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Humanizing Technology Through Post-Digital Art

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Abstract

I draw upon the idea of the post digital to create (1) art for humanization of technology and (2) art as manifestations of digital qualities in the physical world, e.g., through digital-analog convergence, or through enriching our experiences with hybrid constellations of techniques, concepts and aesthetics.
My work consists of two parts: practice-based research in the arts and conceptualizations arising from my practice. Four art projects are presented in this thesis: *Metaphone, Delete By Haiku, S T R A T I C*, and *Panorama Time*. My post-digital approach is manifest through the hacking activities, disruptive techniques and aesthetic approaches I apply. These thrive on a set of constitutive concepts: *machine aesthetics, digital upcycling, aleatoricism* and *chance, deletion, repetition, fault aesthetics* and *glitch aesthetics*. My post-digital aesthetic principles depend on machinic, systematic behaviors in the technologies I explore. Machine aesthetics expose operational and mechanical principles and behaviors. Digital upcycling is a repurposing design process wherein function follows form to add value to old defunct objects. I deploy chance in the design process through a "rolling a dice" approach. I use both deletion and insertion repetitively as design principles. In my work, I also induce technical faults and take deliberate control of machine glitches. These are all aesthetic approaches that help transform the "cold" appearance of information technologies and bring them closer to people, thereby humanizing technology. Some of the aesthetic principles (e.g., machine aesthetics or glitch aesthetics) might not seem "natural" or "human" but I use them to explore digital materiality analogously to how steel, iron and other materials were approached from the early phases of the industrial revolution and Modernism. As such these aesthetic principles are ways of interrogating the digital thriving off a cultural-historical point of view.

Keywords: Humanization of technology, post-digital aesthetics, abstraction, materiality, immateriality, interpretative digitality, hacking, disruption, accelerationism, interactive art, interaction design, human-computer interaction.

Sammanfattning

Jag bygger på idén om det post-digitala för att skapa (1) konst för humanisering av teknik och (2) konst som manifestationer av digitala kvaliteter i den fysiska världen, t.ex. genom digital-analog konvergens eller genom att berika våra upplevelser med hybridkonstellationer av tekniker, begrepp och estetik.
Mitt arbete har två delar - praktikbaserad forskning inom konst och konceptualiseringar som uppstår genom min konstnärliga praktik. Fyra konstprojekt presenteras i denna avhandling: *Metaphone, Delete By Haiku, S T R A T I C,* och *Panorama Time*. Mitt post-digitala tillvägagångssätt består av hackningsaktiviteter, disruptiva tekniker och olika estetiska tillvägagångssätt. Dessa kan beskrivas med följande begrepp: *maskinestetik, digital ”upcycling”, ”aleatoricism”* och *chans, radering, repetition, felestetik* och *“glitch”-estetik*. Mina post-digitala estetiska principer bygger på maskinella, systematiska beteenden i tekniken jag utforskar. Maskinestetik exponerar operativa och mekaniska principer och beteenden i maskinen. Digital ”upcycling” är en återanvändande designprocess där funktion följer form för att lägga till värde till gamla objekt. Jag använder chans i designprocessen genom en “rullande tärning” -strategi. Jag använder både radering och upprepning som designprinciper. I mitt arbete inducerar jag också tekniska fel och tar medvetet kontroll över maskin-”glitches”. Dessa är alla estetiska tillvägagångssätt för att omvandla informationsteknologins “kalla” utseende och ta den närmare människor och därigenom humanisera tekniken. Några av de estetiska principerna (t.ex. maskinestetik eller “glitch”-estetik) kanske inte verkar “naturliga” eller “mänskliga” men jag använder dem för att undersöka digital materialitet analogt till hur stål, järn och andra material utforskades under industriella revolutionen och modernismen. Som sådana är dessa estetiska principer sätt att utforska det digitala genom ett kulturhistorisk perspektiv.

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Stockholm, February 2018 Vygandas 'Vegas' Šimbelis

Contents

1. INTRO-DUCTION

1. Introduction

This thesis contributes to knowledge production through practice-based artistic research within a specific context – the context in which a technology-driven world meets with the world of artistic interpretation. The work is driven by aesthetic consideration, based on my own creative engagements, not in an objective knowledge-seeking endeavor, as could have been expected from a thesis at a technical university, instead, the thesis is written in an interpretative manner. It offers perspectives rather than exhaustive accounts, and the work and knowledge gained have been driven by a realization of myself as an artist.

The field of art to which I belong can be broadly characterized as a contemporary art practice within the field of media art or new media art (Quaranta, 2013). My own art practice was confronted with and fertilized by a second increasingly important and influential field – interactive technology. By interactive technology, I mean technology that is analog and digital, and that also has an interactive capacity that changes as the technology is used (Löwgren & Stolterman, 2004).

My academic contributions form part of the interdisciplinary field of Human-Computer Interaction (HCI). ACM SIGCHI describes the field thus: "Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them" (Hewett et al., 1992). Lately, interactive art has been included in HCI as a valid path for studying possible interactions, alongside the more established paths such as interaction design and user studies. The established Art.CHI community[1] organizes interactive and digital art exhibitions, creates specific art publications and awards, and publishes its own art catalogue.

[1] The digital art community at the ACM CHI conference - http://art-chi.org

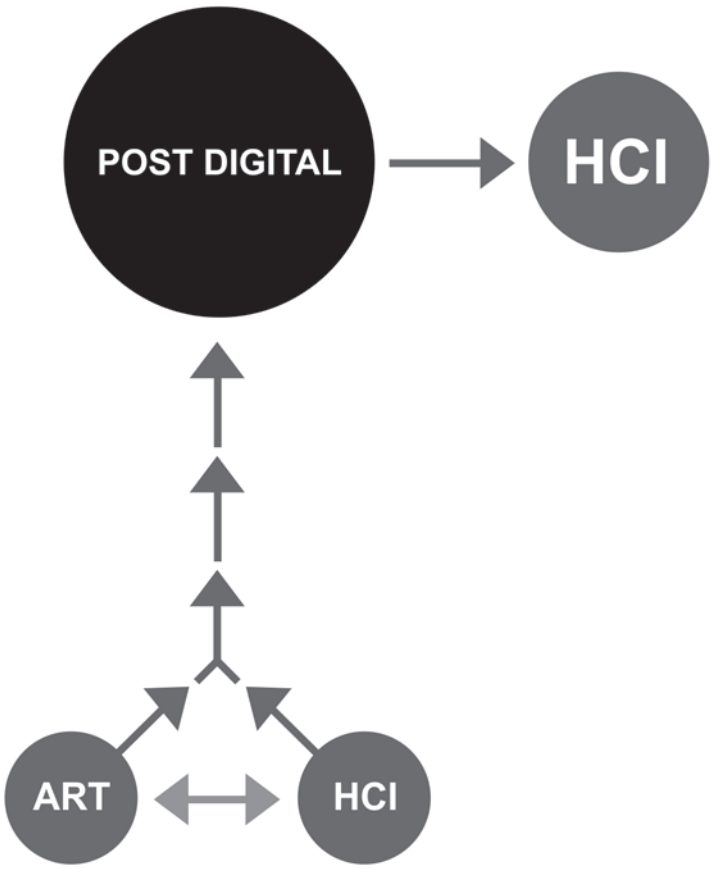

Figure 1. The scheme of the work initially conducted in the arts and HCI – with exhibitions and publications – and its further articulation through the post-digital lens in the thesis, as well as its eventual contribution to HCI with insights and articulation through the lens of the post digital.

1.1 My research journey

During the five years of my PhD studies, I engaged in four different art projects that constitute the basis of my thesis: *Metaphone, Delete By Haiku, S T R A T I C* and *Panorama Time*. The projects were shaped by several different interdisciplinary strands of work, and most importantly through concepts derived from the arts. The theoretical articulation of the contribution of the works, which were first published in the field of HCI and subsequently in this thesis, are discussed through a post-digital perspetive that aims to contribute to the field and eventually bring post-digital aesthetics (Andrews, 2002; Berry & Dieter, 2015; Contreras-Koterbay & Mirocha, 2016; Paul, 2016) to the field of HCI (Figure 1).

My studies at the KTH Royal Institute of Technology altered my comprehension of the world in general. With my art background and my relationship to media art, I was working solely from an art perspective and was creating to enhance my core understanding of the world. After I received my position at KTH, I realized that there are unexplored design and scientific approaches to seeing media and technology, and there are new fields, such as HCI, that exist in parallel and that examine the same issues I had been working with as an artist, but from a different perspective.

1.1.1 Bringing concepts from modernism to the post digital

One way of seeing the work in regard to humanization and of looking more closely at the meeting of various opposing fields in this hybrid work is by thinking of them as two worlds and trying to characterize, on a high level, how they might be perceived. In the first world, we see society as a machine-like world (Brummet, 1999) in which masculinity is the primary force, systematically dominating development through its behavior by what could be called “masculine acceleration” (Berardi, 2011). Such a world could be susceptible to disruptive practices, it could be hacked by its own means, through using its own structures and machinery. A second, opposing world would be one in which technology is used to build a humane paradigm, engaged with emotionality, bodily practices and culturally-rich experiences.

By returning to the early days of industrialism and artistic explorations of what machines would mean to our society, my art projects are rooted in the traditions of modernism (Calinescu, 1987). This return to modernism fuels my deconstruction method – I revisit modernist concepts and bring them forth deconstructively to expose our technological world. A great

Figure 2. Wittgenstein house on Kundmanngasse, in Vienna, Austria, example of modernist architecture.

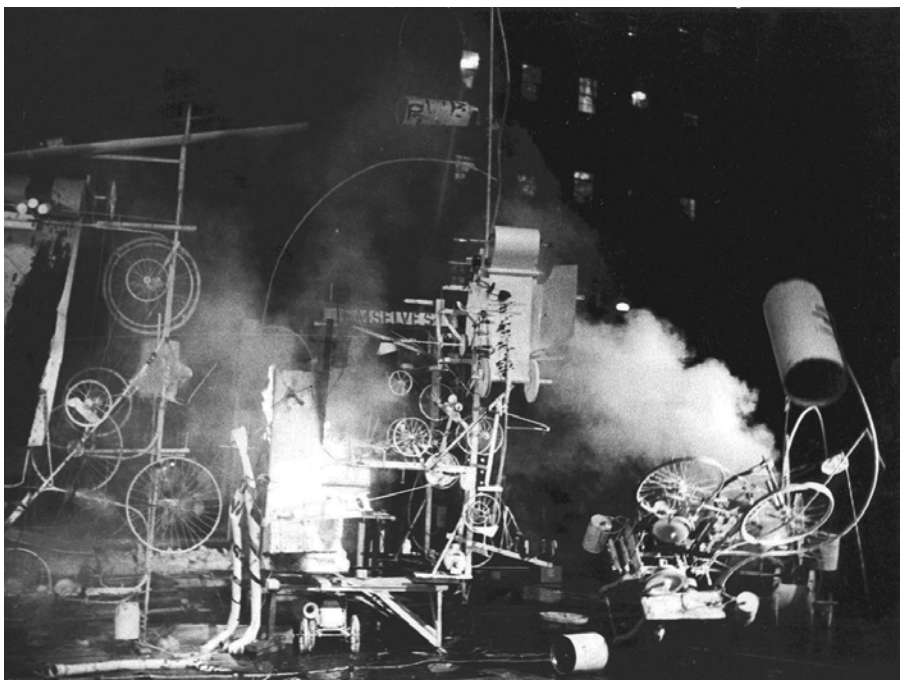

Figure 3. Homage to New York, Jean Tinguely, 1960

example of a modernist approach is the Ludwig Wittgenstein house on Kundmanngasse, in Vienna, Austria (see Figure 2). It has all the relevant parameters of modernist architecture, precise symmetry and proportions, white walls and ascetic look, and contains no decorations at all (Morgenthaler, 2016; Ray, 1990). This piece of modern architecture is an example of how rationality and functionality are exposed, both with respect to the overall house architecture and its interior design elements (like door handles designed by the philosopher). As we shall see below, modernism is an important precursor of the post-digital era (Andrews, 2002). In particular, I have been inspired by ideas such as:

- the machinic from Tinguely's (Jones, 2009) artist practice, which is a form of art involving machines and mechanisms and their exposed and brutal behaviors (see Figure 3)
- the futuristic with the sounds of noise in regard to the concepts of Luigi Rusollo (Russolo, 1986), looking for a potential in machinic behavior for conveying new forms of art, in this instance, noise music deriving from machine noise
- calculating the formal elements of the work and looking at art through the eyes of a formalist (Burnham, 1968; Kosuth, 1966; Shklovsky, 1965), which implies notions of perceiving the work of art in its formal elements such as line, color or shape
- constructing things in line with the Constructivists (Bann, 1974; Gough, 2005), with a constructive notion of the manner in which earlier art production practices based on composition were strongly criticized by those following avant-garde constructive principles

1.1.2 Meeting HCI

The work presented in this thesis has been conducted as part of an interaction design research group at a technical university. This has colored my choice of materials and possible interactions in my art projects – but also, on a deeper level, has influenced the questions I want to ask as an artist through my art projects. Art-driven research is becoming increasingly important in interaction design and HCI; art communities are being established in technology-driven conferences – for example Art.CHI – and many researchers are making use of aesthetic thinking and critical attitudes (Bardzell, 2011) towards their designs and in their research. Research that is not problem-driven (as in solutionism, Morozov, 2013) but is driven by aesthetic explorations is finding its own path. Rethinking, reimagining and reinterpreting are receiving more importance in the HCI and interaction design milieu that has otherwise been dominated by cognitive psychology and computer science. Concepts such as ambiguity (Gaver, Beaver, & Benford, 2003), defamiliarization (Bell, Blythe, & Sengers,

2005), alienation and uncomfortable interactions (Benford et al., 2012), aesthetic experience (Dewey[2], 2005; McCarthy & Wright[3], 2004) and interaction criticism (Bardzell, 2011) have been brought in from the humanities and art fields and are increasingly influencing interaction design and HCI research. The HCI field has borrowed concepts and practices from art theory, philosophy of aesthetics and critical theory in order to address the problems that are arising as interactive technologies enter every walk of life. The so-called third wave in HCI is heading for the experiential qualities and shifts from the workplace to broader and more intermixed contexts such as the home, everyday life and culture, and it "addresses the topics of multiplicity, context, boundaries, experience and participation" (Bødker, 2006, p.1).

When we place digital interactions alongside other materials and media, new opportunities to explore interactive art experiences arise. Apart from creating opportunities for exciting new art projects, it also helps us answer some important questions. The machine is given more and more intentionality and autonomy in this digital era. Self-driving cars, robots and smart adaptive services are produced based on big data (Anderson & Rainie, 2012; Taylor et al., 2015). In a sense, this development had already started with the digital revolution at the end of the last century, or even earlier with the industrial revolution. In this thesis, we have returned to one of the biggest questions asked at the time of early industrialism: if machines can act on their own, can they then start to influence our behavior or even control us?

1.1.3 Digital materials

Taking the humanization aspect of technology down to a more specific material behavior, in this instance various divisions of materials and formats might help us see the problem from a materiality and design perspective (Fernaeus & Sundström, 2012; Fernaeus & Vallgårda, 2014; Robles & Wiberg, 2010; Sundström et al., 2011; Tsaknaki & Fernaeus, 2016; Vallgårda, 2013), and we may want to dig deeper into the digital format itself. This might help us grasp how material behavior influences our understanding of technology and how a positive and constructive attitude can be developed from a humanistic perspective.

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[2] Dewey emphasizes the aesthetic experience in order to appreciate art. Aesthetic experience in his and in pragmatist aesthetic view has an emotional basis and arrives from the aesthetic quality. As discussed by Dewey, all the different elements that make up an artwork need to fuse as a whole to create an aesthetic experience.

[3] McCarthy and Wright discuss how to turn the focus away from the properties of the designed artifacts to focus on users and the qualities of their experiences, instead.

Digital materials have enabled globalization with their new sharing practices, digital production and online participation – and as a consequence our human behaviors have changed. This, of course, has also had an effect on creative practices. These digitally-enabled processes have both affected the art projects themselves (as in data-based art or generative art[4]) and also formed new art-based sharing practices (participation, collaboration, peer production, storing and deleting of information, and art production in the overall digital realm). Questions regarding seeing and thinking about our creative practices through such lenses arise. The materiality of the digital is one of those lenses, and this might be used to look and think from multiple perspectives, one of them being an aesthetic perspective, but also as an enabler of a critical perspective (Bennett, 2010; Bennet et al., 2010; Munster, 2011).

With the increased advancement of the digital the disenchantment with and the critique to the digital and its perfection started to arise. Researchers and art practitioners started to look beyond the digital and rethink it, the practice of incorporating the digital failure glitch as a resource for artistic expression became a signature of the post-digital age. Below I will expand on the aspects of the post digital that are most relevant to my work, but the humanization of digital technology as my research program, materialization of the digital and the particular approach through disrupting are key directions with which I research the topic.

1.2 Research aim

The aim of my artistic practice is to use the post-digital perspective to hack the underlying foundations of interactive technologies, combining them with analog technologies and thereby looking to humanize them. My aims can be formulated in the question:

How can concepts and techniques taken from the arts inform the humanization of technology through bridging the digital with the physical?

With the post digital, I argue that there is a role for analog technologies because these engage us in deeper ways that take culture and our whole selves into account – our movements, bodies, emotions and ways of acting – and they have also been part of our culture for a long time, so they have crafted/changed us and adapted to us and our culture and

[4] Involving participants in the processes of art and sharing the artistic processes between the machine and participant. Data-based art is art run through data, while generative art could be understood as art created through autonomous systems and the results generated by it.

Figure 4. Marcel Duchamp, Fountain, 1917.

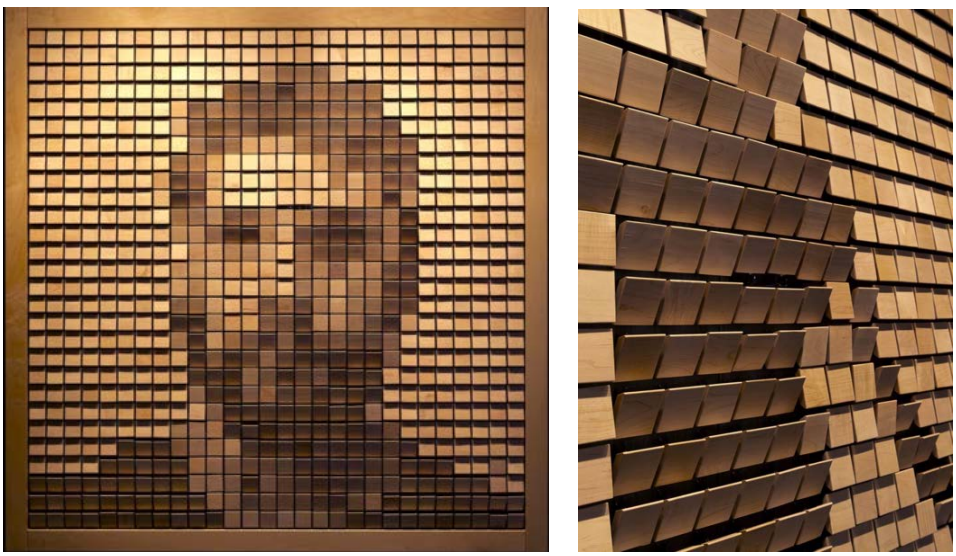

Figure 5. Daniel Rozin's Wooden Mirror, 2014.

vice versa. Digital culture, on the other hand, did not involve us as much physically. It all became "intangible" with its digital "cold appearances" or somehow too "intellectual" – with quick and fleeting interactions and shallow ways of engaging us. And this digital technology was brought into our society very quickly to the extent that our culture has not adapted yet.

But my research did not start with this research question – it grew out of my research journey, with my initial question around issues of authorship (Caughie, 2013; Gray & Derek, 2013). During the five years of working on this thesis, I undertook a journey that started by questioning who is in charge of aesthetic expression as computers start generating artworks. This in turn led me further into exploring the role of control and abstraction in interaction – a topic that has been extensively explored in interaction design and that I could relate to. When I entered HCI, a hot topic was the role of the material in the design process. Below I will briefly describe these three topics because they explain why I ended up engaging with the post digital.

1.2.1 First topic: authorship

In my studies, I started working with technology both conceptually and in practice by looking at it through the perspective of authorship in interactive settings (which is why a few of my early papers (Papers A and B) included here have articulated this topic). In short, authorship is concerned with issues of the status of an author and the author's intentions in producing the work. Collaborative aspects enter the authorial issues – one way is to collaborate with various constellations of experts, while another is to invite and involve participants in contributing to your art projects. Authorship relates to the issue of shifting the focus from the author to the viewer, that the viewer is a perceiver of an artwork and that the work is not related to the artist (Duchamp, 1957). In this regard we can look at Duchamp's Fountain and the whole notion of readymade (see Figure 4). In interactive arts, an active computer agency contributes to and plays an active role in creative processes, alongside the spectator that may also influence the art, thereby questioning who is the author. For example in Daniel Rozin's Wooden Mirror brings issues about the participant being an active part of the installation and making a substantial contribution to the work (see Figure 5).

It is also interesting to see authorship through the digital prism with its digitally-enabled processes such as peer production or digital dispersion and other digital qualities, as well as through design practices and the maker culture (Fuchsberger et al., 2016; Landwehr Sydow & Jonsson,

2015), which disrupt the traditional notion of authorship with its practice involving exposure and sharing of the know-how principles and applying the open source criteria. The openly-shared knowledge through the design direction and instructions on how to build artifacts transforms the user from a passive viewer or reader into an active participant, who is capable of building stuff and taking active positions with a hands-on approach.

The questions related to authorship were always relevant to my work, so I never abandoned it completely, but my research took other paths, and authorship started overlap with other issues.

1.2.2 Second topic: control and abstraction

In parallel with examining the topic of authorship, I looked at technology from other perspectives deriving from the arts and humanities, image theory and critical theory. In particular, the concepts of control and abstraction came to play significant roles in my work. By control (Franklin, 2015), I refer to control issues arising in interactive settings. This also relates to various notions of authorship and participation. Questioning the divisions between loose and direct control or control through playfulness informed my work.

Abstraction is concerned with relationships between the concrete and the abstract, from both a visual art perspective and a machine-learning perspective. When we enter the digital milieu, we might find that machines perceive our lives differently, that they abstract their surroundings and our behaviors in order to understand us and that they make use of such abstractions to respond to us. Such computer abstraction relates to digitalization with "converting continuos data into a numerical representation is called digitization" (Manovich, 2001, p.49). Both methods of abstraction – visual and software engineering – are combined in our interactions. With human and machine agencies and human and machine perceptions, and with our participation, various new forms of interaction and abstraction are created.

1.2.3 Third topic: dematerialization and immateriality

At the same time, as I was exploring these two topics, the academic field of HCI had started to embrace an interest in materiality (Dourish, 2017; Fuchsberger, Murer, & Tscheligi, 2013; Gaver et al., 2010), and many were arguing that HCI needed to engage more directly with the materials (Murer, et al., 2014; Odom, Banks, Kirk, et al., 2012; Solsona Belenguer et al., 2012; Sundström et al., 2011). My interest shifted to focusing on dematerialization (Lillemose, 2006). Dematerialization is a way of rejecting an object of art. This started with conceptual art and continued through

performativity (Ibrahim, 2012) and ephemeral approaches in the arts; it later entered the media art sphere, for example, with the medium of and experiments in video art (Meigh-Andrews, 2013). The notion and practices of immateriality (Ibrahim, 2012; Lillemose, 2006; Paul, 2015) arrived with the digital era. Such immateriality is, in a way, a significant aspect of the digital and of networked constructs (Lovink, 2011; Shanken, 2002; Smite, 2012) because it contains time-based behaviors, ephemeral principles and nonmaterial substances. Digital immaterial behavior might help to establish immaterial qualities, for example, through shared authorship in which many agents, both human and nonhuman, are intertwined in production processes.

At the time I found immateriality to be a troubling aspect of the digital milieu if taken to the extreme. But if immaterial digital qualities can be made to have a presence in the tangible material world, it can be used to emphasize the digital in a material form. Digital qualities are elusive, but they are of primary importance to the digital and are an important quality to bring into our physical world.

In recent years, with the advent of the digital, immateriality has become a means of highlighting the era of the post digital. From Lyottard's position, immateriality is a condition of information, and conceptual processes are turned towards the "techno-sciences" (Rajchman, 2009). The concept of immateriality is also seen from the interaction and conceptual processes by Christiane Paul (2015). However, the introduction of neomateriality expands the notion of immateriality on the data layer, through which networked digital technologies perceive our world and return the data layer to the humans: "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" (Paul, 2015). The post-digital approach of bringing the digital to a physical world is present here, too: "...neomateriality often highlights this condition by turning code and abstraction into the material framework of an object" (Paul, 2015).

In short, at KTH I met with a world of digital interactions, shifting my engagement and worldview from a very concrete material world, in which people are in control, into one of abstractions and dematerializations. In this world, control – or rather, the ways in which control and power are distributed between user and system – is a key design challenge (Participatory Design (Sanders, Brandt, & Binder, 2010; Schuler & Namioka, 1993; Spinuzzi, 2005) and similar), and this relates to the networked society with digital sharing possibilities.

