created work in parks. The program in 2015 has seen an increase in the release of nine more field houses. http://vancouver.ca/parks-recreation-culture/field-house-studio-residencies-in-parks.aspx. Limited space dictates we name only a few herein:

Aberthau/West Point Grey artists 2013-2016, is a group of multi-disciplinary artists, LocoMotoArt, which developed unique indoor and outdoor arts experiences, interactive video and sound installations, real-time computer graphics displays and live soundscape performances at various parks throughout Vancouver. During the residency one event worth noting is *Oscillations*, produced in partnership with ISEA – Vancouver, and the Vancouver Park Board. In response to the awareness of the oscillation between physical and electronic space and place, Giorgio Magnanensi (Vancouver New Music) and Laura Lee Coles (Founder LocoMotoArt) curated twenty-two electronic artists to install works in Charleson Park, which is situated along the waterfront of False Creek.

The Charleson location was once the site of a thriving salmon stream harvested by local First Nation tribes. At the turn of the 20th century, the forest was felled by the logging industry and False Creek became a bastion of logging mills and industrial warehouses. The park was rebuilt and now serves in part as an off-lease dog park during the day and has several ponds, a waterfall, and a meandering stream. In his curatorial statement, Magnanensi stated that, "With this project we wish to invite affective responses while confronting the complex considerations of our predicament in the disruption between *nature* and *place*. We also wish to ignite imagination and stir emotions, while acknowledging the limitations of what is possible as art." With this approach, the works assembled emphasized the electronic and physical space and place by oscillating between the two perceived realms. *Oscillations* pushed traditional boundaries of urban public art to be more socially interactive, immersive, and inclusive of place. For more information, please refer to the following website: http://locomotoart.weebly.com/oscillations.html.

Elm Park Field House artist 2012 to 2015: Germaine Koh, visual artist, used the field house both as a studio and as the home base for the community-based project League. League was a weekly gathering of people who came together to play sports and games that they invented together. It is problem-solving as play. http://league-league.org

Falaise Park Field House artist from 2012 to 2015 was Mark Haney, composer / double bassist. Mark used the field house for daily practice and a rehearsal studio for various projects including regular open-studio hours to encourage and invite the public in to the creative processes of both performing and creating. The community surrounding the field house had been built after WWII for returning veterans. Haney developed a composition for Remembrance Day titled "11" that grew out of the veteran's individual stories. Each story was played by a different brass instrument. Twenty-five hundred people were observed streaming from the neighbourhood to enjoy Hayne's concert.

One individual stood out in this community process as Haney notes, "Edmond Champoux was our only living veteran, 99 years old at the time now 100. We visited him several times at the George Derby Centre, where he lives to learn about his life and experiences in WW2. Seeing how proud he was to attend our event was the highlight of the day, especially since Edmond's son Perry told us that Edmond usually would not attend any kind of Remembrance Day activity and until the last decade never spoke of the war at all. The biggest effect it had on me was to make me really see that with community engaged art the best you can hope for is to really touch someone in a way that is very important to them, but with it comes a big responsibility to treat them and the subject matter with absolute respect." For more information please refer to https://markhaneyblog.wordpress.com.

MacLean Park Field House artists from 2012 to 2015 were the Urban Weavers (Sharon Kallis, eco-based com-

munity artist, author and weaver and Todd DeVries, Haida cedar weaver). These local artist-weavers together with an ecologist explored the creative repurposing of green waste. In the Urban Weaver Project, invasive species are substituted for traditional weaving materials that are difficult to harvest sustainably in the city. Kallis describes her arts practice approach as one leading to the discovery of the inherent material potential in a local landscape. There are several parallel areas in her arts practice; indoor-studio based, outdoor-site specific response as well as in a community engaged installation practice that responds to seasonal shifts and change.

In her community outdoor work, Kallis states that the "creative process begins with a harvest principal that embraces communal stewardship of the land; weeding, invasive species removal, coppicing, gleaning and gathering. Oral traditions of knowledge sharing occur; my own experience with plants and their uses are exchanged with those familiar to a place through close investigation of the surroundings, walking, sharing stories about the landscape and observed shifts in eco-systems. Further she notes that, "Installation ideas spring forth through conversation, idea sharing, identifying what materials are suitable for harvest and the consideration of the inherent physical properties of both place and material used." Please refer to: http://sharonkallis.com.