1.2.4 Finding a home: focusing on post-digital qualities

Over time, working with concepts and materials, rethinking disenchantment with the divide of the digital and physical, combining issues of materiality and immateriality, questioning authorship and control in interactive settings, and inquiring abstraction from visual, philosophical and technical domains, I found an overarching theme and a home in the growing body of work in the post digital – a condition seeking the humanization of digital technologies and relating the digital to disenchantment with information systems (Alexenberg, 2011; Cramer, 2015; Lund, 2015). This allowed me to explore issues arising between art and media technology. More specifically, in my research I came to relate the post digital to the humanization of digital technology and to look for hybrid manifestations of digital qualities in the physical world, e.g. the convergence of the digital and the analog, and to explore the materialization of the digital and how it enriches our experiences with hybrid constellations of techniques, concepts and aesthetics. This understanding of the post-digital age with its conditions for our lives has enhanced my relationship with technology as a general perspective of inquiry and has informed my work.

1.3 Artistic statement

Any practice-based artistic work will be subjective and personal. As an artist, I have certain values, certain aesthetic sensibilities and certain conceptual frameworks that I use to create my art. To properly contextualize my contributions, I therefore need to provide an account of my own position because this will explain how I have arrived at the conceptual contributions of this thesis.

1.3.1 My artistic background

My personal engagement with fine arts started during my earliest days and has continued throughout my entire life. My art education has spanned from secondary school to PhD work at university level, in parallel, I have also worked as a designer as a freelancer and in industry.

Discourses around playfulness (Caillois, 1961), disappearing childhood (Postman, 1982) and early forms of interactive art took place in my early works (Not Here Not Now interactive installation, 1999). Later, the consequences of technological developments and the attendant related societal changes moved my practice to a digital means of working with digital expressions (such as smiley faces made from letters, symbols and typefaces, Non-Stop Digital Smile, 2000), surveillance and data collecting (Digital Zoom Spying, 2010), and the exploration of ecological forms of elusive

media using electromagnetic waves (Maxwell City, 2007; Oslo Sound, 2007; Media Inclusus, 2011). I questioned institutional issues; for example, in the work *Being Background* (2011) I hacked spaces of art institutions, or I hacked academic processes in art academy by documenting and appropriating the composed traditional still lifes of the professors (Academic Still Life, 2009). A critique of legal rights in relation to authorial rights was conveyed in the *Copy Right Now* (2010) film installation or the *Copier Right* (2011) interactive installation. All this work was built on the notion of how societal implications of the increasing speed of life, growing consumerism and freedom of choice relate to our lives and relate directly to technological developments.

A crucial phase in my development as an artist was when several changes in my society collided: one was the collapse of the Soviet Union and, not long afterwards, the explosion of every possible capitalist consequence imaginable – with new understandings of art and its free possibilities, with critical literature and theories becoming attainable, the opening of borders, and the arrival of the internet. This shift was somehow a transformation from the traditional understanding of modernism to postmodernism, or from handmade techniques to digital forms.

A younger generation, who were born in the age of digital tools, they cannot even imagine that there was another way of living, with wired telephony, cassette tapes, or cables. The analog does not exist for them in the same way as it exists for older generations (Cramer, 2015). For me it was different and I went through the shift from one stage to another – from the stage of traditional artistic expression to that of the digital – naturally, slowly, when the technologies were introduced. For example, by inquiring how a poster format could be transformed digitally. Being a poster artist working with traditional techniques, I progressed to using digital solutions in combination with photography, hand drawing and cut-up techniques. Later, the poster format was taken over using digital means of design, and the poster principles were adapted to the digital environment with, for example, internet banners. The digital tools took over the field, but for me it was just another supportive technique to express my design ideas in a constellation of different approaches to the digital and the analog.

From an authorship perspective, my early practice was mainly individual, but in my PhD studies, I engaged in deeper collaborations with various experts from engineering and sound production. Such an approach expanded my experience and practice with interdisciplinarity from a wider range of fields. With this, I moved to more open environments with regard to collaborations and authorial rights because I was sharing my interactive projects with many participants.

1.3.2 Personal post-digital perspective

With regard to the post-digital condition, I am particularly interested in harnessing the notion of hacking to humanize technology in its association with and in its situatedness in the real world.

The world I live in is inundated with digital technology and such an ubiquitous overload raises particular questions in regard to the technologies and the lives we live. However, the emphasis in my work is not the technologies and their development in themselves, but the contributions they provide in order to convey particular messages and how they create the possibility of asking questions they impart. By exploring the notions of how digital qualities manifest in the physical world, I try to create new ways and new situations in which such transitions might appear in our lives. Through this, I aim to evoke richer cultural experiences when my work is perceived. To achieve this, I look at how to humanize digital technology through both hacking devices and broader systems and by enriching it with particular aesthetic experiences, to question the materiality of the digital by converging the digital with the analog, and to manifest the digital in the physical world (for example, in various forms of digital fabrication). The focus is not on the perfection of the digital, but on malfunctions of digital technology that result in various forms of glitch-like behaviors (Kelly, 2009; Murphy, 2009; Shapley, 2012). Thus, it is not that I am seeking to emphasize the technological development in my work; often the opposite. By hacking new technologies and remixing them with old ones, I examine possible hybrid constellations and try to bring new perspectives to viewing the digital. The so-called hyper-digitality (Lund, 2015) or a sort of sleek, sterile, hi-tech, high-fidelity cleanness and futuristic look of digital technology is not my aim in this work, but a more critical stance towards the digital positivist-solutionist attitude in computational procedures and its quantitative methodologies.

1.3.3 My artistic process & Artist Statement

A new project is initiated when my interest is piqued by patterns or some form of systematic principles in the world. I try to find the "system" behind ordinary things and situations, which, in turn, form a particular systematic structure or act as a complex whole. I choose a system to work with based on its particular qualities and the interconnected relationships between these qualities, and, most importantly, based on the association of the system with the concept I am interested in working with – often chosen as a reflection of what is discussed in contemporary discourse, be it interaction domains or technical developments, for example. Subsequently, I try to deconstruct the systematic elements and find interesting procedures within them. Through such deconstruction, I look for concepts

that come directly from inside the systems and that are parts of those systems. I then try to reformulate these concepts and work with them to produce my works. I consider how it is possible to accelerate the connections or make small changes inside the system in order to create a new system and add new values.

In my artist statement below most importantly advocate my particular interests in real-life situations[5] and how these interests have influenced the creative process – in other words, the art practice and research through which I assert my interests and the methods regarding how I have applied various interdisciplinary principles to create my art projects.

More specifically, I engage in *hacking*[6]. The hacking approach is very important for such systematic rethinking because it helps me to deconstruct the system, in most cases from within, and to understand its systematic procedures. This hacking activity relates to two characteristics – the first is a constructive approach through which I express/embody my concepts; the second is a disruptive approach through which more critical attitudes are expressed by disrupting the system by its own means. We will repeatedly return to what it means to disrupt something from within when we describe each of the art projects in this thesis.

Both characteristics of the hacking approach (Bazzichelli, 2013; Bazzichelli & Cox, 2013) – the first arriving from the material design and residing in a constructive manner – the second from the art field with a critical attitude towards disruptive means, sees hacking as a creative activity.

In summary, five major principles characterize and govern my practice and research to:

1. Hacking – hack the system, find a conceptually-appealing system, look for systematic patterns in things, and hack them to make it possible to rethink the system or, phrased in the terminology of the post-digital perspective, the aim is to hack technology to make it more humane.
2. Disruption – with a particular direction, disruption enters the process of hacking the system, and entails precise changes in the system so that the system can continue to operate on its own and with its own means so that eventually we will see the outcome and the consequences of the changes to the system.

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[5] The terms “real” and “real situations” are used similarly in Relational Aesthetics by Bourriaud (2002), in which artists create real situations from real life in order for the audience to become engaged or as realness as described by Lund when referring to material and tangible reality.

[6] By hacking I do not mean only the programming hacking, which is the core for engineering, but also of a more broadly approach, for example, hacking the economic system or hacking the use of a device.

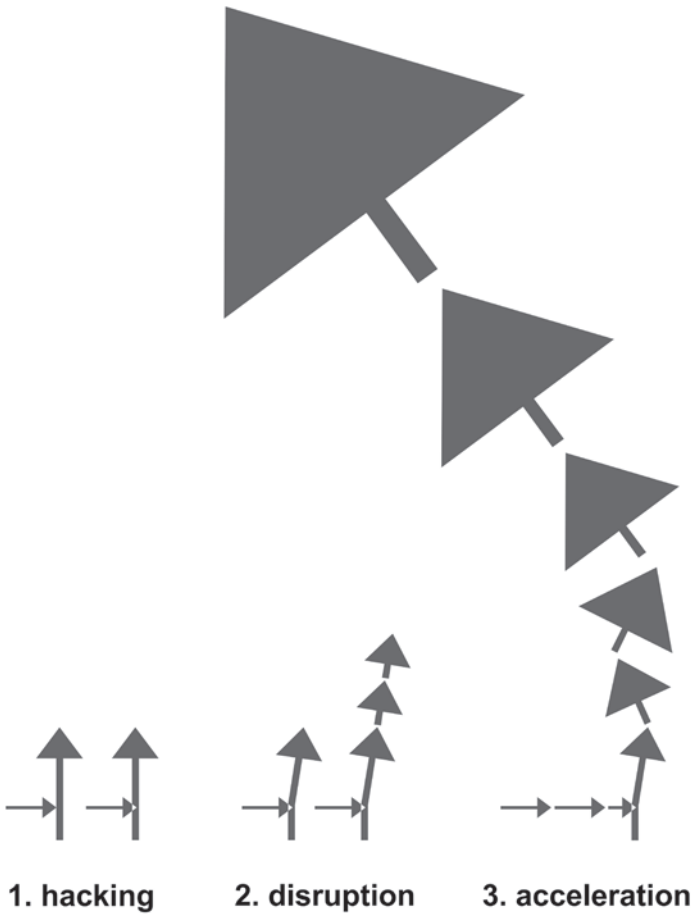

Figure 6. An illustration of three active approaches that run throughout the entire thesis and play an active role in my work – hacking as a stimulus, disruption as a breakage and acceleration as a constant growth in a particular direction. The latter two approaches are of a more complementary nature and creating by making conceptual decisions and upgrading values is also a more general characteristic of my work. While conceptual decisions imply an active stance in conceptual work, the upgrading of values might appear accidentally or without any particular intention.

3. Acceleration – one way to see the system from within is to accelerate it by its own means. If the system happens to be technical – the use of technical solutions, which arise inside of the purely technical domain, takes priority when hacking the system. This practice comes from accelerationism (Berardi, 2011; Shaviro, 2013; Wolfendale, 2014), which aims to break the system (social or political – in general, capitalism, in regard to Wolfendale (2014): "speed the system toward its inevitable doom") from the inside by escalating the inner processes in such a way that the internals of the system create a self-destructive apparatus that can by accelerating its own systematic means eventually bring about a change in the system itself.

4. Concept-driven practice[7] – accelerating within the system with its own means is a way of making a conceptual decision which, in turn, can strengthen the concept. The processuality of the system strengthens the concept through the conceptual recursion when the initial concept gets empowered by the systematic inner forces and processes of the system. The conceptual strategy applies to material considerations – the materials are conceptualized through the emerging/developed/chosen concept. If, for example, we talk about mobile text messages (SMS), we choose the same materials, context and environment in which those messages reside and flourish. In this regard, we do not use completely foreign materials that do not belong to the system, nor do we build an additional device that does not contribute to the system from its internals, nor do we project the operations on the wall as an installation because those means are foreign to the initial concept and the SMS environment.

5. Upgrade of value – throughout the whole creative process, I aim to create additional values or upgrade old ones, for example, by applying a more constructive, constitutive and additive approach when adding something positive to the system, such as adding the creative use of a certain technology. It also relates to imparting participants with the uniqueness of their experiences when aiming to engage them more deeply with the system by creating unique experiences. With such a deeper creative engagement, the participants come closer to changing their comprehension of the problem or concept and are able to rethink in terms of broader and interconnected issues.

In the Figure 6, we can see how hacking, disruption and acceleration work together, starting slowly with one, adopting another and so on.

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[7] The overarching conceptual principle covers the entire process, so it is not directly comparable to the other principles but runs throughout the entire system and the entire production process.

Those two strategies – material design and conceptual abstraction – are constantly overlapping and run in parallel, raising major and minor issues in a constant loop. Such hybridization of the meta-level with material design lies at the root of my work and this thesis. This interconnection can be seen in relation to Schön's theories (1983) – it is a reflective interaction between these components and these components do not always fit well together, but their relationship is a challenge, which raises interesting questions when rethinking situations in such a reflexive way. It brings the post-digital characteristic of hybridity to understanding technology, but also the art approach to more material considerations of the world.

Because the system is not a static element, but a live structural and systematic unit – self-developing – and with its own dynamics and time-driven processuality – it does not remain static, it always changes through its own means and develops on its own. The creative approach that I have explained through these five principles works in a reflective and iterative way in a kind of loop that starts with the first but does not finish with the last, as the last might return to the first to continue iterating. This process of iteration could be called indeterminate recursivity, when the process travels back and forth and in most cases in a loop, but with every iteration builds on the new system and transforms it. After the first iteration, the last upgrade-of-value principle returns to the first hacking principle. If we look at the upgrade of value from an experience perspective such as upcycling, we find that we upgrade experience with new values. However, looking at the same upgrade of value principle, but from a material design perspective, we might lean towards a concept and practice of repurposing, and through this material design approach we return to hacking as a material design approach.

1.4 Art projects: *Metaphone*, *Delete by Haiku*, *S T R A T I C*, and *Panorama Time*

In my work, I have created several interactive art projects[8]. The audience in these projects has sometimes been passive, watching but not actively engaging, but on other occasions they have been invited to actively interact in different roles. Sometimes the role has been as users (when my work has been closer to interaction-design practices), sometimes as participants (when my work has been closer to art-based practices), or sometimes the person interacting has been myself.

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[8] Interactive art can be defined as artistic practice that uses technology and involves participants in completing an artwork.

The machine is a general term to describe a device, which stands at the forefront of technology, be it software, hardware, electricity or mechanically driven apparatus. I concur with Broeckmann's approach to the machinic – as a productive assemblage of forces that are embedded in any type and characteristic of machine, be it mechanical, electrical or digital (Broeckmann, 1997; Broeckmann, 2005).

All of the developed projects and concepts with their relationship to the topic of the post digital will be discussed in detail in Contribution Chapter 4. But let me briefly introduce the projects here.

Metaphone. The *Metaphone* art project and machine aesthetics are further elaborated upon in Chapter 4 as well as in Paper A included in this thesis. In brief, the *Metaphone* (see Figure 7) consists of an interactive apparatus, a machine, that transforms the participant's bio-data derived from galvanic skin response (GSR) and heart rate (HR) sensors[9] (see Figure 8) into colors resulting in aquarelle paintings in a preprogrammed pattern. The bio-data are transformed into behaviors and sounds that are not at all anthropomorphic or harmonic, but instead express their own machine-like ways (Broeckmann, 1997; Broeckmann, 2005; Brummet, 1999; Reichardt, 1987; Taylor, 2009)

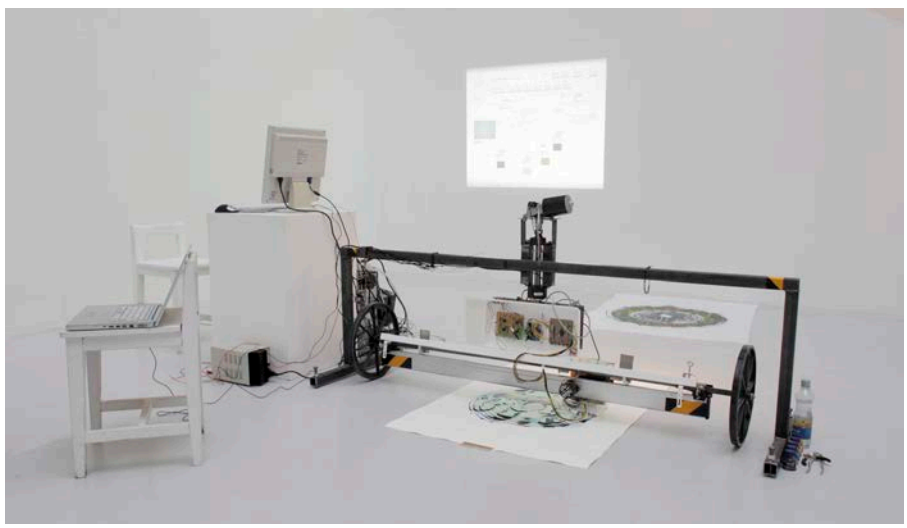


Figure 7. *Metaphone* installation.

[9] A GSR is a sensor for measuring the electrical conductivity of the skin, which varies with its moisture level. Skin conductivity is used as an indication of psychological or physiological arousal. The HR, the heart pulse sensor, measures the number of heart beats per unit of time.

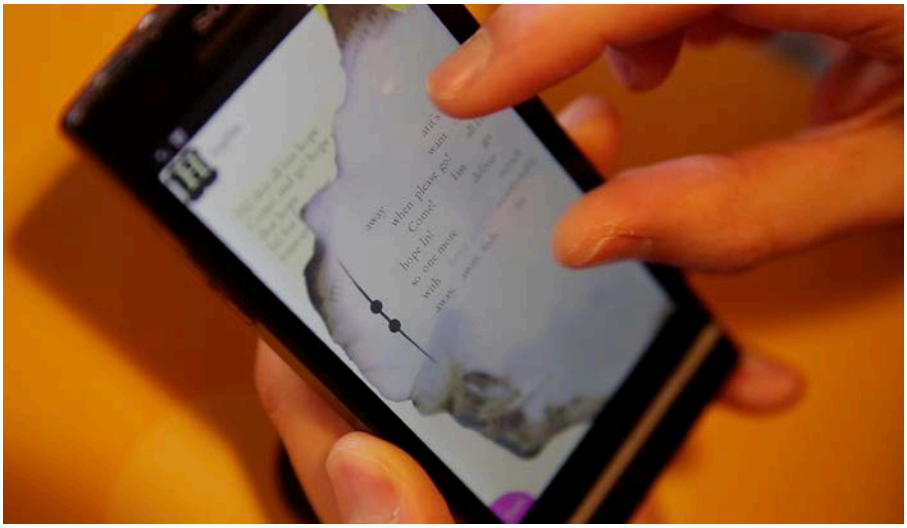


Figure 8. *Delete By Haiku* mobile application.

Figure 9. *S T R A T I C* installation and performance.

Delete by Haiku. The second project presented in this thesis, *Delete by Haiku* (see Figure 8), which is elaborated upon in Chapter 4 and in Paper B included in this thesis, focuses on the upcycling of mobile text messages, in effect deleting the old messages and transforming them into a unique haiku poem created from bits and pieces of the old messages. *Delete by Haiku* thus explores how to transform the deletion of digital waste into a more engaging and aesthetically-evocative practice.

S T R A T I C. The *S T R A T I C* project is further elaborated in Chapter 4 and in Paper C included in this thesis. The bokeh effect (circles of confusion[10]) and sampling rate[11] are explored to create synchronized audio-visual performances and bring forth aesthetic and synesthetic experiences.

The result takes the form of noisy and hypnotic soundscapes linked with an abstract animation (see Figure 9). The abstract animation is generated directly and in real time from the sound itself as the audio frequencies affect the pulsation of the RGB diode. The artist plays with several parameters affecting the light, e.g. amplitude, frequency, phase, frequency modulation and waveform.

Panorama Time. The *Panorama Time* project is discussed in detail in Chapter 4 and in Papers D and E included in this thesis, It presents a way of hacking the use of our daily devices and creating substantially new results with the panoramic photography capability of our mobile phones. Through deliberate navigation and control of the panoramic mode on the mobile phone camera, the user breaks the panoramic view (see Figure 10), and thus the project's technique presents the distinction between fault aesthetics and glitch aesthetics.

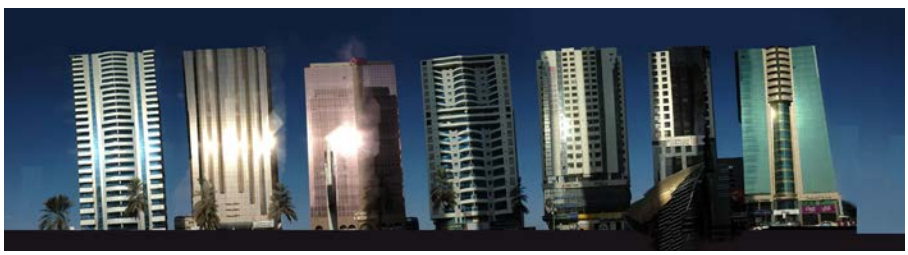


Figure 10. *Panorama Time* photograph.

[10] Bokeh is an aesthetic quality that arises in out-of-focus areas in a photograph. In extreme cases all that remains are abstract circles produced by the light spots in an image. Bokeh photographic technique and the resulting optical spot is called circle of confusion in optics.

[11] Sampling rate is the number of samples that are taken per period of time. It is a reduction of a continuous signal to a discrete sample.

1.5 Contributions: Aesthetic Conceptualizations

My take on post-digital interaction manifests in my art projects. In the *Metaphone* project the focus is on the machine-computer and its interactions, as well as control issues between the machine and human via loose interactions such as bio-sensing technologies. In *Delete by Haiku*, the mobile texting system is disrupted by reusing texts to generate poetry. In *S T R A T I C*, visual and sound generativity come together in a system that can be hacked and upgraded to elicit a synesthetic experience. In *Panorama Time*, the view and image are hacked to create liquidity or broken images through the use of hack and glitch for narrating alternative realities. Embodied in these four art projects, the ultimate particulars, in the words of Stolterman (2008), are the following techniques and concepts:

- *machine aesthetics*: exposing operational and mechanical principles and behaviors
- *digital upcycling*: a process through which defunct artifacts are repurposed to achieve a renewed and higher value
- *aleatoricism* and *chance*: a creative process incorporating and concerned with processes of chance
- *deletion*: digital deletion utilized as a resource, playfully emphasized through interaction, and adding to our understanding of digital qualities
- *repetition*: mechanically-repeated alterations of digital materials (e.g. images) and interactions
- *fault aesthetics*: approach based on accidental malfunctioning or errors to produce glitch effects
- *glitch aesthetics*: deliberate interference with technology in order to force glitches

These come out of my interest in the early machinic, also from formalism, constructivism and futurism movements, but are brought into and given a new meaning in the post digital. I will elaborate further on this in Chapter 5.

1.6 Research method

My research method will be elaborated upon in detail in the Research Methodology presented in Chapter 3, but in short, I follow research frameworks such as those presented in Research through Art and Research through Design (Frayling, 1993). This entails engaging in the production of

art projects and questioning broader appearances in the digital world, in which we build interactive artifacts and expose them to the participants.

The results from the practice-based projects make equal contributions to knowledge and research, as well as abstracted and generalized knowledge extracted from artifacts and from the practice itself. However, traditional scientific methods are not always appropriate or adequate for the field of art and design; in some cases, they stand in contrast to artistic practice and the explorative nature of design, critical stances and the humanities, and in my work they are criticized with the purpose of creating more complex and heterogeneous situations, thus opening up implications for rethinking the (digital) world.

1.7 Reading guide

This doctoral thesis was written at a Swedish technical university and the structure has been taken from the normative standards of KTH. It is a compilation thesis with a cover essay (kappa), together with five academic/scientific articles.

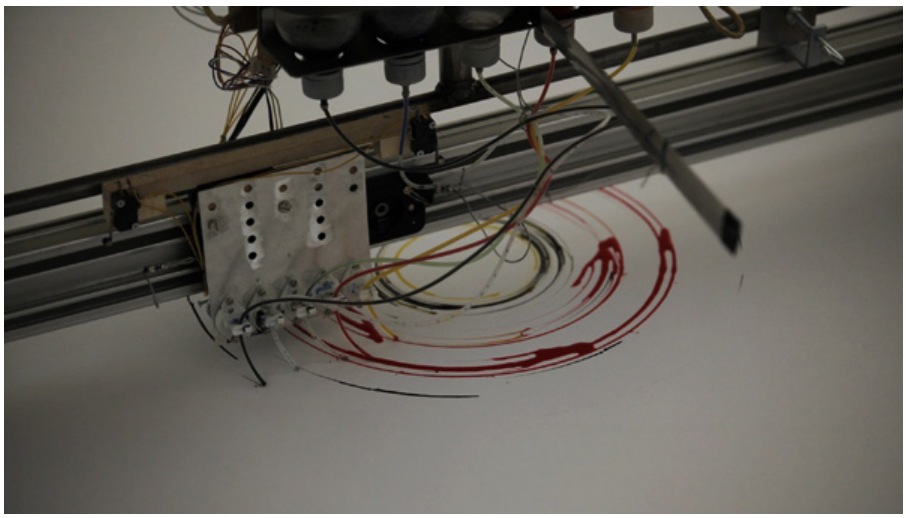
Throughout this cover essay, due to the complexity of the author adopting the role of both researcher and artist, the voice of the researcher has been expressed through the pronoun "I", which refers to my personal contribution and my more artistic intentions as an artist, while the pronoun "we" has been used to express more complex constellations of contributors in regard to the collaborative aspects of the design and publication processes.

In this period of my PhD studies the Internet of Things or Big Data were big topics discussed, and these relate to pervasive technologies such as ubiquitous computing, with which the separation of the digital and analog in the upcoming years will be harder to grasp.

1.7.1 List of papers

This research has been conducted within several research programs in close contact with researchers at the Mobile Life VINN Excellence Centre (2007–2017) and the Royal Institute of Technology (KTH).

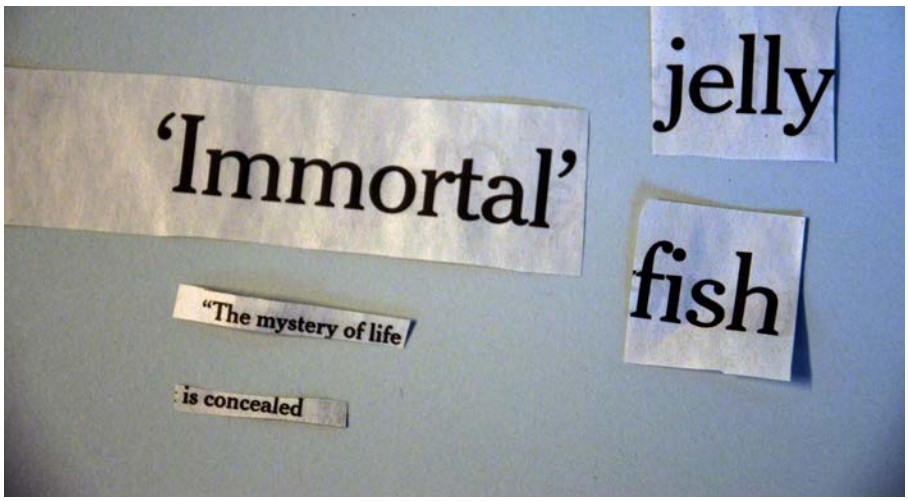
The projects I present in this work were created from my artistic perspective, and which I mainly initiated, designed and developed and also implemented in collaborations with engineers and designers. I worked closely in collaborative teams and shared the workflow in various ways. Below I express my gratitude to and define contributions by collaborating authors.



Paper A

Šimbelis, Vygandas, Lundström, Anders, Höök, Kristina, Solsona, Jordi, & Lewandowski, Vincent. (2014, April). *Metaphone: Machine Aesthetics Meets Interaction Design*. In Proceedings of the CHI 2014 SIGCHI Conference on Human Factors in Computing Systems (pp. 1–10). ACM.

I initiated, built and analyzed the *Metaphone* project at its early stage. Together with Anders Lundström and Jordi Solsona, we examined the bio-sensing technologies and redesigned many parts to fit them to the sensors that picked up biological signals. The explorative journey of collaboration started with Jordi Solsona designing the sensor – bio-ball – with wax material. With Anders Lundström, we regenerated the soundscapes of the *Metaphone*, coupling the senses of the machinic and the bodily, we also mapped the data with sounds and colors and designed the interactions. During the exhibition of the project, many constellations of co-authors took part, reconfiguring the project for new contexts and situations. The study of Cultural Commentators (research method Gaver, 2007) was conducted and analyzed, and research articles and conclusions were articulated together with Kristina Höök, as well as with co-authors Anders Lundström, Jordi Solsona, and Vincent Lewandowski. The *Metaphone* project was presented at the CHI Interactivity exhibition (2013, 2015) and also published as a full paper that was presented at the CHI 2014 conference. The exhibiting contexts varied between artist talks and conference exhibitions (ISEA 2014), art galleries, media art centers (DAC), and media art festivals (EMAF).



Paper B

Šimbelis, Vygandas, Ferreira, Pedro, Vaara, Elsa, Laaksolahti, Jarmo, & Höök, Kristina. (2016, May). *Repurposing Bits and Pieces of the Digital*. In Proceedings of the CHI 2016 Conference on Human Factors in Computing Systems (pp. 840–851). ACM.

The *Delete by Haiku* project originated within the Re-Mobiling research group in Mobile Life. Pedro Ferreira contributed with his insights from the work on mobile technology – SMS text messages – as well as articulating challenges and research questions in connection with aspects of memory and forgetting. Elsa Vaara managed the project and explored issues on how to design for temporality and ‘felt’ experiences of time (Kosmack Vaara, 2017; Lindley, et al., 2013). On a primary stage, my contribution to suggesting the use of particular concepts and practices related to haiku poetry and deletion, repurposing, and upcycling were prominent in the initial design phase of the production. Together with Elsa Vaara, we designed and conducted the initial haiku workshop. We also designed the *Delete by Haiku* interface and interactions through a pinching motion and with themes, a haiku-bin and text falling down in a Tetris-like manner. The layout of the application was designed together with Elsa and I created the graphic design and visual identity. Kristina Höök, Elsa Vaara, Jarmo Laaksolahti, Pedro Ferreira and I worked on the conceptualization of the work in terms of digital upcycling, which resulted in publications such as the CHI 2016 conference paper in the Art.CHI submission, which received an honorable mention, and the CHI 2017 Video Showcase, which included a film screening.

Paper C

Šimbelis, Vygandas, & Lundström, Anders. (2018, March). *Synesthetic Experience in S T R A T I C*. In Proceedings of the TEI International Conference on Tangible, Embedded and Embodied Interactions. ACM.

The *S T R A T I C* project has been an extensive exploration of several techniques (bokeh and sampling rate) and experiments with these techniques that resulted in a number of different formats. The work conducted together with Anders Lundström and Andreas Eriksson finalized the project in a particular way from design and engineering perspectives. Lundström designed the system in relation to sound mapping. Eriksson supported our work with a circuit board. Finding new ways of contextualizing the work by exhibiting it in various formats, the live-performance project *S T R A T I C* has been performed and shown in exhibition spaces and concert halls, finding various surfaces to be screened on as part of the journey. The other noticeable format – *STRATA* film – expanded the exhibiting nature from installations in galleries to screenings in cinema settings to a surface on the facade of a skyscraper (FILE festival, Sao Paulo, Brazil). The publications were presented and the exhibitions took place at CHI Interactivity 2016, the ACE 2015 conference, the ISEA symposium for electronic arts (2016, 2017) and the RIXC 2016 conference and exhibition.

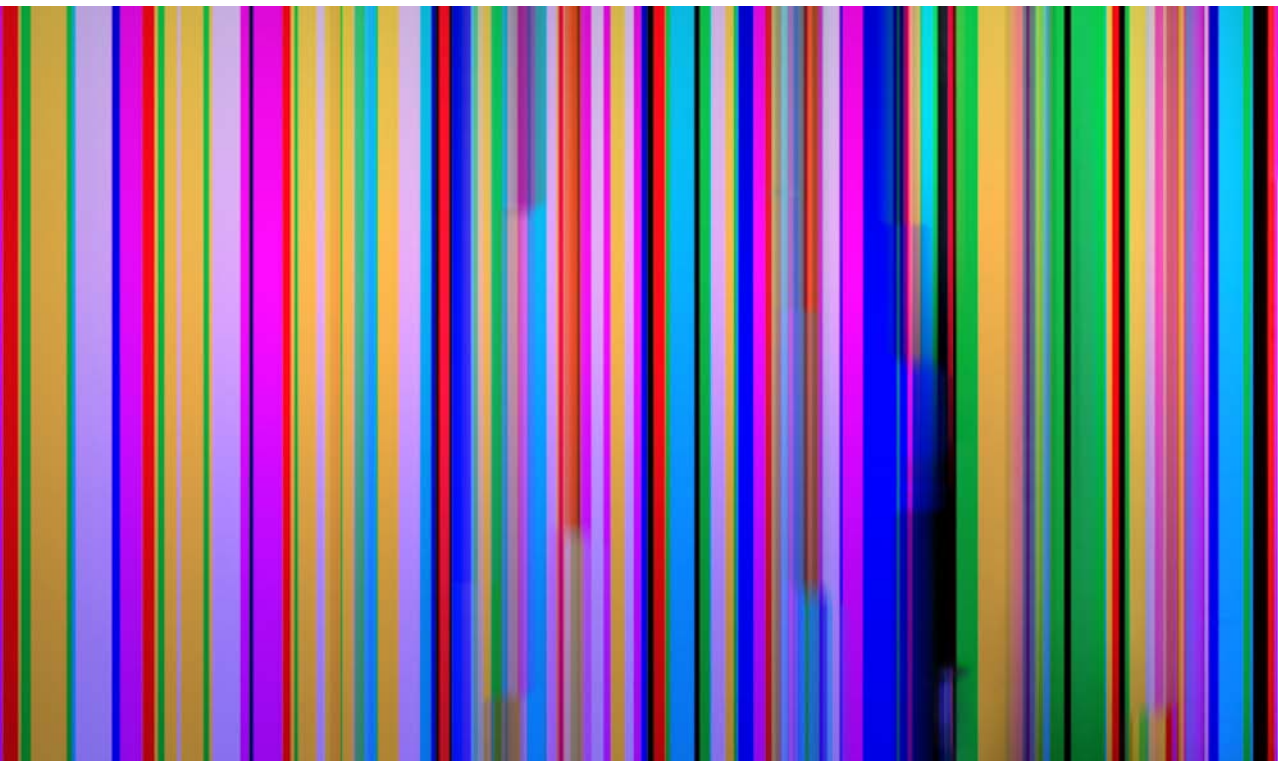
Paper D

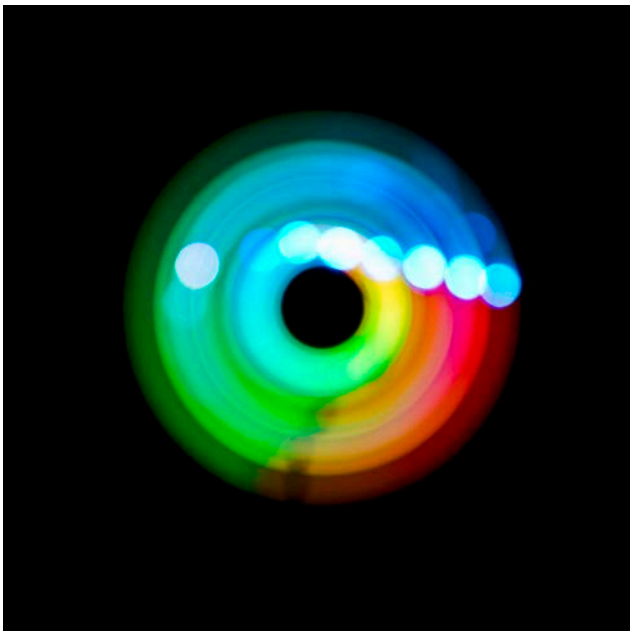
Šimbelis, Vygandas. (2017, June). *Time and Space in Broken Panorama*. In Proceedings of the DIS 2017 Conference on Designing Interactive Systems (pp. 1369–1381). ACM.

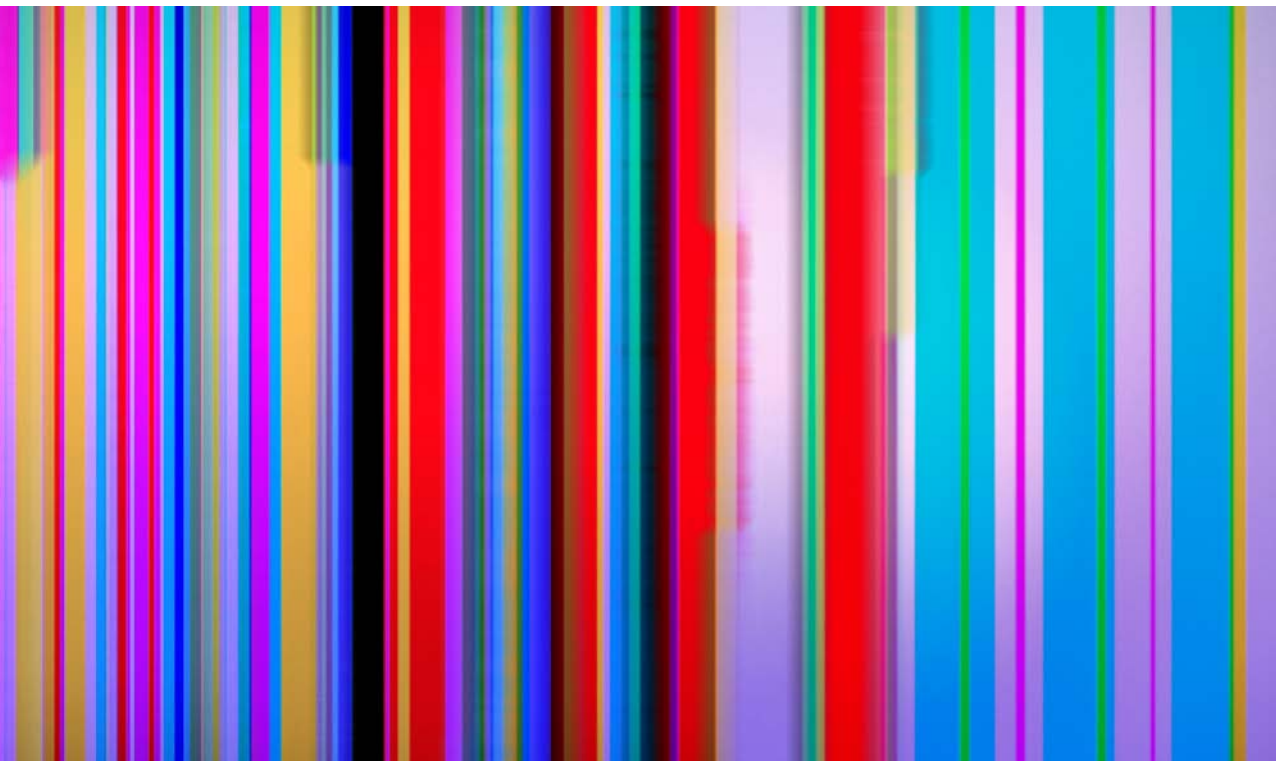
Paper E

Šimbelis, Vygandas. (2017, March). *Time and Space in Panoramic Photography*. In Acoustic Space peer-reviewed research journal (pp. 233–245). Vol.16, Renewable Futures. Art, Science and Society in the Post-Media Age, RIXC, Riga, Latvia, 2017.

The interest in continuing to work with the post-digital quality of glitch, as well as applying the hacking approach to our everyday devices, was my initial plan when I started the *Panorama Time* project. Fruitful findings in the panoramic photography drove the project towards to the understanding of fault aesthetics and glitch aesthetics, the hacking use of our everyday technologies, the post-media condition and the spatial-temporal dimension. All of these allow the photographic *Panorama Time* project to be discussed in relation to the post digital and its implications for HCI and interaction design. Rendered experiments and design directions were published and presented at the DIS 2017 conference in pictorial format and in “Acoustic Space” (RIXC, 2017), which is a peer-reviewed research journal article. The project was exhibited at the SIGGRAPH 2016 exhibition. This work took me many years to develop even with support and feedback of my peers.







Compound experiments

Apart from the projects introduced above, I have performed many other additional experiments in which I build on or mix ideas and results from my own various art projects. The projects I introduced received new shapes in new constellations by remixing the techniques; for example, a panoramic camera was used with different sampling rates and resulted in the *Stratascape* series of photographic images (image on top). The *Metaphone* spiral and rotational pattern were captured with an LED strip and depicted in a form of the *Digital Metaphone* project (image on the left).

Overall, my art projects have been created in intense collaborations with specialists from different disciplines and through working with people with various types of expertise from the fields of design, engineering, programming, sound production and post-production. The shared authorship, participation, collaboration and interdisciplinarity is a reflection of my stance towards art projects as joint "hacking" activities, in which participants and artist come together to create.

1.7.2 Other publications

Apart from the papers included in this thesis, I have also published the following papers – each contributing to my overall understanding of the problem tackled in this thesis.

Šimbelis, Vygandas, and Kristina Höök. “Metaphone: an artistic exploration of bio-feedback and machine aesthetics”. In Proceedings of the CHI 2013 SIGCHI Conference on Human Factors in Computing Systems. ACM, 2013.

Šimbelis, Vygandas, & Lundström, Anders. “S T R A T I C: Performing the Sampling Rate”. In Proceedings of the ACE 12th International Conference on Advances in Computer Entertainment Technology (p. 42). ACM, 2015.

Šimbelis, Vygandas “Vegas”, and Anders Lundström. “Synthesis in the Audiovisual”. In Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems. ACM, 2016.

Lindley, Siân, Corish, Robert, Ferreira, Pedro, Šimbelis, Vygandas, and Vaara, Elsa. “Changing perspectives of time in HCI”. In Proceedings of the 2013 CHI Conference Extended Abstracts on Human Factors in Computing Systems. ACM, 2013.

Šimbelis, Vygandas, Ferreira, Pedro, Vaara, Elsa, Laaksolahti, Jarmo & Höök, Kristina. “Delete by Haiku: Poetry from Old SMS Messages”. In Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems. ACM, 2017.

1.7.3 Chapters in the thesis

Chapter 2 provides a background section introducing the backdrop to the research with topics on the post digital, aesthetics and practices found in certain conceptual and critical contemporary art. In Chapter 3, I describe my research methodology and approaches and how I have used them in practice. Overall results and contributions to the field are presented in Chapter 4, which present all of the individual projects and further relate them to the post-digital domain. Finally, in Chapters 5 and 6, I discuss my contributions.

2. BACK-GROUND

2. BACKGROUND

Let us now turn to some of the theories that form a backdrop to my projects, introducing some of the core concepts, practices and artistic techniques. The post digital is a practice derived from the arts, with a strong relationship to media studies. Thus, most of the ideas and concepts are grounded in the arts. More specifically in my research I came to emphasize the following: (1) focus on how the post digital contributes to the humanization of digital technology; (2) explore materialization of the digital, in which I was seeking a convergence of the digital and the analog through hybridization processes; and (3) engage with disruptions, which supports the disruption of conventional ideas and rethinks the reality we live in. These ideas will be unraveled by providing some background to each.

2.1 The post-digital condition: origins and role in the arts and HCI

"The digital revolution is over" Nicholas Negroponte, one of the founders of MIT Media Lab, claimed in 1998 (Negroponte, 1998). By this he meant that digital interactions could no longer be separated from the world. They no longer existed separately, in their own virtual world. Instead, digital interactions were becoming intertwined with every kind of activity, practice and engagement in the world.

Cascone (2000) was the first to introduce the term post digital in the arts. He coined the term based on Negroponte's statement. Cascone noted that in electronic music creation, various techniques that built on the properties of digital technologies had started to emerge. For example, emphasizing the failure of digital technology and the glitches that occurred in music production became a broadly-used and well-known technique. Such techniques became an integral part of the artistic creative process and new music styles were created, such as microsound or click-and-cut. Various previous attempts to emphasize the failures related to scratch techniques which, if used on vinyl, are entirely analog.

Thus, the post-digital age starts an era in which the digital is fully immersed in our society. The digital is no longer something completely new, it is mundane, and everyone is using it alongside many other formats and technologies to create art – music, fine arts, interactive arts, performing arts, opera and other art forms. While the post digital derives from the use of digital tools and materials, it looks beyond the digital, turning it into a material amongst others. An eradication of the distinction between

old and new media is achieved, both in theory and in practice. This informs the form of design without being particularly concerned with what is digital and what is not. Kenneth Goldsmith notes that his students "mix oil paint while Photoshopping and scour flea markets for vintage vinyl while listening to their iPods"(2011, p. 226). And those students are not rejecting the opportunities that digital tools are giving them, but they have incorporated the digital into their lives without even noticing the difference between the formats, media or technologies.

The post-digital condition also entails a critique of the societal rhetoric that portrays digital interactions as being separate from the world, existing in their own virtual world, never meeting with the physical realities in which the imperfections in human life lives. It is no longer about pristine, perfect gadgets. Instead, we start to see aspects of the digital that are less appealing and satisfying. For a long time they have been seen as sterile hi-tech, as Cramer states: "...a period in which our fascination with these systems and gadgets has become historical" (2014, p.14). Technology runs on pristine and polished surfaces and error-free algorithms are being questioned: "The simplest definition of 'post-digital' describes a media aesthetics which opposes such digital high-tech and high-fidelity cleanness" (Cramer, 2014, p.17). In short, digital material is still used, but instead of regarding it as a sterile material, clean and polished, it is viewed as a material of malfunctions and glitches – a material that can and should be combined with other materials. Such an attitude, in turn, reflects how the digital has become the ordinary and mundane, inseparable from our everyday routines. Through exposing and making interactive arts and applications that thrive off the imperfections and malfunctions of algorithms and connectivity, the digital components come closer to the real world full of mismatches and failures.

Post digital in the arts. The post digital engages with an earlier era of traditional art forms in physical appearance but now incorporates digital technology. This discourse raises awareness of legitimizing digital artistic practices in the discourse of more traditional art practices. In other words, it helps to establish the relationship between digital technology and art forms.

The notion of the post digital informs new art forms that address the humanization of digital technologies. Most interestingly, post-digital art originates from a long-term struggle for the art world to incorporate digital expressions. The art world was not ready to accept the digital as a medium (in fact, the opposite is true)(Paul, 2016; Quaranta, 2013; Shanken, 2002), but as it already missed the early and precocious development, establishment and incorporation of the digital, with the subsequent arrival of the post digital, it started to incorporate more digital and post-digital

works. In a way, the post digital reconnects the digital with other traditional artistic means of expression. Thus, new media art slowly enters the contemporary art world, but it takes time, as new infrastructures have to be obtained: "New media art in its multiple manifestations has become an important part of contemporary artistic practice that the art world cannot afford to ignore, but accommodating this art form within the institution and 'art system' raises numerous conceptual, philosophical, as well as practical issues" (Paul, 2007).

Post digital in HCI. The post-digital concept can also be seen as an approach that can be applied to arts and technology to expose and alter how the analog and digital come together and work towards the humanization of technology. As discussed above, I became active in the academic field of Human-Computer Interaction (HCI) as I was working in a team that focused on interaction design. HCI is one of the potential fields of technology in which a post-digital approach may be of benefit. For example, researchers in HCI incorporate glitches in their practices (Davis, 2011; Gross, 2013; Mason, 2012; Menkman, 2011; Murphy, 2009), malfunctioning of technology (Lucash, 1986; Murer, Fuchsberger, & Tscheligi, 2015), explore unfinished designs (Tonkinwise, 2005), objects found (Landwehr Sydow, Tholander, & Jonsson, 2017) and imperfections (Morozov, 2013; Murphy, 2009; Tsaknaki & Fernaeus, 2016) and discuss digital materiality in relation to the physical world and with specific examples from our lives (Dourish, 2017). The early research and design experiments conducted in HCI on contextual photography (Ljungblad, Hakansson, Gaye, & Holmquist, 2004), which were intended to be a starting point for Instagram effect layers. The project on the context photography has taken the sensing of the visual input and the context further and by interpreting the input, the visual outcome gets modified in real time. It is a good example to illustrate the importance of the glitch aesthetics, which get derived from the real contexts. However, the technological limitation implemented and explicitly exposed to the user in the Snapchat app is also of a post-digital nature through its extreme use and emphasis of technical and digital logics, and particular alterations of user experience.

While HCI and the post-digital sphere share many underlying values, there are also differences between the two – such as a strong focus on the human counterpart, empowerment of users and engagements, and how digital technologies transform our society and the human condition. The main difference lies in the perspective provided. The post-digital position comes from the arts, media studies and humanities, while HCI is strongly influenced by engineering and new technological possibilities, explored by interdisciplinary teams from sociology, industrial design, or engineering. Hybridization between these different fields is a core feature

of HCI, always strongly focused on the digital, on the computers in the different machines, and emphasizing the technology and interaction in general. But as David Berry and Michael Dieter conclude: “In a post-digital age, whether something is digital or not will no longer be seen as the essential question … as all forms of media become themselves mediated, produced, accessed, distributed or consumed through digital devices and technologies” (Berry et al., 2015). That is, the post-digital position does not set digital technologies aside, as a material that needs to be treated in some special way. Instead, it is a given. This goes beyond the core of HCI in which the computer (the C in the HCI) plays a key role. The idea that interactions happen only within the computer has been questioned in HCI (Márquez Segura, Waern, Moen, & Johansson, 2013; Murer et al., 2015; Vallgarda, 2014; Vallgårda & Fernaeus, 2015). Some argue that what we should be designing are activities enacted between people, not digital systems. The digital is just a component that acts as a scaffold or support to the activity. Their concerns stand along with the post digital even if they arrive at the problem from a different angle.

2.2 Humanizing the digital

The humanizing aspect of the post digital is a goal or possibility rather than a necessary consequence of the unification of the physical with the virtual. Humanizing could be achieved with any technology: purely digital or purely physical. The post digital refers to various hybrid constellations of formats; it reflects the next media. With this position, new possibilities arise; we can become inspired by as well as question the role of digital material – especially when it becomes increasingly fused in the Ubicom/IoT/sensor-network era. With the arrival of these technologies, the opportunities for critical engagement and expressiveness are richer. They permit new art forms to evolve. Such new art forms might permit a process of humanization – but that is not a given. This is where post-digital artists have a role to interact – and in particular, where my own art practice is aiming to contribute.