Conclusion

The definition of community-engaged art is rapidly shifting towards the inclusion of non-artists in professional artistic works. Professional artists and arts organizations are finding it difficult to afford studios, creative and production spaces in urban spaces. They are also faced with a shortage of space inventory due to development so they are seeking immediate alternatives to sustain their art practices. In doing so, these artists include collaborations with the non-arts community to augment their growing arts practices, and develop specially valued creative and collaborative relationships that emerge overtime, fostering the urban environment.

Sociologist and author Sacha Kagan reminds us that local "community art" initiatives, are pointing at a shift towards a culture where the creatives take responsibility and work together with the social and ecological communities in which they are embedded. Out of this an aesthetic "sensibility of patterns that connect" and an "artistic rationality" (Dielman 2010) become qualities shared with communities and not the exclusive domain of a creative social class, sector or system." [8]. More telling for artists is that several funding entities have dedicated specific grant support for this changing genre, defining "community engaged arts," as a form of cultural mediation. A report by Canada Council for the Arts, notes that in other countries the definition of community engaged art varies, "English Canada, the United States, United Kingdom and other English-speaking countries, the terminology is generally focused around the idea of arts participation or audience engagement, while in Quebec and France, there is a greater usage of terms such as democratization of culture, cultural citizenship and cultural mediation. Other European countries use a mix of both. Most use these terms to illustrate a commonly desired end result of many publicly funded interventions in the arts: a public engaged with the arts. [9]

Grant funders, city programmers and planners are tasked with exploring new options that will transform, support and expand cultural experiences for both artists and audiences. It becomes apparent that collaboration between artists, cities and citizens is necessary. As "tactical urbanism", and as authors Lyndon and Garcia claim, "[I]t makes use of open and iterative development processes, the efficient use of resources, and the creative potential unleashed by social interaction." They further comment that "For citizens, it allows the immediate reclamation, redesign, or reprogramming of public space." But most importantly, it "Reaffirms and invites a new conversation" cities and citizens together explore long-term transformation but also adjust as conditions inevitably change. [10]

The Vancouver Park Board Fieldhouse studio program is one such innovative effort that emerged because disparate factors came about at the same time that there was an awareness that a solution was possible through the recycling or repurposing of the former caretaker field house system. The inventory of field houses for creative purposes will be increasingly taking into consideration environmental, recreational, First Nations and scientific communities. There are currently nine new field houses under development for release in the near future.

Acknowledgement

We thank all of the artists and the Vancouver Park Boards Arts, Culture and Environment staff team, grantors and in-kind supporters, who without their support, this program would not have been possible. We also thank the local politicians and elected officials of the Vancouver Park Board for acknowledging the importance of this program.

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Authors Biographies

Ms. jil p. weaving is the Vancouver Park Board Coordinator for Arts Culture and the Engagement. She has a Bachelor of Arts and an Interdisciplinary Master's in the Humanities. She also was a member of the BC Arts Council Community Arts Advisory Committee during the creation of the provincial 'Arts Based Community Development Funding Program.' She has developed and managed numerous programs and projects for the Vancouver Park Board including the "Art, Health and Seniors Project" in conjunction with researchers at UBC and Vancouver Coastal Health Authority; and the Stanley Park Environmental Art Project in collaboration with the Stanley Park Ecology Society and the Community Arts Council of Vancouver.

Ms. Laura Lee Coles is an arts-based researcher and publish author with interests in human, technology, nature interaction and the re-visioning of urban space. Her arts practice involves photography, site-specific interactive and contemplative video installations, (Exhibition style and *in situ)* and nature collages. She is the founder of LocoMotoArt. Laura Lee has a Master of Arts from Simon Fraser University School of Interactive Arts and Technology (SIAT).