The focus on a human being instead of technology in our interactions brings notions and practices of thinking through the lens of the humanization of technology; it relates to a phrase “…digital technology and art forms that are more concerned with being human than with being digital” (Alexenberg, 2011, p.35). Alexenberg also saw the possibility of opposing the early Sci-fi: “frightening people into believing that computers would take over the world and enslave them” (p.56). The latter quote refers to technological singularity with its powerful artificial superintelligence, which might easily take over our lives and we will be surrounded by it for-

ever. But it also refers to simpler technologies, such as robots taking over not just industrial jobs, but academic professions or the Internet of Things entering our homes, transforming them into efficient machinery. The post digital is a counterreaction to these frightening predictions, making digital technologies expose their imperfections and making them fathomable to human beings.

I argue that the humane approach towards digital technology can foster creative encounters and deepen the engagement with technology. It is not just a simple interaction between machine and human. It is an involvement that requires a deeper engagement with what we are doing. In a way, possibly not always noticing either the technology or the interaction. However, it might not be the case of implicit interaction (Ju & Leifer, 2008) as more engaging activities might include our full (intellectual and bodily) capacities and critical thinking in order to unfold the meanings. Such engagement might be evolving through creative encounters between art, science, technology and human consciousness (Alexenberg, 2011), but also to elucidate the humane approach through how this engagement is produced. How Alexenberg emphasizes it is in direct relation to the art practice and through the explicit understanding of cultural perspectives and he relates it to the translation of the term 'art' from various languages. However, its importance points to the relationship to artistic practice, creativity and processuality (the importance of process, interaction, participation, and collaboration) in general.

Humanizing – how is it done? But what methods and processes can we use to create this deeper engagement through the lens of humane aspects? It is not through a scientifically rigorous approach, nor through a positivist-solutionist approach with its agile methodologies and market needs, but is linked to emphasizing processuality and concerns about the temporal dimension. Several examples of art concepts that have been imported into HCI, such as ambiguity (Gaver et al., 2003) with its troubling nature of bringing multiple and complex interpretations and meanings. Defamiliarisation (Bell et al., 2005) when familiar things are transformed into the nonfamiliar, human playfulness (Caillois, 1961; Fernaeus, Holopainen, et al., 2012; Lieberman, 1977; Salen & Zimmerman, 2005). Or somaesthetics (based on the philosopher Shusterman's ideas (Shusterman, 2013) and introduced into HCI by Schiphorst (Schiphorst, 2009), Höök et al (Höök, 2015, 2016) and others), which is concerned with the consolidation of body and mind through our interactions applying methodologies such as Feldenkrais or Mindfulness, involving performative aspects. These concepts create a bridge and a closer connection to the arts, and also expand on the notion of what it would mean to humanize the technological domain.

The HCI research Soma Mat example (Ståhl, 2016) is a design for somatic experience in which the focus is on conscious bodily interaction and concentrating one's inner world through subtle movements (breathing), but also through the heat sensation of other parts of the body. The design is made through somewhat implicit interaction as the technology and interactions are not explicitly exposed but given as a hint to explore the potential of an artifact.

One way of thinking about the whole idea of bringing something "onto a human scale" is without making a dualist distinction between the physical and mental states. Such a stance allows us to use our human capacities, our bodies and physical ways of being in the world – a form of humanizing. In a way, it serves the confluence of body and mind and examples from somaesthetic design might be these, which try to bridge it with a particular focus. Also, full-body interactions, thinking of it not only as body, but as a complex soma system, a subjective whole connecting mind, body, emotions and sociality, might be referred to as a deeper bodily engagement with digital technologies, which from the outset might otherwise be seen as mainly addressing our mental, language-oriented skills in a cold and uninviting manner.

Since the human condition involves having a body, emotion, thought, sociality and culture in general, and being engaged with/producing tools through which we engage with and experience the world – in which none of these can be separated from the others, they are all intertwined processes – the digital world has previously been too single-handedly focused on only certain aspects of our corporeality. The post-digital art condition is uniting the physical with the digital, thereby making technology accessible to us on this human scale: with our bodies, emotions, sociality and culture.

Humanizing through deconstruction. To really achieve a deeper engagement with the digital, to understand and experience the complexity of what it means to be human, requires a full cultural account. We need several different expressions, different forms, to help us see paths to humanization in digital technology. We should look for culturally-enriched experiences, the way aesthetic experiences evoke new understandings of the discourse. The hybridity of forms might also support the richness of our relationship to technology, such as merging old and new, analog-digital, virtual with physical, and fabrication of the digital. Emphasizing the processuality of these terms, the way systems work and relate to network logics (Bazzichelli, 2013; Contreras-Koterbay & Mirocha, 2016; Franklin, 2015; Lillemose, 2006; Lovink, 2011; Mayer-Schonberger, 2009; Smite, 2012) and introspect on their own behaviors, and the way we achieve deeper engagement with technology, also lies at the core.

These forms of the humanization of technology can manifest from a constructive approach, in which we design for positive humane qualities, those most appreciated in our everyday lives. However, there is also another path to seeing humanization: it can also be found through a critical lens, by deconstructing the technology and finding discursivity within that process. I would argue that a disruptive approach is a critical, but also a productive, way of rethinking interactions and technologies. When working with and emphasizing technological qualities, which might contradict the whole understanding of humane purposes, we might find that such conflicts can bring rich humane experiences. So the hybrid field of human and machine could misinterpret humane logics and bring algorithmic encodings to the foreground; these hybrid logics pave the way for questions on more ambiguous and "border" grounds in which the post digital is inherent.

For example, machinic, deletion (Mayer-Schönberger, 2009; Morozov, 2013), repetition or glitch briefly mentioned above might be seen as strictly technological properties but brought back to the technological domain they could subordinate the acceleration of technology and expose criticality through engaging with its own processes. Morozov relates technological imperfection to humane qualities (Morozov, 2013), and as discussed above, Cascone introduces failure and glitch in the digital aesthetics of music production.

Sound artist Ryoji Ikeda explicitly exposes visualized streams of data and the processuality of the inner generative processes of the sound he is playing. The music is constructed through deconstructing the production processes and the visuals convey what is happening inside the processors. Alva Noto has another approach and through the illustrated schematics of processes shows how the sound and visual operate together. The other way of seeing the machinic in digital realms and through its imperfections is via 3D printing experiments and through "uncanny discourse between algorithms, data, and humans that mutually 'misinterpret' each other" (Koutsomichalis, 2018).

2.3 Post-digital materiality

Another path to engaging with the post digital is to look at it from a materiality perspective (Bennett et al., 2010; Fernaeus & Sundström, 2012; Fuchsberger et al., 2013; Gaver et al., 2010; Giaccardi & Karana, 2015; Miller, 2005; Munster, 2011; Sundström et al., 2011). We already know from previous sections that the post digital contains and emphasizes digital qualities, which are taken from a digital context but then we look beyond the digital, and that the core quality of post-digital technology is not to

look at the digital as clean and perfect, but where our work thrives on its imperfections.

"The digital". To engage with the concept of the post digital, as a starting point we need a shared conceptual understanding of what we mean by the "the digital" itself. Importantly, the term "digital" in its literal meaning does not in itself imply high-tech, or intangibility. Coming from the Greek word 'digit' (finger), it refers to values that are discrete, as when counting on fingers, compared to measuring e.g. size. This fundamental meaning does not require the manifestation to be driven by a computer or electrical power. The abacus for instance is an example of a pre-electronic digital counting device. On a similar note, the cardboard punched cards broadly used in the early days of computer science were nothing but physical representations of digital data. Or as phrased by Rydarowski et al. on artistic forms: "There is a long tradition of painting, film, architecture, sculpture, and new media works that use analog equipment to produce discrete signals" (Rydarowski, Samanci, & Mazalek, 2008).

With this as backdrop, there is still an ongoing discourse within Human-Computer Interaction, as well as within the humanities and the arts, of a so-called "the digital-physical divide". This concept is based on a more everyday understanding of the digital based on information science, as of information content being "digitized", i.e. turned into computer format and stored digitally, on e.g. hard drives, SD cards, USB sticks, cloud services, and then mediated through electronic devices. Within HCI, this way of looking upon the digital as essentially separated from the physical world has some of its roots in Nicholas Negroponte's visions expressed in "Being Digital" in the mid 1990s, in which he articulated an understanding that while the physical world is constructed from atoms, the so called digital world is made from a stream of voltage signals that we refer to as bits. In HCI, this notion of atoms and bits has been highly influential, especially within the field of tangible interaction (Ishii & Ullmer, 1997).

There are occasions where this conceptual divide may need to be further problematised. Firstly, in reality, the digital is of course, even in Negroponte's everyday notion of the term, enabled by physical processes. One way of seeing materiality and the physical manifestation of the digital is through the physical objects and materials from which they are made, for example, a phone with its physical interactions, sensors and actuators. Dourish argues in his book The Stuff of Bits in relation to information: "material arrangements of information – how it is represented and how that shapes how it can be put to work – matter significantly for our experience of information and information system" (2017, p.4). In contrast to earlier statements from Claude Shannon (Shannon & Weaver 1947) that the information is abstract and not related to the object, Dour-

ish contradicts it by arguing that "the information remains independent of that matter" (2017, p.4).

There is a slight difference between going deeply into what digital means through reducing it to the fact that it builds on zeros and ones (a reductionist account), versus recognizing it more broadly as what we typically mean by the "digital" – i.e. algorithms, data and the ability to traverse different hardware equipment, servers, sensors, actuators, IoT and so on – but most importantly having computation at the core. Another question is how the process of computation could be recognized as the digital and found in every stage of our lives, for example, in the Jacquard loom (Fernaeus, Jonsson, & Tholander, 2012). These relate to finding countable, discrete units in our environment and behavior. These accounts differ, but at the same time cause these perspectives of the same world to converge. In my work, I rely on more of the "everyday" notion of what we mean by digital technologies and materials – the everyday culturally-accepted definition rather than the strict reductionist account. That said, my approach does not reject any of these perspectives, but the proposed *interpretative digitality* account is emphasized in my work.

How we interact with our devices also reflects on the digital in several ways. One way is through tangible interaction with, for example, our mobile phones, when we physically interact by shaking them. Another way is seeing the digital unit in every stage of our lives. The form of a mechanical calculator or any other similar device is both analog and digital, as digital is anything that contains countable units; it could be the fingers of one's hand. Lund expresses it thus: "'Digital' simply means that something is divided up into exactly countable units – countable with whatever system one uses, whether zeros and ones, decimal numbers, strokes on a beer mat or the digits of one's hand" (Cramer, 2015, p.19). As all these examples demonstrate, the physical and digital do not have a perfect divide. They arrive reciprocally and vanish somewhere in between "...'digital' information never exists in a perfect form, but instead is an idealised abstraction of physical matter which, by its material nature and the laws of physics, has chaotic properties and often ambiguous states" (Cramer, 2015, p.19).

The reductionist way of seeing the digital is through the process of digitalization. The process that takes bold stances in digital materiality and, as described by Kerlov and Rosebush (1986), is built on principles of sampling in pixels and resolution: "sampling turns continuous data into discrete data. This is data that occurs in distinct units: people, pages of a book, pixels" and quantization, as Lev Manovich describes: "quantified is assigned a numerical value drawn from a defined range" (2001, p.28). Having said this we might relate to all process as algorithmic and countable

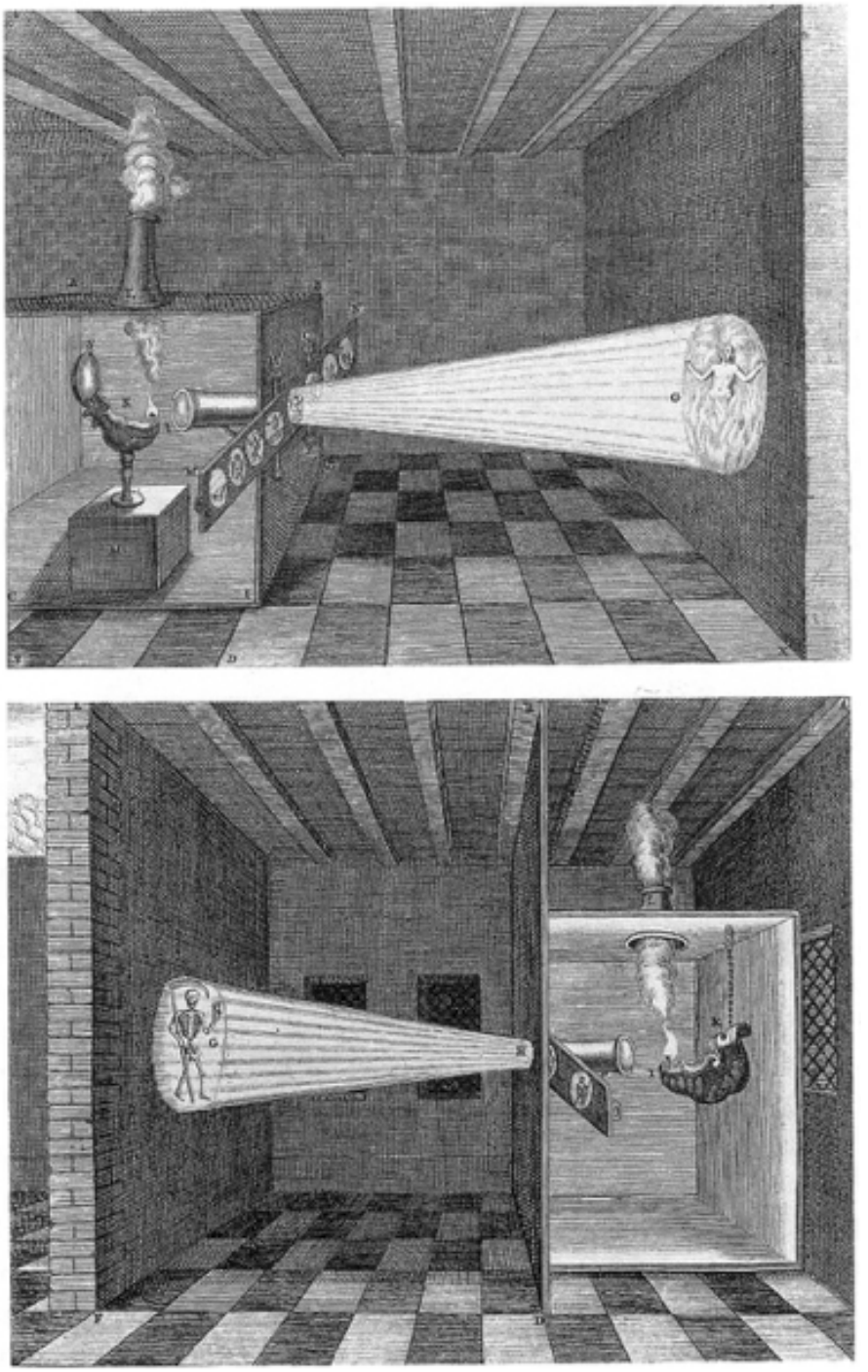


Figure 11. Athanasius Kircher (1601 – 1680), Ars Magna Lucis et Umbrae, 1671.

units through assigning them a numerical value.

One established way of achieving digital materialization is through digital fabrication (Fuchsberger et al., 2016; Landwehr Sydow & Jonsson, 2015), the example of 3D printing when the digital gets fabricated in a physical form through printing. Various representations of information and data visualization are also fields in which information takes a physical form, be it image or object. We may relate more closely to image culture by sharing digital information and printing images, but it is also of the same relevance to other media. The difference between visualization and physicalization, which relates to making data physical, is "to communicate data using computer-supported physical data representations" (Jansen et al., 2015, p.3227).

There is, of course, a long tradition of engaging with novel technologies in similar ways we currently engage with the dichotomy between the digital and the physical. In media archaeology we learn how different technologies throughout history have had similar concerns. Starting with Gutenberg's printing press (1455) that innovated book printing and through the notion of mechanical reproduction by Walter Benjamin (2008). Eric Kluitenberg (2005) rediscovers the mechanical clock and articulates it to be a measurement of time and how it influenced human behaviors and the synchronization of human actions. Renaissance inventor Athanasius Kircher (1602–1680) with his inventions related to the contemporary midi keyboard protocol, prototype of the megaphone or Ars Magna Lucis et Umbrae – the first apparatus capable of projecting images onto a wall (see Figure 11). Zielinski's (2006) analysis of the technology shift with electricity and its connection to dynamicity, instead of historically-appreciated stillness.

On the level of how digital communications have been taken into use in our society, many have argued there is no point in distinguishing between the real world and the virtual world. While many hoped that the internet would become a genuine democracy with free speech and free-flowing communication – a utopia – in the end, the same social interactions have been reproduced and the same regulations are required as for any society in which crime, bullying, corporate life and communal activities occur.

Cramer writes that neither "old" nor "new" media are meaningful in separation, as the meaning is in they merge in the post digital (Cramer, 2015). He refers to the processuality of the production process and emphasizes the DIY culture with its hacking and tinkering processes. And, in his case, analog or old media takes over the digital as the digital is always embedded in these processes.

Figure 12. Deimantas Narkevicius, Proposal for Whatever You Play, It Sounds Like the 1930s. 2012.

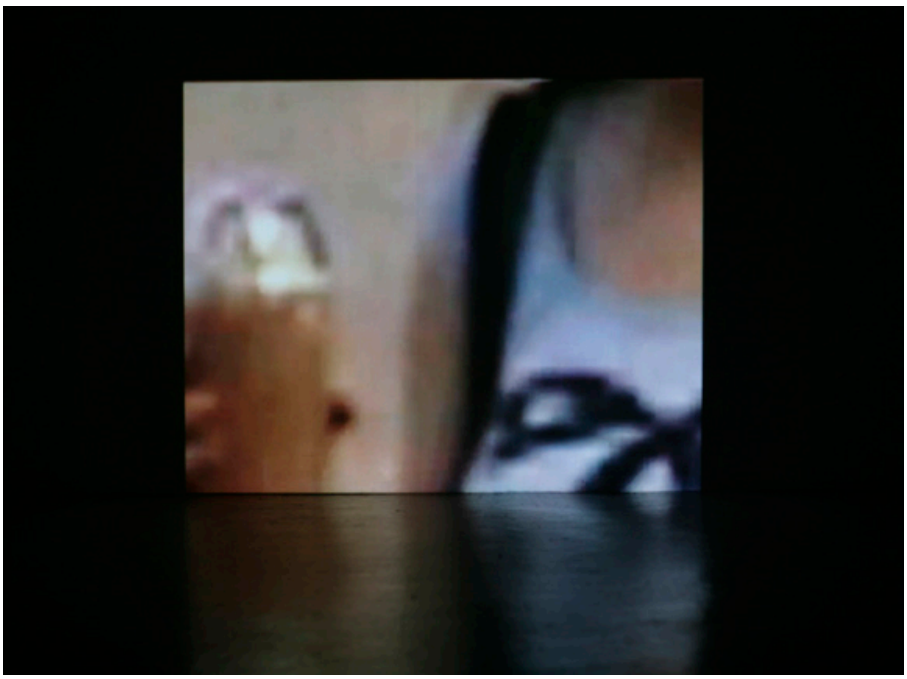


Figure 13. Vygandas Simbelis, Digital Zoom Spying, 2010.

Post-digital materiality strategies. Lund characterizes four strategies by which the post-digital qualities could be brought to life: one strategy is to look retrospectively and bring the analog to the digital realms; another strategy is to simulate analogicity digitally; the third strategy is to make "handmade-digital" hybrids which, in a way, refer to digital crafts; and a final strategy relates to hyper-digitality, which brings and emphasizes the digital qualities and their origin, but also emphasizes the digital qualities through exploiting them and "inadequacies attached to the digital" (Lund, 2015). The return of the digital to the physical, as the digital was developed from the physical and to some extent took over the physical world, it is now time to go back and bring the digital to the physical. If digital qualities are translated back into the physical world and obtain new forms, they can acquire new meanings. These digital qualities could be materials as, for example, related to the physical world, with the highest quality being the bass sound in powerful sound systems (Fleischer, 2009) or the opposite – the digital quality – as pixelated images (Lund, 2015). These might arrive from the highest audio or image quality obtained with digital devices, small earphones and smartphones. An example of the sound qualities, apart from those experienced through a powerful sound system, could be turned to the artwork by Narkevicius Proposal for Whatever You Play, It Sounds Like the 1930s (2012), see Figure 12, exploring the old speakers as a quality threshold to listen music from other periods. But the technology provides sound with its limitations, in this case, the speakers produced in the 1930s deliver sound from that period of time. For image resolution, we could look at my own video work *Digital Zoom Spying* (2010), see Figure 13, in which I use a camera's digital zoom feature to zoom-in on passersby to capture their body fragments, also somewhat satisfying the viewers' imagined voyeuristic desires, but also hiding the details through the extensively pixelated image and partial abstraction.

Hybrid materials. Designing for the post digital is not about nostalgia or raging against machinery or computation – it is about demystifying the digital and encouraging hybrid designs that equal the status of digital and analog design materials.

Hybridity as a post-digital quality is arrived at from Alexenberg's conception on hybridization of forms from various subjects, be it human or non-human, animate or inanimate, human and technology, the mix between biology, psychology and other disciplines:

"...pertaining to art forms that address the humanization of digital technologies through interplay between digital, biological, cultural, and spiritual systems, between cyberspace and real space, between embodied media and mixed reality in social and physical communication, between high tech and high touch experiences, between visual, haptic, audito-

ry, and kinesthetic media experiences, between virtual and augmented reality, between roots and globalization, between autoethnography and community narrative, and between web-enabled peer-produced wiki-art and artworks created with alternative media through participation, interaction, and collaboration in which the role of the artist is redefined" (Alexenberg, 2011, p.35).

The term "post digital" also aligns well with the materiality of the digital, as it emphasizes a disenchantment with the terms "digital" and "analog" relating to their colloquial meanings (digital = computational and electronic, analog = non-computational) (Cramer, 2015), and thus their corresponding, and proposed inaccurate, positioning in opposition. This, in turn, fits with both of them being on the same side and neither of them taking over or outweighing the other. Examples of analog technologies such as the Jacquard loom (Fernaeus, Jonsson, et al., 2012) or other technologies working on punch cards (Manovich, 1999) are forms of computation. This returns to our previous discussion on reductionist and interpretative accounts of digitality, and also to examples of media archeology, through which a convergence of the digital and analog operates.

The post digital does not refer to the dichotomy – physical things versus screen-based interactions, but more the notion of "eradicating the analog/digital divide" (Cramer, 2015) and questioning the terms to expose the fact that it is actually very much about tangible interactions. Hybridity, fabrication, the digital combined with the physical and other notions are the core manifestations and processes of the post digital, as many things could be combined to create hybrid assemblages. Resulting in these assemblages by combining digital and analog, and fusing other forms that do not directly respond to this dichotomy like electronic, computation, mobile, algorithm, signal and similar, new possibilities for art manifestations arise.

The relationship between the digital and the analog in the post-digital can be seen as a venture to combine those digital bits and pieces into a more seamless analog (tangible) environment: "the growth of digitization, segmenting everything into the discrete, binary code of the digital, makes us cling to the ideal of this real, unfragmented whole which is the analog" (Lund, 2015, p.2). The question is how the digital can become seamless through analogicity, but where the digital qualities are still retained, enriching the digital with the analog and vice-versa.

In the post-digital era many turn back to vintage (analog) media and vintage technologies such as vinyl records, tape cassettes and analog photography. Old media is resurrected as post-digital devices (Cramer, 2015). "Leads to analog products that are aesthetically derived from digitality, that cannot exist or be understood without digitality, since—even

though the objects are analog—they are aimed to look and feel like digital objects" (Lund, 2015, p.2).

I had the honor of curating the Arts Track exhibition "Beyond Convergence" at the TEI conference, which focuses on tangible interactions. The 2018 theme I have proposed is around the post digital. One of the submissions is a project called Au Clair de la Lune on Gramophone (Jo, 2018), an interpretation of a gramophone through digital fabrication: the engravings were made on a surface of a lacquered anodized aluminum plate by a laser cutter (see Figure 14). With this work the author seamlessly combines the digital with the old technology, a vinyl-playing gramophone.

Figure 14. Kazuhiro Jo, Au Clair de la Lune on Gramophone - For Édouard-Léon Scott and László Moholy-Nagy (1860/1923/2015).

Figure 15. Marcel Duchamp, L.H.O.O.Q., 1919.

Figure 16. Prayer Companion, 2010, by Interaction Research Studio, Goldsmiths, University of London, UK.

Remix culture. The remix culture dates back to long before the global introduction of digital materials. But ideas from the remix culture have come to take on a new meaning in the post digital and became important to my own work. Let us therefore introduce some of the origins of the remix culture before discussing how this can now be seen as a tactic in the post digital.

The principles of remix culture emphasize the process and result, which is derived from other work through recombining materials, elements or parts to produce a new work. By reusing/using already existing materials and objects and remixing them into new combinations, new constellations and new works are produced.

Walter Benjamin's work on mechanical reproduction in 1936 discussed the need for a new form of art in the age of mass reproduction – a political way of questioning the role of originality and mass production. Together with the possibility of printing and mass reproduction came replication and creating new art from compositions of old pieces. An example is the collage technique that manifested during the rise of modernism. Various forms of collage were used in art from manifestations in cubism, futurism, dada to multimedia (Wolfram, 1975) and the term appropriation art was established as a theme to address broader theories in the arts and social issues (Irvin, 2005).