School of Media Studies, The New School

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Abstract

The School of Media Studies links media theory, creative production, and management practices to provide students a scaffolding for understanding the social, cultural, and economic impact of emergent media technologies, the expressive capabilities of media forms, and the nuances of diverse global media cultures. The Media Studies program offers innovative graduate studies that educate people for existing and emerging creative, academic, and business careers. It offers an MA in Media Studies, an MS in Media Management, a BA/BS in Media Studies, as well as a Graduate Certificate in Media Management, a Graduate Certificate in Documentary Media Studies, and Continuing Education Certificates in Film Production and Screenwriting.

Keywords

Digital Cinema Production, Documentary Studies, Transmedia and Digital Storytelling, Media Management, Media Analytics, Sound Studies, Participatory Media and Learning, Public Interactives, Transnational Studies.

Setting up for recording in the Media Studies Loft.

Introduction

The School of Media Studies links media theory, creative production, and management practices to provide students a scaffolding for understanding the social, cultural, and economic impact of emergent media technologies, the expressive capabilities of media forms, and the nuances of diverse global media cultures.

The school's vision rests on the foundational principle that experience matters. Experienced faculty combines both media theory and practices to offer students unrivaled expertise and professional guidance. The experiences of students in and outside of the formal classroom manifest a range of learning opportunities for understanding and expressing the human experience of media, in its various forms, diverse cultures, and different social contexts.

The School of Media Studies seeks to inspire, educate, and engage creative media makers, media managers, and students of media cultures to become leaders across disciplines, visionary media artists, bold industry innovators, and socially responsive global citizens.

The New School History

The New School was founded in New York City nearly a century ago by a small group of prominent American intellectuals and educators, among them Charles Beard, John Dewey, James Harvey Robinson, and Thorstein Veblen. Frustrated by the intellectual timidity of traditional colleges, they envisioned a new kind of academic institution where faculty and students would be free to address honestly and directly the problems facing societies in the 20th century. In 1919, they created a school of advanced adult education to bring creative scholars together with citizens interested in improving their understanding of the key issues of the day through active questioning, debate, and discussion. The founders named their new school The New School for Social Research.

Some of the outstanding individuals of the 20th century developed pioneering courses at The New School. In 1948, W.E.B. DuBois taught the first course in African-American history and culture ever taught at a university. Around the same time, Margaret Mead taught courses in anthropology and Karen Horney and Erich Fromm introduced their new approaches to psychoanalysis. The New School also became known internationally for courses in the creative arts taught by some of the 20th century's most innovative artists. Among them were Martha Graham, Frank Lloyd Wright, Aaron Copland, and W.H. Auden. John Cage was involved with academic courses at The New School for Social Research between 1950 and 1960. The New School was the first American university to teach the history of film and one of the first to offer college-level courses in photography and jazz.

Media Studies History

The social impact of mass communication has been studied at The New School since its founding in 1919. The first college course to investigate the motion picture was offered at The New School in 1926. Marshall McLuhan's

colleague, John Culkin, brought his Center for Understanding Media to The New School in 1975; that year, The New School began offering the Masters' of Arts degree in media studies. This was one of the first graduate programs of its kind in the United States.

Today, the graduate, undergraduate, and continuing education programs of the School of Media Studies thoughtfully and creatively balance theory and practice. Students are critically engaged with contemporary media scholarship as well as with the latest tools of media production. Our media management students study the changing structure and practices of the creative industries. This foundation enables them to engage in critical research and scholarship, creative production, and the formation of new business opportunities. Their creative projects range from documentary films, to websites and online media experiences, to installations and multimedia projects. Our programs prepare students to participate in many careers and to shape the future of our media landscape and the work of the creative industries.

Media Studies Programs

The Media Studies program offers innovative graduate studies that educate people for existing and emerging creative, academic, and business careers. The school also offers an extensive undergraduate curriculum open to degree students in all divisions of the university and to noncredit and general credit continuing education students.