The example of appropriation art is Duchamp's appropriated image (a found postcard) of Mona Lisa in his L.H.O.O.Q. (1919) work onto which the artist drew a moustache and beard in pencil (see Figure 15). The act of appropriation is taking a found object and reappropriating it for the artist's own artistic pursuits.

And all types of media appropriations, for example, Prayer Companion (Gaver et al., 2010) using news media in William Gaver's studio work (Figure 16), or much broader use of copyrighted works in a mixed media technique of collage extended digitally in the work CopyCut – The World is Your Palette by Grammenos, exhibited at Art.CHI 2015. Or American Derivation: Three Kings (Fair Use Portrait #1-#3) dealing with the concept of fair use and through this process to avoid the copyright infringement and create musical instrument and a sound piece, by Nishino and Cheok, exhibited at the Art.CHI 2016 exhibition.

Mass production has accelerated with the advent of digital technologies, in which artists can copy, cut and paste anything they want and easily repurpose texts, music, games and other forms, rendering new forms of art. In music, historically, sampling moved the music industry further into "musical collages" (see e.g. DJ Shadow and his sampling techniques in the 1996 Endtroducing album or sound compositions produced by Schaefer with his Tri-Phonic Turntable from 1997). The turntable rebuilt by

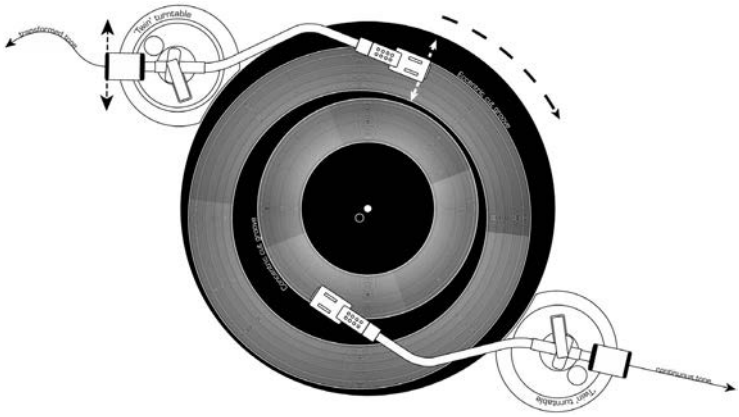


Figure 17. Janek Schaefer vinyl player - Tri-Phonic Turntable (1997)

Schaefer (see Figure 17) is a great example that supports affordances of such technology through DIY practice, as discussed by Hansen and Bresin (2006) the scratching equipment is not built as one single unit, but with a case of Tri-Phonic Turntable, we see the extension of such paradigm through rebuilding the existing technology. Through such practice artists from different disciplines can revitalize materials, which help to create novel artistic narratives. All these terms very much intertwine and overlap through various artistic practices, although in this framework we might even talk about plagiarism (Goldsmith, 2011) and other forms of artistic expression (pastiche, derivative, etc.) involved in a broader concept of originality and authorship.

Bourriaud and colleagues discuss the relationship between deejaying practice and contemporary art as a way of postproduction (Bourriaud, Schneider, & Herman, 2002). The authors claim that experimenting has higher value than interpretation and engaging in critical commentaries. The authors elaborate on the hacking approach and shows indefinite forms as being available for various manipulations.

In respect of the remix approach, creative hacking manifests as a practice to extend remixing through its own principles. With hacking, we are not only making new compositions of already existing artifacts or recombining them, but also exploring the artifact's logic and trying to understand its behavior. It is experimentation with time-based systems, which includes temporality, is self-contained and self-operational, in a way it is an active agency with its own principles and in its behaviors.

2.4 Disruption

Disruption, that is, the way technology or a system is prevented from continuing in its expected direction, can support various precise modifications to the system itself. A disruptive engagement might entail taking advantage of its own technological means to disrupt the technological system and make its course change.

But how can this be actively achieved? One such path is "Disruptive Innovation" (Christensen, 1997), i.e. an innovative technology enters an existing eco system, breaking the economic stability of a particular market segment, or even entirely redrawing the map for how that market works. The most recent example of digital disruption is the sharing economy in which companies such as AirBnB or Uber have disrupted the hotel and taxi industry, respectively. We also see this happening through other market strategies that rely on digital technologies, such as the shared economy, peer production, crowd sourcing or crowd funding. What is important to note is that it is often not the newest technologies that are

used to “break the ice”. It is when new technologies have already become well-established in our society that they can revolutionize new markets (Christensen’s theory).

Another theory, “Creative Destruction” by Schumpeter (1994), points to the cyclical patterns of economic systems and that frequently growth will benefit from stagnated periods and crises. It shows how profit is built through renewal in a cyclical economic way. In “Creative Destruction” we see a “process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one” (Schumpeter, 1994). Such economic growth revolutionizes business practices through disruption: in turn, old technologies in novel combinations upgrade in values and modifying value systems.

Sometimes this development will not lead to entirely novel eco systems with new players producing services or goods in entirely different ways. Instead, as Cox (Berry & Dieter, 2015) discussed with regard to the hype of the dot-com era and its collapse, it might entail keeping the status quo: “...where old technologies are repackaged, but in ways that serve to repress historical conditions rather than repurpose them” (Cox, 2015).

Post-digital disruption. Disruption has played a key role in the post-digital condition (Alexenberg, 2011). It is one of the signifiers of a post-digital art practice, probing ways in which we can engage with technology more creatively. Disruption not only takes place on a small scale, for example, within a particular art project, but should also be seen on a larger scale. One of the questions raising is: can we disrupt the overall system and reexamine the established, but also conflicting areas such as making money and engaging with art in our society? If we take art production as the main reason for earning money, it is already a conflict. But on a critical level, engaging with art by critically re-examining the monetary system (or engaging with art through the process of making money, but not making money through producing art) is a completely different approach. It questions the systematic deconstruction of the structure, through which by engaging in systematic logics and behaviors the art is created.

In the post digital, innovative disruption has also come to take the role of critiquing a solutionist development. To a solutionist, the whole world looks like a “problem” that can be “solved” through technological infrastructures and applications. Morozov, for example, criticizes the Silicon Valley attitude, focusing on efficiency, is solution-driven, and takes technological determinism seriously, seeing it as the only way for our future development (Morozov, 2013).

With a solutionist approach the world is seen as being driven by algo-

rithms enhancing processes. These algorithms eradicate imperfections and focus on addressing urgent needs instead of looking for the elusive and the aesthetic. Based on my personal experience of teaching young computer engineering students, it is clear that the solutionist stance is very strong in their minds. Students being supported by a technical university refer to market needs and work with agile methodologies to deliver solutions to such market needs. This rush to action to solve "problems" in our life and in societal development, seeing everything through a problem-solving lens, does not bring value to all aspects of human life (Ferreira, 2015; Morozov, 2013). The solution is not always more technology or building infrastructure. There is also a need for the complexities of culture, organizations and people to come together, as we are complex human beings – not machines that can be maintained and kept perfect only if the right machinery is around.

To engage with technical development in a different way, Ferreira proposes replacing the idea of "solving a problem" by engaging with technology as a path to enjoyment, instead (Ferreira, 2015). He frames play and playfulness as a human right, a human freedom (Ferreira citing Amartya Sen, 2015). Playfulness becomes an alternative stance, opposing the solutionist approach, bringing other forms of humanizing.

To some, the rapid development of digital interactions makes them long for the past, wanting to return to the old ways. But one way of seeing the post digital as disruption in itself lies in how it brings the digital onto a human scale, returning to playfulness and engagement, as a developed and finished phenomenon, normalizing it in our daily conventions, and how it "is a condition in which digital disruption is not transcended as such, but becomes routine or business as usual" (Berry and Dieter, 2015).

Post-digital hacking tactics. To achieve disruptions – or at least point to possibilities for disruption – I came to use a set of specific tactics that can be broadly categorized as hacking. These comprise two fields of hacking: one is with design practices including a lo-fi attitude towards technology manifest in the maker culture (Landwehr Sydow & Jonsson, 2015; Lindtner, Hertz, & Dourish, 2014), tinkering (Jacobsson, 2013), deconstructivist approach toward design (Murer, 2015; Murer et al., 2015), reverse engineering (Murer et al., 2014), and repurposing (Les, Churchill, Denoue, Helfman, & Murphy, 2004; Lin & Huang, 2010; Robinson, Pearson, & Jones, 2014; Sant, 2015). Another field involves a broader understanding of hacking activities through disrupting and hacking the overall systems (for instance, political-economy, capitalism or neoliberalism) in accelerationism (Berardi, 2011; Noys, 2014; Wolfendale, 2014), for example, taking a particular segment of the system and accelerating it to the maximum

limit until it breaks, hacking activism (Bazzichelli, 2013; Bazzichelli & Cox, 2013), for example, taking active stances and speculating on alternative models within various systematic models, or as seen above with examples in the sharing economy. These also cover artistic interventions and aesthetic principles with accelerationist aesthetics (Shaviro, 2013), for example, with the "Protest-Lab" project – fighting for public in-terest and gaining public spaces back from processes of gentrification – by Nomeda and Gediminas Urbonas.

This aesthetic tradition introduced by Shaviro (2013) as a reference to Accelerationism (Noys, 2014) arrives from the political economy, but in relation to the arts. Shaviro discusses how modernist transgression and current accelerationism could be relevant to understanding capitalism. But he also refers to the ways that artistic practice could be employed through accelerationism. Shaviro phrases it thus: "...there is no Outside to the capitalist system, capitalism can only be overcome from within" (Shaviro, 2013). I found this "overcome from within" approach evocative and have employed it in my own art practice. Shaviro discusses such an approach in relation to the aesthetics of political strategy. Shaviro states that accelerationism is keen to make an appropriate change in capitalism and overcome it, and the aesthetic way is more of an illusion, the way we may use this strategy for artistic aims and with aesthetic ends and without an attempt to ruin or radically change anything.

Hacking entails a form of practical exploration and research that examines processes and materials through their imperfections and malfunctions. Cramer states: "It is a post-digital hacker attitude of taking systems apart and using them in ways which subvert the original intention of the design". This understanding has shaped my work and my contributions to the post digital in HCI. I build on the material design perspective, aiming for disruption, as introduced and discussed above, but I do so through hacking techniques. These hacking practices pave the way for structural thinking through which I have got to know the system from within.

The process of hacking involves several steps: first, we need to identify disruptive situations (and collisions of structural elements in the system); a second step involves applying a deconstructive method (on a design level it is more a process of dismantling) to get inside the system; and the third is to make a significant change to it.

3. RESEARCH METHODOLOGY

3. RESEARCH METHODOLOGY

My research combines qualitative research methods with an artistic practice-led approach. What is particularly unique to this research is that it is being conducted by the artist himself (artist-led rather than user-led or researcher-led). I become an insider to the processes, not a researcher looking at these processes from the outside. Others who have worked in this manner – but not as artists – more as design researchers, frame their work under the header "autobiographical design" (Neustaedter & Sengers, 2012). In this respect, my way of working has a strong interdisciplinary nature and could be described as being somewhere between Research through Design (RtD) and Research through Art (RtA) (Frayling, 1993). These two primary methods and their combination in my work and through my own method Research through Art and Design (RtAD) and other influential approaches will be explained below. A lot of development work on different Constructive Design Research[12] (Koskinen et al., 2011) methods has also been conducted. Let us therefore dig a bit deeper into this development work in order to better frame my activities.

3.1 Inquiry into the arts and design

The art projects I have engaged in embody the research theme and the broader thematic questions and eventually answer my research question. The questions I address in the thesis are concerned with the organization of production and the set of procedures of creative processes. I articulate how the projects are produced, which and why particular aesthetic and conceptual decisions have been made in regard to the specific project. Following this, the thesis is shaped around the creative and production processes of my projects in relation to the main theme – the post digital. The research I conducted has many different roots, but, in general, the main emphasis is based around the artistic research methodology, which according to Hannula and colleagues refer to production and creative processes articulated: "Artistic research means that the artist produces an artwork and researches the creative process, thus adding to the accumulation of knowledge" (Hannula, et al., 2005).

Thus, my focus in research and methodology can be described as Research through Art (as described by Frayling, 1993). According to Frayling, it consists of material research (in my case engaging with both digital and analog technologies), development work and action research (in my

[12] Koskinen et al. (2011) use the term "Constructive Design Research" as "design research in which construction – be it product, system, space or media – takes central place and becomes the key means in constructing knowledge".

case through exhibitions and displaying my art at academic conferences). From this perspective the research is based around the process of making art from material explorations, researching the production process. According to Busch, in the Art as Research method (2009), the research is considered to be part of the artistic process and "scientific processes and conclusions become instruments of art and are used in the artworks". Busch further expands on Art as Research claiming that how the artist carries out the artistic process is a core for the knowledge production.

However, I also see a significant connection to my theoretical motivation and the theme and foundations of the post digital with the Research into Art (RiA) method (Frayling, 1993). According to Frayling, RiA is the most straightforward research in the art field and comprises Historical Research, Aesthetic or Perceptual Research and "Research into" a variety of theoretical perspectives: cultural, social, material, technical, structural or political. This "Research into" is taking a strong position in my research and is well articulated through the Background sections of the published papers. I strongly believe that all research has to be grounded in theory and supported by it and, above all else, in practice-based artistic research the theory has to lead the practice. Busch (2009) emphasizes the importance of art engaging with theory and how art practice in general is highly saturated with theoretical knowledge. This interconnection between practice and theory, which is a basis for a process called praxis, mirrors research conducted in artistic settings through practice. Theoretical perspectives and foundations always form part of my considerations in the creative processes from reconsidering the concepts and reflecting on the references of other examples and theories, which are particularly relevant to a specific project. This is a form of ongoing conversation in action (relates to Schön, 1983) between theories and concepts through material and aesthetic considerations during the production process.

As I am a conceptual artist, I see art practice as a process of praxis, that is where theory, practice and reflection are intertwined and the whole artistic processes is in dialogue with theory. Busch continues on the theoretical foundation in art through the Art as Research method as follows: "...theory is now interpreted as a constitutive element of the artistic practice itself, and scientific methods of research and knowledge generation enter into the artistic process". This reflects the art merging with a scientific attitude through seamless intertwining. Bridging theory and art practice we come to a process, in which, according to Busch: "This is not about researching in order to produce an artwork; the work is the research" (Busch, 2009). Her attitude towards the understanding of art in general and its relationship to research refers to a critique of a traditional understanding of art in correlation to beauty and aestheticization, and,

bringing forth critical stances, which strongly couple with my understanding, she writes: "...artistic work does not claim to produce a "work" in the classic sense of the term, but rather (often critical) knowledge, so as to use artistic means to analyze the present day and its social conditions and their structures" (Busch, 2009).

Combining conceptual work with the actual production of an artifact includes several perspectives from the arts and design disciplines. In my processes, I deliberately refer to two disciplines and research traditions: Research through Art (RtA) and Research through Design (RtD). Both of them creatively uncover new perspectives and explore new ways of dealing with information, aesthetics and knowledge. More specifically, both methods cope with practice-based research, but research things in a slightly different manner. These two methods, RtA and RtD, are derived from the fields of art and design (Frayling, 1993) and, in my case, they merge and could collectively be called Research through Art and Design (RtAD). Through my work I argue that such a method brings a convergence of the two fields into one research paradigm, not separating them, but making an inclusive artistic area in which both fields flow together. The specificity of such research is its hybridity and combination of research methods and approaches, which derive from the arts and design, although it is generally undetermined what research in art precisely means and the clarification of terminology is still an ongoing debate (Biggs & Karlsson, 2011; Busch, 2009; Hannula, Suoranta, Vadén, Griffiths, & Kölhi, 2005; Michelkevičius, 2015). Several examples of these debates on terminology are listed and discussed in (Jullander, 2013, and Biggs & Karls-son, 2010): "Attempts have been made to distinguish between different meanings of such terms, but none had won universal acclaim" (Jullander, 2013).

Compared to RtA, RtD is a more structured method. In the HCI community, researchers employ designerly ways of knowing and it is the most established method in the design community through which design researchers produce design artifacts and articulate their research findings (Gaver, 2012, Frayling, 1993, Koskinen et al., 2011, Zimmerman et al., 2007). Through this they wish to highlight designers' practice work as a research instrument in which designers can frame their own research articulation through the practice and contribute by taking advantage of the real skills that designers possess. Such a processual aspect of practice-based research is reflected in design research through comments by Nigel Cross: "Design knowledge resides in its processes: in the tactics and strategies of designing" (Cross, 1999).

The early framings by Frayling of such design research are as follows: applied research, action research and fundamental research. The first is where the resulting knowledge from practical problems is used for a par-

ticular application; the second is using action to generate new knowledge and the last is basic research through studying the fundamental aspects of a phenomena. In this respect, my methodological stances would be closer to Action Research and its efforts to generate and validate a new knowledge contribution through the action.

In this regard, Schön (1983) expands well on the creative and reflective processes in practice through the action. He combines materials and design processes through so-called conversations, when the designer reflects upon the materials and situations and makes decisions in real-time action.

Both RtD and RtA emphasize the organization of production and the sets of procedures that occur in creative and production processes. Producers (artists or designers) generate knowledge through their practice work and eventually their knowledge is also communicated in and through the final artifact. The process of production needs to be structured and driven by argumentation in order to work with "design rationale" and design for "rigor"[13] (Moran & Carroll, 1996). Not only does the production utilizes practical processes, skills, actions and materials, it also involves concepts and situations. This resonates with my artistic practice which is, as discussed above, highly concept driven. Important to this process is the thoughtfulness (Löwgren & Stolterman, 2004) and slowness (Hallnäs & Redström, 2001; Odom, Banks, Durrant, Kirk, & Pierce, 2012) of the process. Compared to my personal experience of being engaged with design and art production processes outside academia, it became clear that slowness and thoughtfulness is a core feature of research practices. Seeing significant differences in educational settings, I could argue that art schools give students more time to think and rethink the processes they go through, while design and technical environments are, in most cases, driven by economic principles and market needs and pace, so scientific students and researchers have no extra time for iteration or another cycle of rethinking. Hannula (2013) discussed time and thoughtfulness in artistic research as follows: "The central aspect of any serious and self-respecting research project, along its long-term commitment and slowness, is the task of digging deeper and staying with".

The philosophical foundations of research conducted through art or design emphasize the difference between scientific and artistic research. Artistic research enables particular forms of knowledge production, which are not necessarily related to rigorous and traditional scientific structures or methodology. I would argue that art in general cannot be structured

[12] In RtD, the term used is "design rationale". It is a concept that is being debated as the creative process of design is not always a rational process where one step inevitably leads to the next.

by or follow a positivist scientific methodology in which a hypothesis is being proved against a theory and some empirical work. However, we can combine various approaches, in which certain methods may derive from an artistic foundation and others pertain more to a structured, step-by-step validation of work, creating an interdisciplinary way of achieving fruitful results. Artistic research is a specific artistic form of knowledge, according to Busch (2009): "Art as a different form of knowledge permits, therefore, a subversion of science when it refers to the exclusions inherent in scientific knowledge production". According to this, its significance is less about "...showing the invisible, but rather showing the extent to which the invisibility of the visible is invisible" (Foucault, 1987). This quote from Foucault shows the possibilities in complexity and the attitude of how to look at things and that not all things are measurable and have a reductionist approach between the two divisions.

The emphasis on hybridization of the field with a collision of art and science is shown in what has been called Hybrid Research methods. Busch frames these as follows: "...the sciences did not culminate in the scientification of art, but rather in the development of an intermediary zone where both the arts and the sciences should each be able to mutually interconnect". She refers to Derrida, through bringing forth Derrida's understanding on the importance of openness in experiencing the unknown, or the impossible (Derrida, 2002) and "the fact that art is dedicated to phenomena that cannot be ruled by scientific-experimental classification is, of course, an inevitable topos in art theory. Traditionally, art is committed to representing the ephemeral forces and manifestations that emerge spontaneously and involuntarily. This opening for the unknown, yet the imminent and the yet to come, means that cultural sciences are making a step in art's direction" (Busch, 2009). This follows up research conducted in HCI on aesthetic experiences, which are difficult to formalize and design for (Boehner, Sengers, & Warner, 2008).

3.2 Autobiographical approach

Autobiographical work lies at the core of this thesis. It is an inherently artistic position that is taken by most artists. My aim is to articulate my artistic practice-based research and take into consideration the production processes of my artworks, as well as some accounts of user encounters reporting on their experiences regarding my work. An autobiographical approach engages the artist as artist and user in the same person, being engaged in both producing and experiencing the work simultaneously (Neustaedter & Sengers, 2012). So, what I do here is examine my work from my own experience, seen both from the author's and

the participant's perspectives. This approach is seen in particular in those instances when my art is performed as, for example, in the *S T R A T I C* audiovisual show, where I performed my own work live. In this show, the immediate performance happened in the here and now, the spectacle was created in real time. I created the work right in front of the audience, but I also experienced it together with the audience (see Paper C).

In the field of interaction design, when the HCI researchers Neustaedter and Sengers discussed autobiographical design, they noted that the target user in an autobiographical design process becomes the designer him/herself.

In summary, in my practice-based RtA process, I am both the researcher and practitioner in one and the same person. I incorporate all levels of the production and inquiry into the artwork, from the creation process as artist or designer.

3.3 Interdisciplinarity

Looking at my own experience with a background from fine arts, working with design, working in photography and video art, exploring other forms of media art, and eventually now entering the very technical fields of interaction design and media technology, as well as also working in the field of Human-Computer Interaction (HCI), I would like to acknowledge the active amalgamation of these fields. I find these disciplines and fields of equal importance to my practice and research. I do not separate them into disciplines and look at them from a segregation perspective, but instead try to see them as a single whole. In a way, the disciplines bypass their specific parameters and seamlessly merge into one practice and research process.

But this view is not a given in the intersection between HCI and the arts. For example, Sengers and colleagues (Sengers & Csikszentmihályi, 2013) claim that: "Still, there are many reasons to believe that HCI and interactive art (IA) are basically incompatible, as their goals, methods and forums are often completely different. Art practice traditionally shuns scientific method and sees much HCI as too incremental and conservative. HCI practitioners may find contemporary, conceptual art practice incomprehensible". This shows how these two fields differ from each other and that they have different approaches. However, looking from an artistic perspective in regard to researching the production process and in relation to materiality issues we could bring a broad range of "materials" to work with. The same attitude could be applied to theory as material for exploring a particular discourse, and we can say that scientific methods could also become an artistic practice in themselves.

My own work has entered this "incompatible" space between these disciplines. I have consciously striven to invite contributors from various fields (not just as intermedia (Higgins, 2001) practice taking an interdisciplinarity path with artistic genres, but also from outside of the arts). My personal work combines many different disciplines and subjects and, in particular, looks into the niches in-between the disciplines and tries to find new connections and create assemblages. Multidisciplinarity combines several disciplines but my ultimate aim has been to not emphasize any particular one. Transdisciplinarity or crossdisciplinarity crosses multiple disciplines in a linear fashion and makes clear connections instead of mixing them. However, I characterize my work as interdiscplinary, which finds importance in the in-between gaps of the disciplines and seeks for the extremes and edges. I would argue that some attributes that derive from the edges of the disciplines, not from the thematic cores of the disciplines, are of major importance to interdisciplinarity. With an example from engineering, if we take a creative live-coding[14] practice, it could be seen as a marginal and extreme case in the coding discipline, which may entail audio and visual appearances, additionally incorporating the exposure of live code and glitch aesthetics, in a performance.

An overarching approach of my art practice and research is interdisciplinarity, making use of different artistic, scientific and technological resources. The fields that primarily inform my artistic practice and research are contemporary art that comes from the fine art tradition[15], visual studies, image and critical theories. The field of media with its media studies and media art and new media art represent the humanities and more of a humanistic understanding of the technological domain, instead of being rigorously validated, scientifically. The humanization of the technological domain and the demand for a new dialog between humanistic and scientific methodologies in the field of HCI have been discussed by Bardzell and Bardzell (2015). Thompson Klein (2004) discusses bridging disciplines through transdisciplinarity in which knowledge of complexity and choice instead of solution in problem-solving is emphasized. Looking at it from an artistic perspective and working in an interdisciplinary manner in the field of contemporary art, it is important to highlight the influences deriving from the conceptual paradigm and navigating through post-conceptual art perspectives, which shed light on articulations about critical and conceptual discourses.

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[14] Live coding is a form of performance art in which the sound and visual performance is produced live by writing a source code as part of the performance.

[15] By "contemporary art that comes from the fine art tradition", I am referring to the contemporary visual arts sphere which has more of a traditional conceptual grounding than other cultural forms such as cinema, music and theatre.