Media Studies offers the following programs:

- Master of Arts in Media Studies: This dynamic graduate program applies social theory and research, art and technology, and business education to the investigation of social communication and emergent media forms.
  Areas of Study:
  Digital Cinema Production
  Documentary Studies
  Media Management
  Media Analytics
  Media Archaeology
  Media History, Criticism, Philosophy
  Participatory Media and Learning
  Public Interactives
  Sound Studies
  Transmedia and Digital Storytelling
- Master of Science in Media Management: This graduate program is designed for individuals pursuing management careers and media professionals seeking advancement. The curriculum brings together media business practices and critical analysis of communication industries and their practices.
- Graduate Certificate in Media Management: This is a condensed business education program for people working or planning to work on the management side of the communication industries, in areas including production management, technology development, marketing, consulting, and entrepreneurship.
- Graduate Certificate in Documentary Media Studies: An intensive professional education program for prospective documentarians. Each student develops, shoots, directs, and edits an original short documentary movie on a New York City-related subject. Production work is informed by courses on the history and theory of documentary filmmaking.
- BA/BS in Media Studies: Undergraduate courses in media and film for students enrolled in our Bachelor's Program for Adults and Transfer Students. Students gain conceptual, technical, and practical skills in media analysis, production, and management. In the Media Studies program, students learn to think critically about the creation, distribution, and reception of historic and emergent media forms in a global context.
- Continuing Education Certificate in Film Production: This program guides the student through the contemporary art and craft of film production, using traditional 16mm film and digital technologies.
- Continuing Education Certificate in Screenwriting: Students are guided through the entire process of writing a script for a full-length motion picture.

Students in *Experimental Narratives* working with the software of Hirshon Artist in Residence Toni Dove (Spring 2015).

School of Media Studies Projects

RED Dog Productions

RED Dog Productions is a creative agency, launched in 2013, as a platform for generating original content at The New School. RED Dog provides a wide scope of turnkey video solutions, bolstered by the School of Media Studies cutting edge style and supported by the industry professionals that embody our faculty. Our company is staffed almost entirely by New School students, many of whom come from diverse media backgrounds.

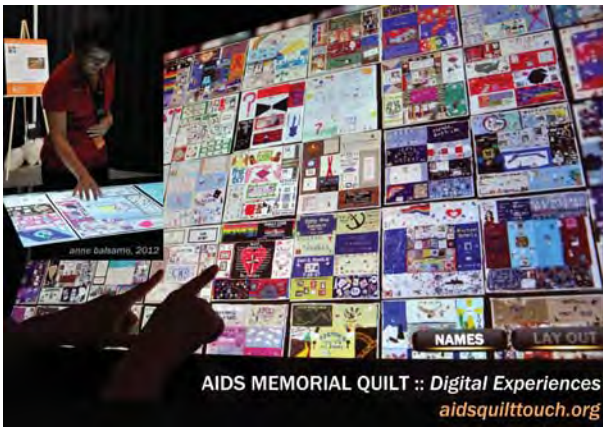
Engage Media Lab

Engage Media Lab promotes civic engagement through participatory media projects. empowering the voices of youth and marginalized communities in New York City. Projects inspire critical inquiry into the socio-political issues of the city and cultivate engaged media practitioners.

Public Interactives

Public Interactives is a research-design project led by Dr. Anne Balsamo. The term *Public Interactives* names the broad category of mediated experiences that are now on offer in communal and public spaces. Public Interactives are technological devices that serve as the stage for digitally mediated conversations with audiences members in communal spaces such as museums, theme parks, tradeshows, outdoor entertainment plazas, and urban streets.

- *The AIDS Quilt Touch Digital Experience* – funded by grants from the National Endowment for the Humanities, Microsoft Research, and The New School. The team recently presented the project at SIGGRAPH 2015 in Los Angeles.
- Development of an *Online Gallery of Public Interactives.*
- Prototyping *Experimental Embodied Interfaces*.
- Exploring *Interactivity in the Wild*.