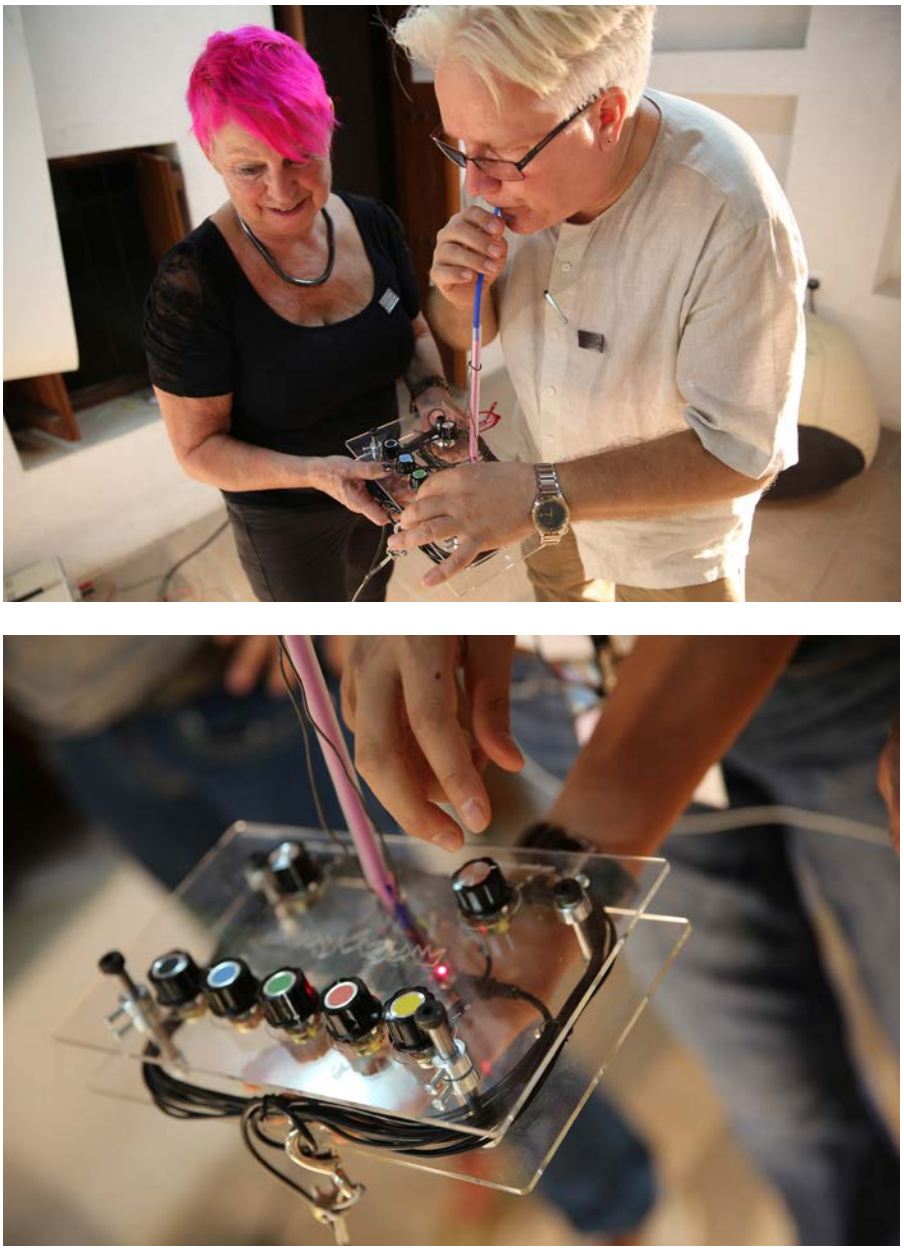

Figure 18. *Metaphone*'s version with a blowing interface, which consists of a blowing sensor and turning knobs.

Two recent developments concerning the issue arrive with the concepts of post-disciplinarity (Nyström, 2007) and anti-disciplinarity (Ito, 2017). In these methodologies the disciplines are seen from beyond the disciplinary perspective. These less developed but more recent approaches are closely related to my work through not encountering disciplines from their perspectives but challenging the way disciplines could be seamlessly merged.

I mainly use art as a platform for my practice and research, but the interactive concern derived from HCI and interaction design is always present. In particular, I am interested in those aspects of interaction design that couple contemporary art practices with materiality issues. In my thesis it manifests in some of the choices of methodology and production processes, as well as in how I articulate my knowledge contribution.

3.4 "Conversations" with materials and situations

My practical work is closely connected to the materials and situations I reflect on and re/shape. I try to create other situations, systems and artefacts, which transform those previous situations into something substantially new, add value to old situations, or bring forth unusual combinations.

A core process in my work can be described under the heading of "Reflection-in-action" (Schön, 1983), i.e. getting involved in a conversation with materials, whereby the knowledge embodied in professional practice is exercised and developed, including framing and reframing problems and questions, exercising knowledge during practice and reflecting on the results (Schön, 1983). This is how the four stages of, for example, the *Metaphone* machine were developed: design, reflection, re-design, feedback from exhibitions and so on. The first version of Metaphone was built as an interactive apparatus picking up on vocal expressions (hence the name Metaphone). In a second step, bio-sensing technologies were connected using an electroencephalographic (EEG) sensor: the interactive apparatus receives brain impulse emissions and translates the impulses into colors. In the third phase (the one discussed in the thesis and Paper A) of the *Metaphone* project, the drawings are based on data from biosensors (GSR and HR) that pick up on aspects of the participant's emotional processes. This came about as a response to my move to KTH, encountering a whole range of biosensor-based technologies and applications, such as Affective Health (Ståhl, Höök, & Kosmack-Vaara, 2011), Brainball (Hjelm, 2003) and Xth Sense (Donnarumma, 2011). And finally, the fourth version of the machine transformed into an audio-visual instrument via playing it through a blowing sensor and knob-turning interface (see Figure 18). This took place

as I was working with Anders Lundström and we were reflecting upon the *Metaphone* machine as a musical instrument with more precise interactions.

Analysis of the materials, thorough examination of the content, information and interaction, and consideration of the context in which the project is installed or with whom it is shared – influenced the development of the projects. As we were developing multiple versions of the *Metaphone* and exhibiting them in various contexts, we reconsidered the project and came up with several future scenarios. The other art projects presented in this thesis have similar iterations, which I will detail below.

3.5 Performative aspect of research: situatedness and Relational Aesthetics

How research is conducted is a key issue in validating the results, but is also of primary importance to the core of the research and the way it was conducted. Performativity in research results from reflexive negotiations with the subject of research and, as I demonstrate below, situatedness and contexts are crucial impactors.

An academic study of design does not solely concern the process of shaping artifacts, nor the study conducted from outside of the practice, which empirically documents what designers do. Academic design research also includes engaging yourself actively as a design practitioner, immersing yourself within the process and performing design actions simultaneously. In the latter case, our aim is to engage with the research being conducted within the processes, as we perform it. It becomes important to understand how the producer is involved in real situations, relating processes to autobiographical negotiations and how these processes shape the understanding of what we do (Boehner et al., 2008; Dalsgaard & Hansen, 2008; Höök, Sengers, & Andersson, 2003; Neustaedter & Sengers, 2012). Hannula (2013) frames the question thus: "What is it that you do when you do what you do?" This question tries to frame the importance of reflection in action. In other words, the importance of the question – how do we perform the research in action? – becomes the core research activity. Simonsen and colleagues (2014) describes how situations and reality affect our behavior in relation to the research we conduct: "...research is shifted from a position of providing perspectives on a reality that forms itself regardless of research, into a position of making reality while researching it. Research not only describes what it studies, it also makes, creates, enacts and designs. Inquiry forms part of the enactment of reality; research is performative" (Law & Urry 2004, see also Mol 2002, Law 2004, 2007). Situated design methods by Simonsen (2014) in

relation to artistic research Hannula (2013) talk about the importance of engaging in reflective discussions in the research environment: "... that allow us to concentrate and to focus both on analysing what someone is doing and at the same time analysing and thinking about what we as participating agents are doing".

This way of studying design places the importance of situatedness at the core of our design research activity (Haraway 1988). Design researchers propose a "Situated Design methods" (Simonsen et al., 2014), which refers to Haraway's (1988) notion of situated knowledge, arguing that knowledge is situated and partial. Knowledge production takes place under specific historical, political and situational circumstances. She also argues against universal knowledge production and relates it to a need to actively involve researchers in their activities, so the participation within the processes is not separated from the research results and claims. The universal knowledge production refers to a certain proposition that by removing a researcher from the active research processes such method in turn progresses to objectify the claims and such approach supports the objective knowledge, is not supported by Haraway's stances.

Suchman (1987, 2007) challenges the traditional view of the relationship between plans and action by proposing that plans are merely resources for situated action. This means that plans are no longer seen as set procedures to be simply acted out but as guidelines that can be modified in accordance with the situation at hand.

Situated knowledge is a particularly relevant perspective in my research conducted from this internal, performative perspective. My work enacts this approach through artistic practice when, as an artist, I become engaged in these situations and perform them from inside of the processes. The situations I work on constantly change during the production and exhibiting processes; different contexts in creating my artworks (for example, *Panorama Time* photographs captured through a train window) and working with contexts when exhibiting in different settings.

Bourriaud introduces the concept of aesthetics discussed in relation to broader contextual narratives in the field of contemporary art, better known as Relational Aesthetics (Bourriaud, 2002). He tries to connect human relations to social context and explains how social life influences everyone's decisions. According to Bourriaud, relational art encompasses "a set of artistic practices which take as their theoretical and practical point of departure the whole of human relations and their social context, rather than an independent and private space" (Bourriaud, 2002).

A relational artist might, for example, create a situation in which the artist and the audience interact through a conversation. A particular environment could be produced to create a social environment in which

people come together to participate in a shared activity. The created situation is an artwork in itself. Relational aesthetics through social relations create a social experience. Bourriaud claims "the role of artworks is no longer to form imaginary and utopian realities, but to actually be ways of living and models of action within the existing real, whatever scale chosen by the artist" (Bourriaud, 2002). This claim emphasizes the role of the existing real, which takes precedence over artificial ends. By creating social situations in which participants immerse and act according to certain rules, the role of the artist and issues surrounding authorship arise. The shared experience through interaction leads to a focus on relations, which bring meaning through the interaction. "(Relational Aesthetics)... refers to artwork that is open-ended, interactive and resistant to closure. Relational Art takes place in time and space and creates interactive communicative experiences and intersubjective encounters in which meaning is elaborated collectively" (Biederman, 2006).

3.6 Criticism as a design method

RtD also engage with a form of design that is referred to as critical design (Dunne & Raby, 2001), in the context of HCI, it critically examines the role of technology in design processes incorporating design fiction and speculative design approaches. In general, a common practice for any design work is to criticize designs during the design process, although more advanced criticism and discussions on broader discursive levels are established in HCI through critical and discursive design practice as manifest in the design itself. In short, critical design practices will bring forth design artifacts or interactions that are not intended to become real products as such, but that embody a critical examination of already existing designs, problems and ideas that flourish in the field or targeting aspects of social, political or any other important aspect of the discourse. They often serve the role of provoking debate within the internal academic discourse – not necessarily aiming to bring forth usable products or discussions in society.

Another path to criticality in the interactive realm has been proposed by Bardzell (2011). He sees an opportunity to establish interaction criticism based on the way the humanities reads a "text" in HCI. Bardzell argues that there is a connection between the interface and user experience in engaging with the aesthetics of interaction and assisting the cultivation of more sensitive and critical reactions to designs. These critical stances render critical practices that are derived from aesthetics, analytic philosophy and critical theory. They all occur in practical work that entails fictional and speculative design proposals, using critical theory as a lens to design new critical artifacts.

Looking at criticism as an aesthetic value, we can become engaged in practices through justification and evaluation, helping practitioners, researchers and critics to look at things critically and to judge various forms of culture. Thus, in critically seeing the aesthetics of interaction we may cultivate a more sensitive approach towards our practice and knowledge production. In the field of interaction design and HCI, Bardzell (2009) frames interaction criticism as follows:

"It is a strategy that enables design practitioners to engage with the aesthetics of interaction, helping practitioners cultivate more sensitive, insightful and imaginative critical reactions to designs and exemplars. The benefits of such an engagement can include informing a particular design process, critiquing and innovating on design processes and methods more generally, developing original theory beneficial to interaction design, and exposing more robustly the long-term and even unintended consequences of designs" (Bardzell, 2009).

Such a critical attitude in my research spans both the arts and design. The first questions and criticizes the established norms in broader terms, while the second manifests in bringing critical thinking to the process of design. For example, if we look at the Metaphone, the overarching critique of a straightforward control in our interactions with technology is questioned, and it is a way of loosening these narrow assumptions. From the design perspective, criticality enters the production and design phase and entails the aesthetics of interaction as "sensitive, insightful, and imaginative critical reactions" (Bardzell, 2009).

For interactive arts, "emptying the material of all its potential" involves not only the various materials and situations that the artwork is constructed from, but also the dynamics of how the interaction unfolds over time (as this is a unique quality of interactive, digital materials), in other words, the aesthetics of interaction. The contemporary notion of aesthetics does not invoke traditional forms of the beauty or the sublime but implies other specific aspects of the particular field and discourse. In the field of interaction design, the Interaction Aesthetics discussed thoroughly by Löwgren (2009) emphasizes the qualities of aesthetic interaction. When we strive to contribute to interaction design, then the qualities of interaction become the main criteria for discussing interactive aesthetics. According to Löwgren these are: time-based interaction, qualities of artifact and participant's experience. These three criterions incorporate the main aspects of aesthetics in relation to interactive settings, starting with an object, focusing on the interaction between the artifact and the interactor, and what the participant gains via experience through such interaction. On a performative level tensions between user-system-spectator are analyzed by Daalsgard and Hansen (2008).

3.7 A conceptual way of conducting practice and research

The processual attitude towards the production of art raises questions concerning which procedures are taken into account and in which order or priority they are approached. In querying how the artwork is produced, does it take a design priority path and start with a direct exploration of the materials from which the ideas arose, or does it start from the idea and the conceptual foundation and then find paths through the conceptualization of materials? I would argue that the first designerly approach that focuses on material explorations from the start of the process is more common to design disciplines and relates to object production. However, the conceptual beginning drives art and artistic foundations towards the projected aims and during the process it may alter. This is the understanding I have obtained from my practice and experience. However, it has strong ties to a conceptually-based art tradition. Other design approaches are very much problem driven, such as solutionism or like the above-mentioned critical design with an emphasized process of arguing with broader and more critical issues within the design process.

3.7.1 Conceptual Art

Conceptual art prioritizes concepts and ideas versus traditional art issues such as aesthetics and materials. While the material manifestation is not in focus and not always present in its core essence, the concept has the strongest precedence. Such a position is formulated, arrives from the 1960s and has had strong implications to art production thus far. In this tradition the position of dematerializing art objects was deliberately presented (even if total dematerialization never occurred). From the dematerialization perspective in arts, it is also clear that a conceptual issue has been emphasized; it is also prioritized against the physical ignorance of materiality. Art forms that occurred in these times deliberately related to dematerialization, with time-based, performative and ephemeral approaches. Conceptual art also emphasizes the way conceptual decisions are made and that they take precedence from the start, in the way LeWitt talks about his own creative approach: “When an artist uses a conceptual form of art, it means that all of the planning and decisions are made beforehand and the execution is a perfunctory affair” (LeWitt, 1967).

Production of art based on dematerialization questions some of the fundamental ideas about art: the need to express and create from within, with a single, strong artist expressing himself/herself, thereby owning the entire authorship of the art. In regard to his instructions shared with others to produce a work of art, LeWitt said: “To work with a plan that is

preset is one way of avoiding subjectivity" (LeWitt, 1967).

How objects of art become dematerialized through conceptual practice is one of the aims of conceptual art. Another issue that concerns the conceptual artist is referring an art object to the notion of commodity, questioning the artwork's value and relationship to market values. Questions about the status of the object of "art as a commodity" (early examples of Duchamp's Fountain and the concept of readymade), also the discourse around the institutional relationships (institutional critique) turned art into a certain practices. Arising questions about the ways of exhibiting referring to the traditional exhibiting principles of the Salon and "white cube" urged the artists to exhibit their projects in other contexts[16]. Conceptual art initially conveyed meaning through various indeterminate manifestations, but also explication of the process of revealing critical and conceptual foundations. Conceptual art manifests a close relationship with language and concerns the processes and systematic inquiries into an administrative society.

Subsequent instances of conceptual efforts occurred with video experiments in video art (for example, works by artist Nam June Paik). Other forms connected to conceptual art manifested. Video and artistic film processes and approaches took forms through remixing and montage techniques, emerging as a continuation of the dematerialization discourse. However, the flickering of a moving image and the qualities of a TV monitor and analog signals were also crucial to finding references to media art, and emphasis on specific mediums, in this case, highlighting technological development, various signals and formats, the impact of electricity, or intermedia (Higgins, 1965), were brought forth. In many of these examples, processuality was a key aspect and projects were combined with a performative approach.

These issues arriving from the conceptualism are still very strong in the field of contemporary art and media art. As it never went out of scope, conceptual thinking continues to make more impact. With this, the post-conceptual (Osborne, 2013) practices emerged, which continue inquiring into the same topics but in a new, contemporary context, by which we could mean various social changes, technological development and involving new technological processes, such as data. And further, the incorporation of media relates to immateriality, in which digital processes transcend the possibilities of the material world.

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[16] One example of conceptual art in relation to "exhibiting" in public space and coupling social issues with a notion "art as a commodity" is made by Maria Eichhorn is Acquisition of a plot of land: Tibusstrasse, corner of Breul (1997) where she bought a piece of land to address ownership issues of land (http://installationart.net/PDF/Eichhorn.pdf).

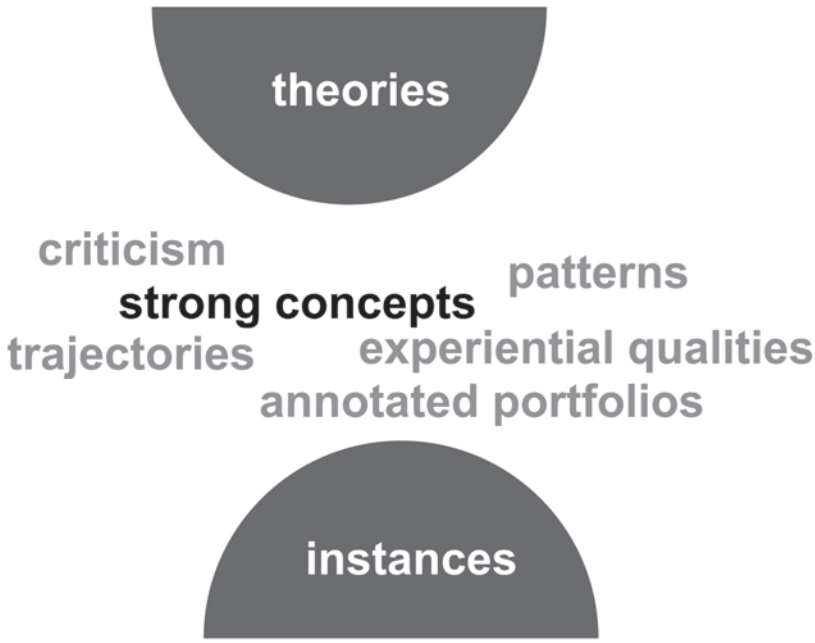

Figure 19. One of the intermediate-level knowledge is strong concepts as described by Höök and Löwgren (2012).

Similarly, insofar as dematerialization never occurred in an absolute non-material substance, it is interesting to note that it is also a conceptual practice in terms of how we materialize the digital. How the digital manifests in the analog or physical world is a question of both materiality and conceptual processes.

It is important to discuss my production process in detail to bring forth the negotiations I deal with. All the work undertaken for the thesis is grounded in conceptual practice. Firstly, an idea emerges (it arrives from research undertaken within an interest area through investigating relevant theory and practice) and after that other decisions will follow. For example, if the idea is about machine aesthetics, as in the Metaphone project, the materials and aesthetics will be chosen accordingly. In other words, the conceptualization of materials and situations occurs after the concept has been re-evaluated but in an iterative and interrelated process. Of course, it is not just a one-way process, as the iterations and the back-and-forth reflections from the concept to the materials and aesthetics take place in a continuous loop. My point here is to emphasize that the final manifestation, the art object itself, is not the main attribute in understanding a work of art. The ontology of art sits not in the object itself, but in the conceptualization and other factors such as situation, context, aesthetics, experience, authorial rights, subjective matters, relationship to other examples of art practice and art history, etc. Discussions and conversations happen not only with materials (as proposed by Schön, 1983), but also with concepts and ideas, and aesthetic considerations constantly appear in the creative, artistic and design process.

3.7.2 Strong Concepts

In design-oriented research, which is interaction design in the HCI field, Höök and Löwgren (2012) discuss the importance of concepts and their relevance to particular use situations. The term introduced as "Strong Concepts" is intermediate-level knowledge, which resides between the particular instances or ultimate particulars (Stolterman, 2008) and a field of theories (Figure 19). There are further examples of intermediate-level knowledge, but we will focus on strong concepts, which reside on an abstract level between practice and theory, i.e. above particular instances.

As we have seen from the conceptual art example of Sol LeWitt (1967), he has focused on the generativity of art with his instructions. In design, strong concepts have a direct role in supporting other designers to produce new designs. In the paper, Höök and Löwgren (Höök & Löwgren, 2012) present two strong concepts, which arrive from the past and have already matured – social navigation and seamfulness. These strong concepts open design space for designers to relate to and design new artifacts through

these already established concepts.

How I see the ideation process in design differently from conceptualization is that ideation is a smaller and partial phase in the design process, but the conceptual way of doing things is an overarching approach that covers the entire process. In concept-driven art, the idea takes into account all processes of creation with its ideation, all phases and forms of production, and the final reception and perception of the artwork. Looking to design theories, Kolko (2010) discusses ideation as a creation of ideas and possibilities, and synthesis is a deeper engagement with the ideas for developing the project.

I appreciate how conceptual art and strong concepts take precedence in artifacts and projects. It has been well articulated in strong concepts that concepts are generally abstractions of our processes, and I agree on the existence of such intermediate-level knowledge, which resides in between theory and practice. Thus, this shows how artists work with theory and practice, how concepts bounce inside theory and particular instances of practice, and how conceptual approach might be of relevance to all practice and creative processes. However, it is important to mention that in art the conceptual attribute is taken more broadly than in design research and is not elaborated on a methodological level, but takes such understanding on a wider level via articulating it more specifically through the particular instances in practice and in concepts.

3.8 Deconstruction approach

As discussed in Chapter 1 above, in my work, I have made use of deconstruction as a means of analyzing the internal constructs; firstly, qualities and assumptions implicit in situations and artifacts and, secondly, systematic and processual inquiries. The first is concerned with materiality design (this could also be seen as the dismantling of a system) in which the knowledge is embedded in the artifact, while the second refers to artistic practice and philosophical attempts and assumptions through engaging in critical and conceptual idioms.

A deconstructive stance basically entails attempting to see what is there from the outside, stepping back and aside from the work process and breaking it into pieces. However, the most important approach is based on being inside the system, analyzing and understanding it, accelerating it from inside and trying to break it into pieces from the inside, while being active in it and researching. The advantage is that this may allow us to create entirely new situations, artifacts and knowledge rather than adding to what is already there. Practical work on analyzing interaction discourse is used to understand situations, including the analysis of

content and context. And following on how Murer and colleagues describe deconstruction process in interaction design: “deconstructivist perspective supports reflection on the act of taking apart form, function, meaning, concepts, or artifacts to enhance our knowledge and expressional vocabulary for a form-giving practice in interaction design” (Murer et al., 2015).

Gaver emphasizes building upon previous results through analyzing them, but also deconstructing them before constructing something entirely new: “We may build on one another’s results, but we can also usefully subvert them, suggest alternatives, or establish entirely new constructions, and this applies equally to our concepts, methods, processes, artefacts and approaches to evaluation” (Gaver, 2012).

3.9 Reflection on the work

At various stages of the production and research work, I applied the Annotated Portfolios[17] method (Gaver & Bowers, 2012; Löwgren, 2013) to reconnect my practice and research with the concrete research theme and question, and also relate to the work I have undertaken, re-examining several art projects and trying to link them conceptually. This mode of inquiry helped me concentrate on the practical work and reflect on it, relating it to its theoretical roots, not losing the common thread, but following it. Through finding connecting terms and concepts, which related to several projects simultaneously, I could gradually reconnect them to each other, but also continue developing the work towards the broader discourse of the theme of the thesis, not focusing on one project at a time, but seeing the whole picture (see Figure 20). Throughout the process, I worked with several projects simultaneously, also bringing back old projects, revising and rethinking them.

Figure 20. Annotated portfolios of my work.

[17] Löwgren (2013) describes Annotated Portfolios: ”the notion of annotated portfolios entails selecting a collection of designs, representing them in an appropriate medium, and combining the design representations with brief textual annotations”.

According to Hannula, with his phrase and essay “What do we do when we do what we do” (2013), the work can be researched after the production phase through the process of the investigative lens. My research is a practice-driven work, the practice takes the major presence and it leads the research, and how Busch (2009) argues about the close relationship between practice and theory. So there is sometimes a need to revise the process and the results and get them articulated not just in the middle of the production phase, but also after you see the whole picture. It is important for me to signify that the artifacts in themselves, like design artifacts, art projects, images, installations, and exhibitions, in short – production and dissemination – are all integral and key elements in my research, which are not separated or fragmented from the whole art project. Stating that an art project consists of elements does not lead to an understanding that the project itself could be dismantled into pieces in return to call those integral elements as independent objects. An art project is an integral piece of work, which could be read just with the all-inclusive parts and could be seen as just a single whole piece. So rethinking the already finished work with its context and other relevant components lies at the core of comprehending a piece of art. However, finding other relevant contexts in which to install the work, or if the installation has multiple exhibitions in different contexts, they all become endemic parts of the art project. All this makes it sensible to revisit the project from time to time and even after the project is completely finished. This way of reflecting and researching gives new perspectives to the project and might influence future work and references.