School of Media Studies Signature Events

- Creatively Speaking
  Over the past 18 years, *Creatively Speaking* has become known as the leading film series for presenting independently produced media that conveys a realistic, universal portrayal of people of color.
- DocTalks
  Doc Talks is a biweekly series with contemporary film and video makers, festival programmers and new media distributors, editors, composers, and sound designers.
- Fine Cuts
  Fine Cuts is curated screening series of short film and video works produced by Media Studies students as part of their coursework.
- Kinoscope
  Kinoscope's mission is to enhance the awareness and understanding of the film and filmmaking process by screening a wide variety of national and international films.
- Ruff Cuts
  RUFF CUTS is a monthly opportunity for students to exhibit and discuss their media works in progress. Students receive constructive feedback from faculty and peers on their film, video and audio works in progress.
- Truth Be Told Documentary Festival
  This annual three-night event offers public screenings of short films made by students in the School of Media Studies' graduate certificate program in Documentary Media Studies.
- Voice Over
  Media Studies' annual script reading event where excerpts of screenplays written by students' completing the Screenwriting Certificate are read before an audience of students, peers and invited film industry professionals.
- Emerging Media, Leading Industries
  Discussion series sponsored in the Media Management program in collaboration with the Center for Communication and The Producer's Guild of America.
- Mixed Messages
  Mixed Messages is an annual exhibition of outstanding creative work by graduate students in the School of Media Studies.
- Dorothy H. Hirshon Artist / Director in Residence
  Established in 2001 through a bequest from Dorothy Hirshon, a trustee of The New School for 61 years, the program promotes excellence and education in the cinematic arts through screenings, lectures, and master classes with distinguished artists-in-residence.

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THE SWISS ARTISTS-IN-LABS PROGRAM

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Abstract

Since 2003, the Artistsinlabs Program has placed over 40 artists into many different science labs in the life sciences, physics, cognition, computing and engineering. In this presentation I will give an overview of this history, an outline of the methodology we had to invent and an idea of how to facilitate this exchange for other people who might be interested to set up similar programs in their own institutions. Within this program my colleague Irène Hediger and I have facilitated international residencies for artists, exhibitions, concerts and publications, research projects and Art/Sci/Culture exchanges. The program has evolved through various stages and the funding sources have changed alongside the growth of art and science into a new discipline.

Keywords

Art, science, exchange, building bridges, new methodologies, experiential embodiment as education, evolution of the program.

Introduction

In 2003, I founded the program with René Stettler (curator) and Marille Hahne (filmmaker) and with the help of the Swiss CTI (federal commission of technology and innovation). We arranged for the hosting of 12 international artists in 9 Swiss science labs. In a second stage (2006-2013) we were jointly funded by the Zurich University for the Arts and the Swiss Ministry for Culture, SITEMAPPING. At this point Irène Hediger became the co-director. Marille Hahne continued in her role to make film documentaries of the results. (1) In 2013 we entered into stage 3, with Irene's leading concept of International Exchange Residencies and Exhibitions funded by Pro Helvetia, the Swiss Arts Council as well as research initiatives funded by the Swiss National Research Foundation. However our aims have remained educational and experiential in nature. These are:

- To give artists the opportunity to be immersed inside the culture of scientific research in order to develop their interpretations and inspire their content,
- to allow artists to have an actual "hands on" access to the solid raw materials, pertinent debates and scientific tools,
- to encourage unique potentials and allow them to attend relevant lectures and conferences held by the scientists themselves,
- to help scientists gain some insight into the world of contemporary art, aesthetic development and the semiotics of communication that is understood by artists to reach the general public,
- to encourage further collaboration between both parties including an extension of discourse and an exchange of research practices and methodologies.

New Methodologies

By stage 2 we had invented and tested a methodology, which provided the opportunities for scientists to work with the artists right from the beginning of a full 6-9 month long term. Application processes supported this methodology. Proposals were collected from artists, and these had to be specifically focused on the lab of interest. We received about 70 applications per year. We then constructed juries of both artists and scientists to select the applications. Our choices were based on content and the technical and /or social issues of transferring scientific inquiry into the public realm. In the first round of the analysis the jury assessed the quality of the proposal. These had to be well-researched concepts that considered the current state of research in the residency environment and why this particular location was an inspiration for each applicant's artistic production. We discussed the level of originality, the thematic relevance and the levels of innovation and interpretation. We were not looking for scientific visualization projects, but for filtering and interpretative abilities. We then reviewed their project plans for the residency including a prototype production schedule as well as their ability to communicate artistic ideas, processes and methodologies with others around them. In the second round for the 10 finalists, we conducted on-line interviews, followed by discussions with a second mixed jury of art organizers and scientists. In this step we compared the relevance of content in the artist's proposal to general development in me-