3.10 My own research approach: RtAD

My own research methodology refers to the above-mentioned approaches and methods, which are concerned with principles that drive research not on the user, nor the consumer experience, but take stances from a broader humane perspective, taking into account a whole “life experience”. The humane perspective is a matter of making a subjective decision, the way the artist examines the world froms his own subjective experience and arrives at personal assessment. However, a program with a humanizing approach regarding technology lies at the core and is always present throughout the entire methodological process.

During my studies, I have built a research program comprising four different art projects in relation to the interconnected concepts. All of these ran partially irrespective of one another, partially inspiring one another, one spurring the next. This builds on Redström’s program’s theory (Binder & Redström, 2006; Redström, 2017) in which experiments and building

exemplars are key, but where an enclosing program with certain starting points – aesthetic axioms – are taken as starting points. The program is filled with content through the building of exemplars, developing and changing the program in a mutually constituent process. If we look at my work, the program concerns the humanization of technology and post-digital qualities, underlying the various design/art manifestations. While the artifacts are different from each other they arrive from and contribute to the same concepts/aesthetic axioms I have chosen to explore the program from a broader perspective and try to expand it with different media and platforms. That is why we find a mobile application next to a machinic art installation, live performance, and a hacked daily-device to produce broken storytelling – all formally different but belonging to the same program.

The projects have not been built in a linear, chronological way, they all were over-lapping and taking their own space in different times. But we can say that I have started with the *Metaphone* and machine aesthetics and moved further deepening my research and developing concepts in relation to the post-digital issues. The research program was shaped in the way I present it in this thesis, *Metaphone* first, *Delete by Haiku, S T R A T I C* and *Panorama Time* as a latest work. I have also worked on other projects in parallel, which seem to be out of my program and less relevant to the topic. But all of them share a specific post-digital program under which these projects and concepts underlie.

If we look at my process from a design perspective starting with the concept and then getting our hands on the materials, all these processes are driving my reflections and "conversations" (Schön, 1983) with the concepts, materials and aesthetics. We start with one, but we lose track of what came first or what comes next, as iterations and conceptualizations take over. The conceptual drives the materials and aesthetics towards conceptualization to meet the program. The conceptual process leads the design to look beyond the object's self-referential approach towards a broader contextual (standing outside of the object) issue, so the ontology of the object spurs from outside the object, and refers to a constituent discourse, instead of to an object itself.

The ontology of art is not comprehended in order to see the ontology of artworks as objects. In other words, art is not just a practice that aims to produce an object, nor should it be emphasizing the primacy of that object, according to Heidegger and Gadamer (Bertram, 2016). It is also about the recipient's experience, interpretation of artwork and eventually a transformation of the person who experienced the work of art. In order to understand the work of art we have to engage in an evaluation process; we interpret and experience the work of art, but the work of art

also speaks back to us, it transforms us through our experience of it. This approach inquires the understanding of the ontology of art being engaged with everyday practices. How we reflect on art object, which takes a similar approach like other things in our everyday human practices, but refers to something external and outside of the object.

In the discussion about the difference between a work of art and a daily object, we find that the ontology of an art object does not merely entail the properties of the object, it requires a broader discourse to be covered. Art must be understood as a practice of reflection (Bertram, 2016).

Through my proposed Research through Art and Design (RtAD) method I examine the conceptual, critical and performative aspects of my art projects. Through these frameworks I engage with my practice and approach situations and systems through hacking, disrupting and accelerating lenses. These concepts lead the whole process: criticality is relating to higher level questions, e.g. engaging with societal issues; performativity is important to the processuality – both to the system's inner behavior, which becomes disrupted through its own means, and also in the design processes, which relate back to materials, concept, and aesthetics.

In the chapters below, I discuss my four major projects that constitute part of my knowledge contribution and I also discuss knowledge extracted from them, i.e. their relationship to the theme of the post digital through humanizing aspects and its element of materiality on the convergence of the digital and the analog. I also expand on other qualities of the approach with concepts such as: machine aesthetics, digital upcycling, or fault aesthetics and glitch aesthetics – my contribution to the field of interactive arts as well as more generally to the academic field of human-computer interaction. My aim with these concepts is to abstract from the specifics of the discussed projects and provide insights in a form that might be relevant to others attempting to address their unique art and design settings. It also includes my understanding in terms of how these knowledge results and insights explore the concept of the post digital and commit to the program with the humanization of technology, and what we can learn from them.

4. FOUR PROJECTS: METAPHONE, DELETE BY HAIKU, S T R A T I C AND PAN-ORAMA TIME

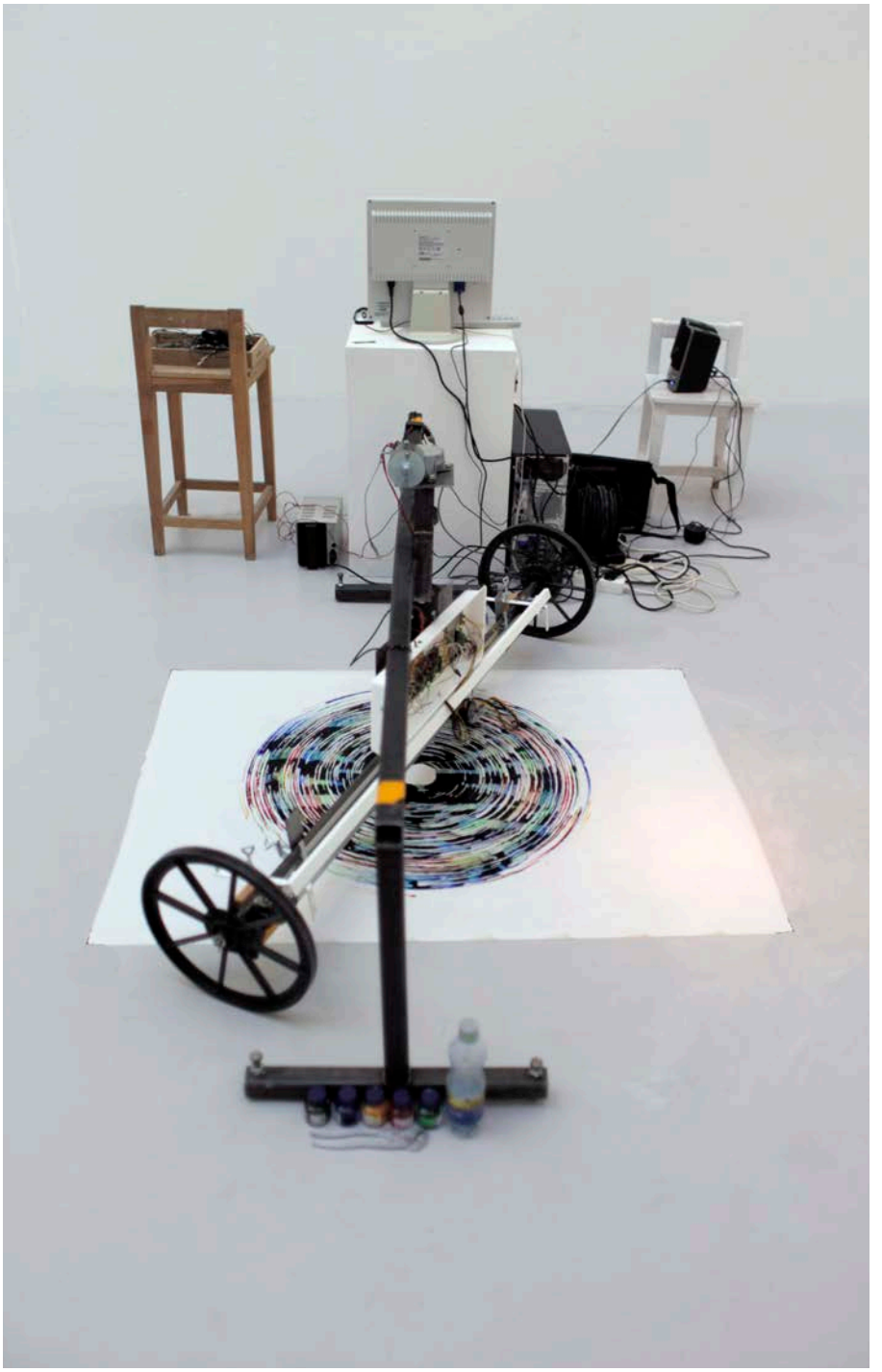

Figure 21. The *Metaphone* machine.

4. Four projects: *Metaphone*, *Delete by Haiku*, *S T R A T I C* and *Panorama Time*

Let us now turn to the four art projects that form the empirical basis of this thesis. Each project has been published in the attached papers and exhibited in conducive contexts. These projects are discussed in relation to particular concepts through exploration via the concept and the qualities of the post digital and the humanization of technology program.

4.1 Project 1: *Metaphone*

The *Metaphone* project[18] is an interactive art installation. It is an electromechanical and computational device, a machine (see Figure 21) that runs on actuation and variable sensor parts. It is a machine, which, through real-time interaction, produces visual paintings and soundscapes. Colorful paintings are made on large aquarelle paper (see Figure 22) underneath the machine and a soundscape generated from the mix of the participants' data, machine input and the painting's colors and visual patterns are translated into sounds. In this thesis, I discuss the version of the *Metaphone* that runs on biological signals (GSR and HR sensors) picked from participants who interact with the machine (as described in Paper A).

Figure 22. Two different *Metaphone* paintings.

[18] www.metaphone.net

4.1.1 Machine aesthetics

In light of formalism and constructivism, machine aesthetics can be described as exposing the inner aesthetics of technology – the mechanics or algorithms it uses – by turning the machine inside out, i.e. no casings or other ways of hiding technological details of the constructed artifact are used. Exposing the functions and operational properties of the artifact become core values of machine aesthetics. In a way this could be viewed as anti-style, as machine aesthetics rejects any attempts to apply an aesthetic layer as a superficial surface (decoration) to the artifact. This was my struggle with the steampunk introduction to HCI (Tanenbaum, Tanenbaum, & Wakkary, 2012) regarding the movement's strong decorative approach and connection to a style. This refers to the understanding of the machine aesthetics with a comprehension of the machines as being perspicuous and transparent, rational rather than ornate.

The project stems from an idea of a form of convergence of body and machine, mainly questioning the essentials of interaction between human and machine. Taking perspectives from machine aesthetics, the project implies notions of affect and adaptation of the emotional world by machines and, vice versa, how monotonic rhythms of the machine affect humans through interaction with them. Sharing an empathy between two opposite worlds, the project explores a manifold world and creates antagonistic dichotomies and heterogeneous schemes, but also a single world within the duality of human and machine.

What the *Metaphone* study shows is how the machine and participant interact in a closely intertwined manner and it is hard to describe who and what is affected more. Feeding the machine with biological signals and being strongly affected by machinic interference mixes all these impulses into one evocative experience. As the machine is run by bio-data, it loses its own rhythm and never repeats the same interaction. Feeding the machine with biological signals, in a way, animates the machine, the flux behavior enters the machine and is accompanied by non-monotonic rhythms.

4.1.2 *Metaphone* installation

Let us now turn to how the inspiration from early art movements became embodied in the *Metaphone*. The version of the *Metaphone* I focus on in this thesis (and in Paper A) is driven by the participants' bio-data.

Context of the project. The exploration and combination of various materiality formats into a hybrid constellation lies at the core of the project. Combining the digital and analog, computational and mechanical, hidden and exposed parts of the machine, and other means of technology, the project serves as a great platform for extending the dichotomies with

Figure 23. Jean Tinguely's Métamatic series (1955-1961).

hybridity and creating hybrid environments and situations. It is important to note how the system serves hybridity and brings various heterogeneous attributes together into a single whole.

The creative process of the project took place by revisiting a conceptual understanding of the modernist artistic production process (such as Jean Tinguely's Métamatic series (1955-1961)(Brett, 1968) see Figure 23) and producing traditional paintings via traditional painting techniques, most importantly through the generative machine, bringing machine aesthetics, bio-sensing technologies and intimate interactions to the forefront. The project should be seen as a single whole: the process, the machine, the interaction, the painting, the soundscape and other attributes comprise the project. The conceptual aspect of the idea about the interaction taking place between the person and machine in a slightly different way than we expect lies at the core. Machine aesthetics expose the brutality of the machinery and the intimate and close interaction involves the participants to rough and machinic situations. The "artistic result" and the materials they consist of are chosen to be aesthetically appealing, i.e. the paper and aquarelle painting, the flow of the paint and other parameters. The soundscape reflects the machinic and mirrors the bodily signals in one mixed track.

The *Metaphone* is part of an interactive digital art community within HCI (Art.CHI) that explores bodily movement and bio-data as materials in art, alongside, for example Khut (2006), Ilstedt-Hjelm (2003), and Moen (2006) work. In such a context other instances and questions are explored. However, their inquiry is slightly different. Some art projects in HCI point to limitations in the ways we think about current wearable and mobile technologies and their impact on bodily behaviors and practices. As our bodies are shaped by the tools we surround ourselves with – not only in a metaphorical or "cultural body" sense but also in a concrete corporeal sense (Grosz, 1994) – we have a major responsibility whenever we design using biosensor data or movement. Not all bodily experiences with digital technology are impoverished, limiting or painful. The art projects mentioned in this paragraph, as well as the *Metaphone*, open a much richer design space, with many different possible aesthetic experiences.

Control of the machine. The issues discussed through the art project *Metaphone*, in the *Metaphone* papers and in this thesis can be summarized in several points, although "machine control" is a seemingly important insight that stems from the study of the *Metaphone*: moving from strict to lose control and switching from trying to influence the machine to surrendering to the machine. These insights were evaluated by Gaver's Cultural Commentators' (Gaver, 2007) approach[19] when 6 participants were invited to reflect on the project. The study is elaborated in detail in Paper A. Others who have explored interaction control in HCI are, for example, Benford and colleagues, who wrote about control as one of the primary forms of discomfort and as a new topic for designers to consider (Benford et al., 2012). Höök and colleagues spoke about the balance between control and complete randomness in their Influencing Machine pro-ject (Höök et al., 2003); Fällman talked about well-defined controllable and less controllable problems in design research as well as taking control of objects in virtual environments (Fällman, 2003).

The project examines the control issue of the machines by evoking "strange" situations – strange in the sense of diverting from what we have come to expect from digital interactions. While research in HCI has explored the question of how to mirror biological data in interactions (as in, for example, Ståhl et al., 2011) or using bio-data to control machines (Hjelm, 2003), few attempts have been made to influence the participants back (Sundström, 2005).

Biosensor input is, of course, a quite indirect way of interacting with a machine. You have to make yourself excited or move vigorously to get

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[19] Gaver's Cultural Commentator's method requires choosing commentators relevant to the project at hand.

your GSR readings to peak or your pulse rate to increase. The relationship is not always straightforward. However, our commentators all knew that this was their way of influencing the machine, and thus, of course, this is what they wanted to do: control or at least influence it. But for all the participants in our study it turned out to be the opposite: the direct impact of the machine's behavior manifested in their experience and mood, and even seemed to increase over the study time. In a sense, they evidently surrendered to the machine, letting it take control of their experience.

4.1.3 The post digital in *Metaphone*

In this section I focus on the qualities of the *Metaphone* in relation to the post-digital discourse. Below I try to explain how the qualities of machine aesthetics unfold through the post digital in *Metaphone*. Two core aspects of the post digital will be brought to the interpretation: the first part of this discussion is concerned with the humanizing aspect, reflecting the convergence of body and machine in the *Metaphone*; the second part reflects materiality issues in regard to the analog-digital divide – the exposure of the inner activity of combined materials – both digital and others.

Combining body and technology as one. The project derives from the convergence of body and machine, mainly questioning the essentials of the interaction between human and machine. Combining perspectives from two different worlds, machine aesthetics (Andreas Broeckmann, 2005; Brummet, 1999; Kluitenberg, 2005; Reichardt, 1987) and somatic engagements (Somaesthetics; Shusterman, 2013), the project implies notions of the effect and adaptation of the emotional world by machines and, vice versa, how the monotonic rhythms of the machine affect humans through interaction with them.

In the project the explicit synthesis of the machinic and human body through the interaction and through visual and sonic appearances highlights aspects of the humanization of technology. This mode of interaction between the body and machine is clearly expressed through the fusion of heterogeneous elements in the installation. One thing is the machine, which is fed with biological signals, and another, the human, who is strongly influenced by the machine, surrenders to the machine, letting it take control of his/her experience through the intimate interaction. The present combination of body and machine does not demarcate these two as being separate, they merge into a single whole. The hybridity perspective that takes over the post digital brings the human and nonhuman, animate and inanimate, human and machine, living organism or computational system into a single system.

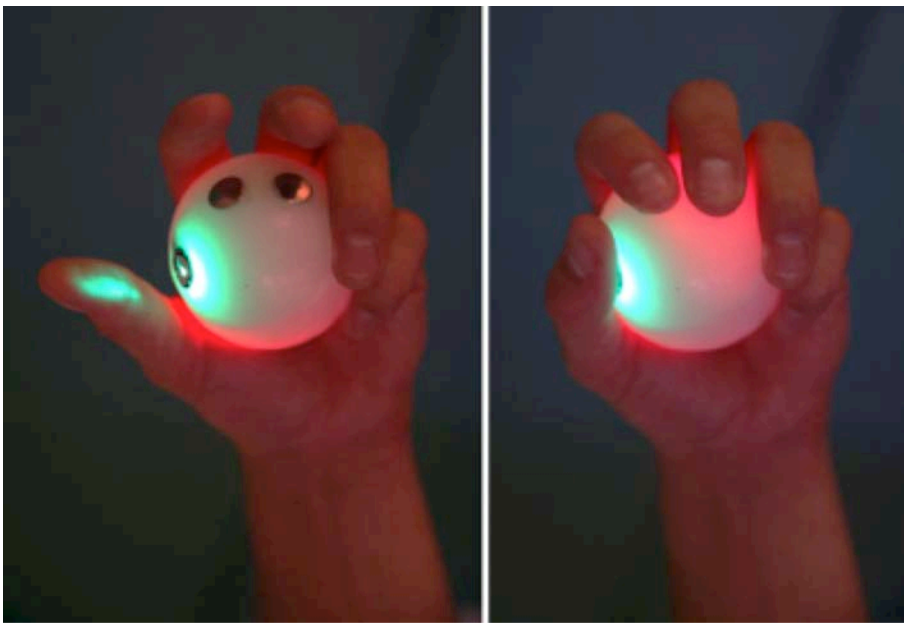


Figure 24. Sensor bio-ball, lighting and blinking in red and green.

The hybridization of human and machine is not exclusively about humanizing aims, but supports the idea of bringing these issues onto a human scale or looking at technology through the lens of aesthetic experience. However, there are many examples that do not imply notions of humanization and might be seen as contradicting the humanization of technology. The cyborg movement, for example, the works of artist Stelarc, could have other aims such as dismissing the human body or relating to the body as obsolete, or extending the body with technology.

Exposing its inner world. In machine aesthetics, by exposing the electromechanical inner world of the machine we reveal the process. But there is also a digital layer here, which is hidden and not easily readable from the outside. We interact through both of them at once in the *Metaphone*. The digital layer is exposed in several ways, the bio-data signal flashes in the bio-ball through LED light (Figure 24) and the sound exposes the computational interiors of the software through the soundscape.

The mechanical parts of the machine and exposed inner world of technology runs in parallel with new technology, which is digital and wireless. The biosensor we designed (with Jordi Solsona) contains sensors and wireless communication with the system, the physical ball is molded from wax and the combining element of software couples the mechanical machine with a sensor. By using bio-sensing technology and connecting

it to the hardware of the mechanical machine we use another software code that immediately reacts to the participants' s and the painting that emerges as a result of their interaction.

The translation of digital signal to analog takes place on many levels of the intricate installation. In essence, the *Metaphone* constitutes three main elements, namely, (1) a bio-ball (Figure 24) that fits into the palm of the hand, sensing the biological signals of the participant, converting them into a stream of bio-data transmitted wirelessly to the rest of the machine, (2) a drawing machine that converts sound as input into drawings on a large aquarelle paper underneath it, (3) a sonic core that both converts the bio-data into sounds (internal, not heard) that the drawing machine can understand, and makes it audible to the participants.

The translation of the biological signal (bio-data) into sound and colors also takes place here. On a smaller scale, translation takes place in more delicate formats: the sonic core is built in MAX MSP and receives midi notes wirelessly from the bio-ball. The software then converts the midi notes into sawtooth waves (sound) and adjusts the amplitude of the notes to better fit the audio analog filtering circuits on the input of the drawing machine. In sum, it creates a soundscape for the audience that aims to enhance the experience with the machine.

Exposure of software and process. To design for machine aesthetics in interaction, it is not sufficient to just turn the machinery inside out, avoiding a casing, and show the inner workings of the machine. We also need to uncover and show aspects of the software, the wireless connectivity and the biosensor in terms of machine aesthetics.

But how do you turn the software "inside out" in the same way that you turn a mechanical machine inside out? In this version of the *Metaphone*, we worked hard to make the algorithms and interpretations of the machine accessible and visible or audible to the participants, but we did not show the raw code, executed line by line. On the other hand, going back to our understanding of formalism, if it looks, sounds and interacts like a machine without hidden parts, it is a machine. The invitation to turn the machine inside out, revealing all its hidden functions, should not be taken too literally. Instead, to draw on machine aesthetics, you need to create an experience that unfolds in its own machine-like ways through the interaction.

The algorithm used to convert biosensor data into color and sound is also, in a sense, made tangible, but only through observing the dynamics of the interaction over time. While the exposure of moving mechanical parts and hardware constitutes what a typical machinic perspective would emphasize and expose, in our design process, we became concerned that the *Metaphone*'s software does a lot of the hidden work to make the in

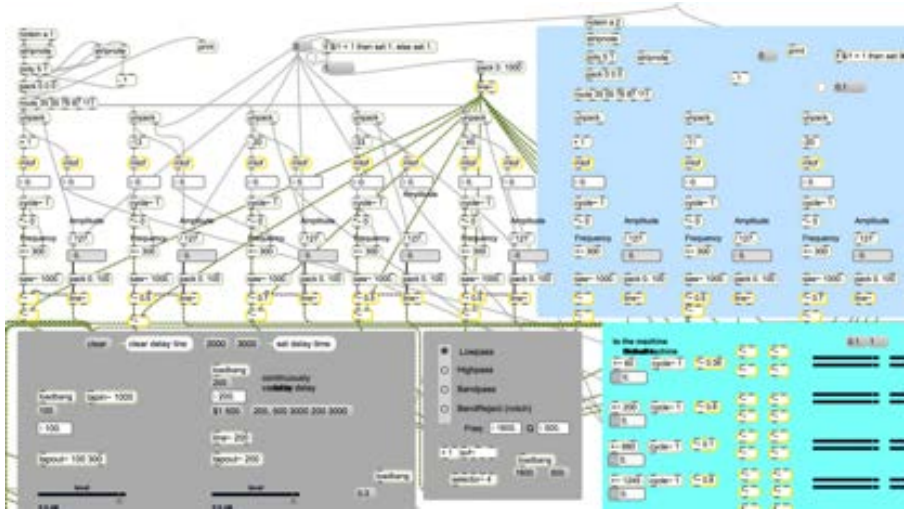


Figure 25. *Metaphone* software in MAX MSP.

teraction happen. It became key to us that the *Metaphone* would not only expose the machine aesthetics through the moving mechanical parts, but also in how those movements are stitched together by the software (see Figure 25). Thus, with Anders Lundström, we mirrored the inner logics and machine properties by using sounds (different frequencies) as a direct mapping of the instructions sent to control the machine.

The description of machine aesthetics may have erred on the side of decorative machine aesthetics with no function or process exposed. We want to emphasize that machine aesthetics was not only used for superficial purposes and for the purpose of aestheticizing the subject, but most importantly at the core of its behaviors. Exposing the inner aesthetics of technology and of the functional machine is just one very important part of machine aesthetics. With this exposure of the process we aim to show how the machine works and that all constitutive elements play an active role in machine aesthetics.

Interacting through old and new hybrid technology. An important component from a post-digital perspective is to see technology from a historical perspective in order to make notions of the "old" appear in a new light. One thing is that the digital is operating not only through computational and electronic means but, historically, could also be seen in many other devices, colloquially known as analog. Audio cassettes, mechanical typewriters, lomography and other technologies and techniques could be utilized in novel designs to create post-digital use (Cramer, 2015). When revisiting the old we may bring the post digital alive through the use of digital technology: "The concept postdigital does not signify a new phase

in cultural history, rather a maturation of the digital experience that makes us value presence once again" (Fleischer, 2009).

The post digital can be seen as a cycle in time, returning to the past and revaluating past concepts. It may benefit from a return to modernism (Andrews, 2002). In the case of the *Metaphone*, the digital – analog dichotomy vanishes and instead creates a more complex hybrid constellation.

In the *Metaphone* and in the use of old technologies, mechanical parts, reused engines, open interiors and exposed software and processes, we examine the notion of the machine being brought to a new level through being mixed with digitally-enabled processes. In such a context the technological "black box"[20] is dismantled for the purpose of engendering a stronger belief in technology and to create richer experiences.