dia arts or other relevant fields of practices, reviewed the previous work of the artist and the potentials to expand or exhibit the results. In all steps we considered issues of gender equality, geographical location problems and levels of commitment. Our very final choices were about each artist's ability to orient, integrate, reflect and produce. These artists were treated on the same level as PhD students by the allocated science lab, with special desks or studio spaces, keys and internet addresses. We made contracts for them to have "hands on" experiential access to research processes, scientific tools and methods, conferences and discussions. Monthly wages and in some cases material costs as well as some of the scientists were paid to tutor the artists.

Results

The details of the results can be found in our two publications (2). However, in summary, the public access to science was improved due to the robust scientific knowledge embedded in the interpretative prototypes that were built by the artists. Great new projects were developed. Also the artists found it inspiring to be able to be engaged in the ethical discussions around scientific processes and discoveries. Lectures by resident artists about contemporary art were popular and well attended by the scientists. The know-how transfer between artists and scientists increased and we could compare the skills, methods and processes of art and science. New recommendations were suggested to improve the collaboration potentials. While it was easy for us to collect the advantages and enthusiasm from the artists for such a program we also assessed reactions from the scientists. The following is a few example comments collected from our publications and documents. (ibid 2)

"Working alongside an artist allowed us access to different approaches and points of view about our own research and how to bring it to the public."

"They gave us the ability to see an experiment or problem from another perspective and to think about building our own differently."

"We gained a lot of training in answering all those great "why" questions from the artists."

"The know-how transfer of science is easier than we thought to non-scientist."

"It was interesting for us to watch the interpretative process unfold-from conception to production and presentation of the art work."

"We realized that art could be a catalyst for the opening up of more discourses about the ethical and social side of our research in the future."

Current Projects

Right now we are in stage 3 of our evolution. As mentioned in the introduction, this includes international exchange residencies, exhibitions, national residencies and Swiss national research projects. More information about these projects can be found on the artistsinlabs web site: www.artistsinlabs.ch. (3) In 2010, Irène Hediger initiated a Sino-Swiss residency exchange entitled: SHANSHUI-Both Ways with 2 Chinese artists, Aniu and Liao Wenfeng and 2 Swiss Artists, Aline Villat and Alexandre Joly. This was followed by another Indo-Swiss residency exchange that took place in 2011, with one artist, Sureka Anil Kumar from Bangalore, who spent time in aquatic ecology at EAWAG and with one Swiss artist, Adrien Missika who was located in biology at NCBS, Bangalore, India. Currently there is a Russian-Swiss residency exchange taking place with Claudia Comte (Swiss artist) and Urban Fauna Lab (a Russian group) exploring ecosystems in Russian and Swiss labs. Other current projects include the national Artists-in-labs residency **(**The current one is Marc Boulos located at the Laboratory of Cognitive Neuroscience EPFL) and an AGORA SNF project entitled: *The State of the Art: Science and Art in Practice*. Also Irène recently collaborated and co-curated an exhibition with Haus Konstruktiv in Zurich on seminal exhibition about the interface between art and physics entitled: *Quantum of Disorder* (4)

Conclusion

Over 12 years we have evolved from an international project into a fully-fledged program and our investigations have led various comparisons and revelations. In the beginning we had to invent our own methodology, and this methodology continues to evolve with current discourses about art, science and society. We remain committed to the analysis of subjective and objective phenomena and we are about to publish our third book on the potentials of new knowledge that our program investigates. This book is entitled *Recomposing Art and Science*: *Artistsinlabs* with 8 accompanying documentary films.(5)

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Biography

Jill Scott is the Professor for Art and Science Research in the Institute Cultural Studies in the Arts, Zurich University of the Arts, Switzerland, founder of the Artists-in-labs program and Vice Director of the PhD program, Z-node (Planetary Collegium). She is also a media artist who works across neuroscience, social science and environmental science.