Exposing the inner world of the machine through the deconstructing principle brings a greater understanding, somewhat liberating, of technology. We find out how machines work through their inner mechanisms. In a way, the post digital is a deconstruction of the digital. A better understanding and confidence is also developed with old technologies in which we trust their historical context and that we have known them for a longer period of time. Through transparency we circumvent repercussion: we see what is inside and how it works, and we assume that the know-how principle works, as we already know the logic of the technology, for example, a mechanical mechanism is much easier to read and trust than a more secret "black box" laptop.

4.2 Project 2: *Delete by Haiku*

How can we make our everyday lives more interesting, significant or even momentous and how can we add meaning to our mundane devices, adding new values to our things and experiences? In *Delete by Haiku*[21] we explored these topics by engaging with an "everyday material" – old mobile text messages – that we transformed into poetry. To make revisiting old text messages more interesting and acute we added a process of deletion, which emphasizes how data, even if old and obsolete, can be difficult to get rid of or can feel very sensitive.

Typically, we accumulate mobile text messages on our mobiles and we rarely look at them again. Our design challenge was to transform these texts but, in some way, keep and even enhance the emotional connections to the messages we deleted. Looking at different forms of digital

[20] In this case the "black box" is discussed from a technological perspective as a technology that is opaque and its internal workings hidden and unknown.

[21] www.DeleteByHaiku.com

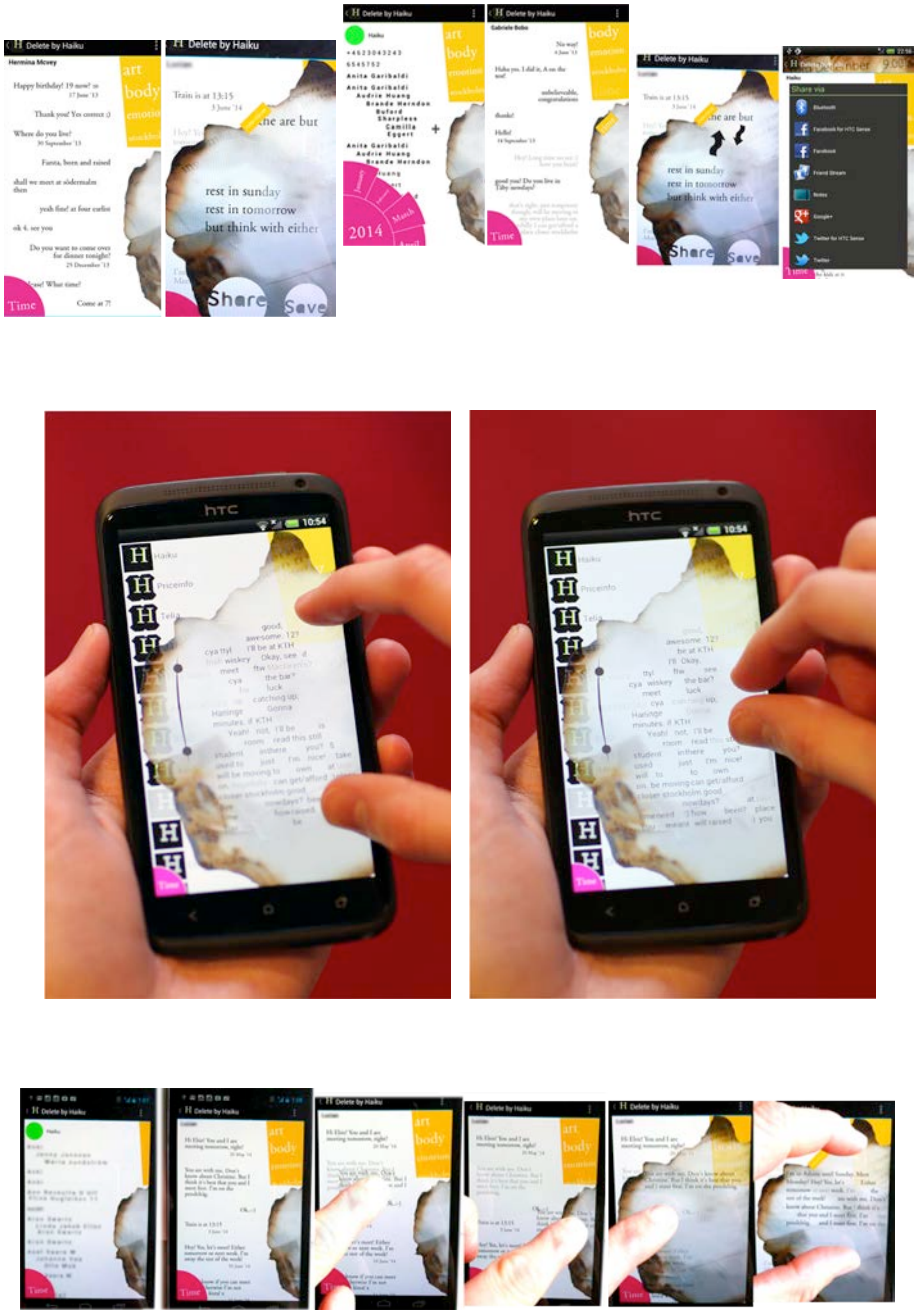


Figure 26. *Delete by Haiku* application: top images a) SMS thread with a themes folder, the “haiku-bin” with a generated haiku, the sharing window. Middle images b) pinching gesture. Bottom images c) interaction with the app: selecting text messages, pinching, etc.

and physical forms of compressing pictures, words or information such as Facebook timelines, we decided to work with haiku poetry. Haiku is a traditional form of Japanese poetry that features a simple constructional form with a limited number of syllables in a specific format (see Paper B for more details). This constrained format of haiku poetry provides users with a playful process that is both open and engaging, while at the same time enforcing strict limitations (Pierce & Paulos, 2014) that help frame and enhance a playful potential (Caillois, 1961; Salen & Zimmerman, 2004, 2005).

In the *Delete by Haiku* application, the user starts by selecting text messages to be deleted and then engages, interactively, in a gradual deletion of those messages, step by step, until the haiku poem that lay hidden in the jumble of words is revealed, like a gold nugget in a sifting pan. All the elements of the *Delete by Haiku* application, the interaction with it, the creation process and valuation are explained in detail in the attached Paper B. But in short, once users have chosen which text messages to delete, they "pinch" (Figure 26b) the messages and the words are deleted, step by step, until what remains is only the Haiku, composed of some of the words from the messages. The choice of which words to use is achieved through applying a database with significant words. In Figure 26, screenshots from the different steps are shown.

When designing an upcycling process of transforming SMS into haiku, the constrained format of haiku poetry, together with the SMS material on the mobile phone, created our design space for a digital upcycling process – taking us to the second conceptual contribution of this thesis.

4.2.1 Digital Upcycling

The critical stance employed in the *Delete by Haiku* art project focuses on the proliferate and, in some senses, careless use of data in conventional devices. Old messages are deleted without any further ado when the user needs more space on his/her phone, despite how they could potentially create a great space for aesthetic interaction. By repurposing a mundane technology, such as text messaging for artistic ends, we engage in what might be framed as upcycling. Upcycling is a method that derives from sustainability and recycling practices in which it is used to take old defunct objects and repurpose them for new use, aiming to achieve a higher value in the new use. However, in the *Delete by Haiku* project, our focus was on upcycling as an aesthetic expression, rather than looking at it from a sustainability perspective. A secondary motive for us was to show how a technique that concerned physical artifacts might be applied to a digital domain that creates digital upcycling to enrich the aesthetic experience.

Through the *Delete by Haiku* project, we show how repurposing aesthetics and the user experience through upcycling aesthetics may open up design spaces and support the humanization of technology – transforming deletion and the memory of an aesthetic process, adding value, humor, engagement, into a mundane activity. This is how the *Delete by Haiku* project relates to the post-digital discourse introduced in this thesis. Let us elaborate on the humanizing aspect and convergence of the digital and analog in *Delete by Haiku*.

4.2.2 The post digital in *Delete by Haiku*

In this discussion section I try to relate the project to the qualities of the post digital and how the qualities of *Delete by Haiku* unfold through the post-digital dimension. Structurally in the text below, the main issue of humanizing interactive technology is addressed first and the convergence of the digital and analog is then further discussed. In the discussion, the post-digital perspective that covers the whole range of characteristics and qualities of the project is raised: how small amounts of data, or as we choose to express it little big data (see Paper B), may have sentimental values; digital deletion seen as a disruptive approach in interactive technologies; incorporation of chance in design processes; emphasizing adding quality in relation to our (mundane) data and information; and finally, issues of materiality in regard to the physical-digital.

Little Big Data as a sensitizing approach to personal data. The way we approach data in the *Delete by Haiku* application reinforces our understanding of what data is and how we may engage with data and relate to its various manifestations. In the *Delete by Haiku* project, new approaches such as deleting, letting go and getting rid of data reveal new interactions in relation to data. It questions memory and remembering issues and puts the user into sensitive situations in which the user has to delete in order to create something substantially new.

As mentioned above, mobile text messages over time, or any other personal and sentimental data, through their abundance on personal users' devices, could be thought of as little big data, large in volume on an individual level, but not really on the scale of "Big Data". Such data is of undetermined quality, untouched and not yet interpreted, until it has been saved on the users' personal devices, and is not harvested by third parties nor shared with anyone. Most of its qualities are personal, private and valuable on an emotional level, sometimes sentimental, whose importance lies in its content and information rather than as data. Often, these streams of little big data are worth a lot to corporate entities that may use them to learn about our habits and commercial needs, while at the same time they have little value to us as end-users. Upcycling these

text messages into haiku poems draws our attention to the value of the mundane, putting us in touch with the kind of data that corporations are already tapping into and using for their own projects. The materials may be cheap and readily available, but their potential value has become enormous.

One path to humanizing this small trickle of data is to thrive off its sentimental value, approaching it as valuable personal information instead of abstract data. With such a view, the data starts to become emotionally and sentimentally charged, qualities that are capable of elevating our lives as we revisit personal memories in our interactions with everyday flows of data.

Deletion. To make the revisiting of old personal text messages more acute we added a process of deletion, thereby emphasizing the sensitivity of sentimental data. The decision to bring the deletion forefront was brought as a contrast to sentimentality and the emotional connection to our personal information which, in most cases, is randomly deleted by the app's algorithm instead of being deliberately revisited and managed by us. This contrast criterion arrives as a conflict in the psychological and emotional connection to our sensitive information. In our case, through discussing these issues with the users, was understood as being disruptive and not always welcome as the data would be gone forever.

Studies have documented the vast amount of personal information stored in users' devices (Ferreira, Sanches, & Weilenmann, 2013). Other studies have reflected on the storing and discarding of digital artifacts (Odom, Pierce, Stolterman, & Blevis, 2009). Despite these, and other efforts (Mayer-Schonberger, 2009; Odom, Banks, Kirk, et al., 2012; Odom, Banks, & Kirk, 2010; Odom, Zimmerman, & Forlizzi, 2011; Sas & Whittaker, 2013; Taylor & Harper, 2002), little has been done to explore the experience of deleting and curating the growing amount of our digital possessions. Here we are not problematizing digital memory or storage space, instead we are seeking a creative space in which deletion can take place. There are some commercial systems that address deletion, including the very successful Snapchat app, in which pictures are sent and deleted within a predefined time frame. Similarly, the Meteor app automatically deletes photos after a certain amount of time. The question we ask is: are there ways we could deal with deletion in a more graceful and aesthetically evocative manner through an upcycling process?

The well-known Snapchat app upcycles itself through its functions. By deleting images after a short period it transforms photographs and the whole conversation into something completely different. The study conducted with Snapchat (Pierce & Paulos, 2014) indicates that the inability to retain images is seen as a "negative affordance" towards the photo-

graphic function. However, the app is referred to more as a chat app and images are perceived as spoken words instead of photographic objects.

The introduction of chance in design processes. Chance, which is extensively covered in the *Delete by Haiku* paper (see Paper B), supports a more natural approach to the technology we use. It is important to note that aleatoricism does not occur much in our everyday devices with their utilitarian and practical functions. However, in the *Delete by Haiku* project we make provision for aleatoricism and include chance as an approach to our daily devices and interactions within the *Delete by Haiku* application. From purposefully introducing chance into our *Delete by Haiku* workshop process and also into the way in which the *Delete by Haiku* algorithm works when selecting words and sentences from the text messages, we want to elevate our daily interactions and support a more humane attitude with it.

With examples of maker (Fuchsberger et al., 2016; Landwehr Sydow & Jonsson, 2015; Landwehr Sydow et al., 2017) and remix culture (Gunkel, 2015), code and data bending (Mason, 2012), repurposing (Les et al., 2004; Sant, 2015) and DIY practices(Lin & Huang, 2010; Murer, 2015; Murer et al., 2014), all these rely on an element of chance in the design process. By reassembling and placing objects next to each other, turning and flipping them, reconfiguring them, ideas arise both in and through seeing old objects in a new light. Taking "found objects" as design material, opening them up and working with them strongly correlates to a chance attitude as we open up the unknown (forgotten) world for us to rediscover. This approach also brings the notion of returning to and highlighting old technologies. Repurposing is one way of dealing with old technology in light of new technological possibilities. Recombining old and new possibilities creates richer experiences.

Qualified-self perspective on technology. By looking at technology as a companion to our culturally-rich lives, we may want to take a more sensitive stance and, instead of taking a technologically positivist approach towards design, we may prefer to enrich technology with cultural implications. Meaning making is probably one of the most post-digital aspects: through engaging with data and information, in this project we transform our lives to achieve better and more humane experiences. In other words, the digital text, the data, initially becomes the material for upcycling our memories and experiences and then, by repurposing the digital data, we create a more humane interaction with technology.

Living a rich life means engaging in practices such as remembering (Sellen & Whittaker, 2010), dealing with life and death (Brubaker, Hayes, & Dourish, 2013), creating our identity (Juhlin, Zhang, Sundbom, & Fernaeus, 2013; Odom et al., 2011), managing our social relationships, avoiding being

overwhelmed by all the data we receive from life-logging applications (Sellen & Whittaker, 2010), and so on. In many of these settings, design through the lens of repurposing aesthetics and user experience through upcycling aesthetics may open up previously untapped design spaces, helping us create practices that are manageable on a human scale. Directions for the upcycling and repurposing of design processes can provide a means of coping with the masses of information that we generate without losing its sentimental value – a form of qualified-self instead of the more acclaimed quantified-self (Sellen & Whittaker, 2010) movement.

The emphasized division between interacting with technology and interacting with content is clearly expressed in the project. By repurposing data and information, we engage in creative processes, but most importantly we cognitively and emotionally engage with the content; in this case, with sentimental data, which relates to our memories, stories and narratives with which we were engaged a long time ago, but now, through interaction with an app, we revisit and become engaged with again. Through this process, we upcycle our experience and repurpose data, as well as rehumanize our relationship with the technology, revisit our interactions via qualifying procedures instead of quantifying them.

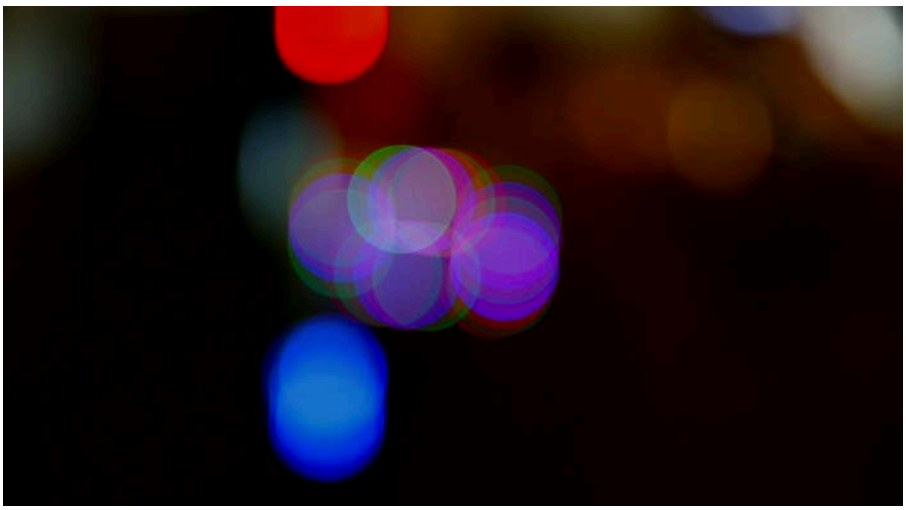
The digital and physical qualities of *Delete by Haiku*. In *Delete by Haiku*, through a pinching motion and in the different steps of the interaction, the user experiences the digital and the analog. Many different layers are incorporated in the app to create a bizarre experience and bring post-digital aesthetics through multiple elements: Tetris-like falling words; haiku-bin; deletion; pinching motion; reselection of words; the generation of the final haiku poem; and the sharing possibility.

While the digital world should not be seen as separate from the physical world, digital materials as a basis for our creative efforts are quite different from creativity that derives from engaging with physical materials. Some acts are much easier to perform in a digital world, such as moving words, deleting them or treating whole text masses algorithmically. The final sharing process, spreading the resulting poem, can also be accomplished in many ways, easily reaching many other users in digital realms, quite differently from physical settings.

4.3 Project 3: *S T R A T I C*

In the *S T R A T I C* project[22], a particular focus has been placed on abstraction and its role in HCI and in the art field. However, we also see the importance of abstraction in redirecting focus from a displayed content

[22] www.Stratic.net



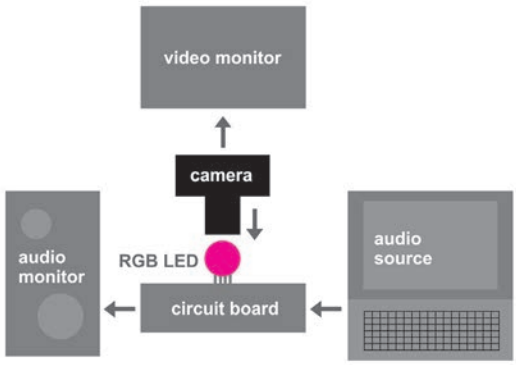


Figure 27. Top image, a) bokeh technique. Middle image, b) S T R A T I C operational scheme showing how signal travels. Bottom image, c) S T R A T I C abstract visuals.

and storytelling to more visual, minimalistic and formalistic presentations, in which more extreme and sensual experiences may arise by examining the ways perception affects our experience.

After exploring the photographic bokeh technique[23] (see Figure 27a) and gaining desirable visually abstract results through photographic experiments, I started to analyze qualities in extreme cases of the photographic bokeh technique. By extreme, I mean the specific use of only abstract circles without any representation of in-focus areas and using the bokeh for abstract imagery in particular. Such an abstract visual appearance relates to the visualization of data (and to Suprematism, as in the example Tableau Machine by Romero, Pousman, & Mateas, 2008) through abstract circles but, in this case, through a camera lens. In a few bokeh experiments and a series of artworks, I found and continued working with a specific focus on an appearance of a sampling rate[24] in bokeh. This phenomenon came to shape the *S T R A T I C* project: I explored and looked at the sampling rate from a visual perspective and started conducting experiments and building electronic circuit boards. This finally resulted in an implementation in which, together with Anders Lundström, I worked on separating the RGB[25] signal – all this resulting in evocative pictures, (see Figure 27c). These experiments gave me some particular insights into the connection between audio and visual signals. As a result, the *S T R A T I C* project was initiated, resulting in several audio-visual performances. The project also manifested in various other formats as a video film or series of photographs.

4.3.1 The *S T R A T I C* project

The *S T R A T I C* project explores the interplay of sensory actuation in interactive media expression and the aesthetic properties of analog/digital transformations engendered by the limitations and qualities of various forms of sensory apparatus – such as the camera. The result took the form of a noisy and hypnotic soundscape linked to an abstract animation (examples in Figure 27c). The abstract animation is directly generated from the sound source (see Figure 27b).

The project is an audio-visual performance that employs sampling rate as phenomenon and as its means of delivering an outcome. Drone-like sounds and colorful moving visuals play the major role in the live au-

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[23] Bokeh is an aesthetic quality that arises in out-of-focus areas in a photograph. In extreme cases all that remains are abstract circles produced by the light spots in an image.

[24] Sampling rate is the number of samples that are taken per period of time. It is a reduction of a continuous signal to a discrete sample.

[25] RGB is an additive color model comprising red, green and blue from which the whole visible color spectrum could be produced.

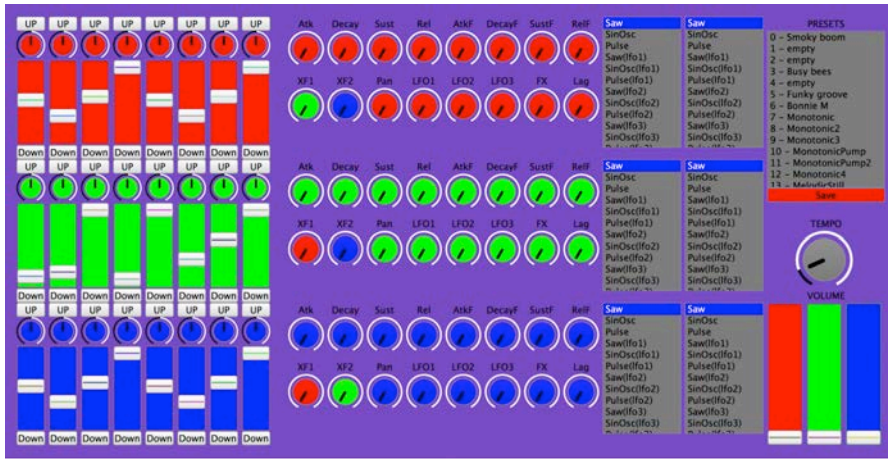


Figure 28. S T R A T I C sound controller inteface in Super Collider.

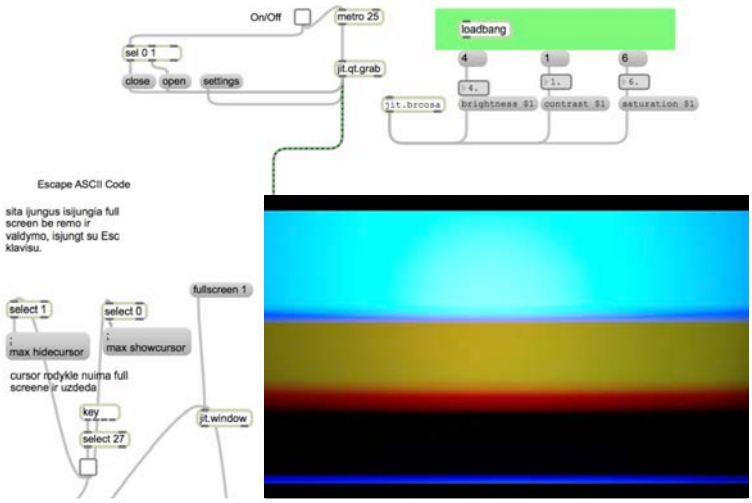


Figure 29. *S T R A T I C* monitoring of visuals in MAX MSP interface.

dio-visual performance, in which images are being generated in real time.

In the project, a complex transformation takes place in the process of generating image and sound. Digitally-generated sound feeds the RGB LED and effects in the intermittent pulsation of the light. The sound is generated digitally and controlled through a digital interface in Super Collider software, see Figure 28, and then sent to the circuit board with LED. The camera captures the pulsating light and, in a filming process, the sampling rate creates colorful moving lines, separating each RGB color. Thus, the thickness and movement of these lines are directly related to the frequency of the sound and of the pulsation of the light in relation to the camera's sampling rate. In parallel and in real time, the video signal travels back to the laptop for preview purposes and is projected. The image is apparent in two locations, projected both onto the public screen and in the laptop monitor (MAX MSP, see Figure 29) for the performer's preview.

When the sound frequencies make the RGB LED pulsate, it interacts with the camera's sampling rate, causing lines to appear on the screen depending on the frequency. Lower frequencies cause thicker lines and higher frequencies cause thinner lines (see Figure 30). Frequencies close to multiples of the camera's sampling rate tend to make the lines stand still in the images or move slowly. In between these frequencies the lines move up or down at different speeds that correlate to the frequencies. Low frequency oscillation and the waveform also affect the thickness and distribution of the lines. The frequencies of the different colors can mix and create blends of colors.

What caught my interest here was how the digital (interpretative digitality) is deconstructed. This deconstruction occurs through the sampling rate and its associated generative capacity. I found it interesting to see how the resolution of the sampling rate appropriates the signal and exposes it as countable units, using formal attributes of visuality through lines, movement and colors. The discrete units are clearly exposed in the formalist elements of the sampling rate.

Problematizing synchronization. One of the main audio-visual problems lies in the transformation and synchronization of different media. In this project, synchronization takes place via the signal traveling over multiple platforms and formats in real time. It starts out as a digital audio signal, then enters the hardware of a DIY circuit board and is reconstituted in the form of a colorful light, which is later captured by a camera picking up the sampling rate, and then, finally, the visuals are split between the projection and a laptop monitor, using a software-driven base. The technology, in this case a camera, captures the colors and generates the image. The use of the camera in these settings is seen as an indexical

device through which immediate interaction with the environment occurs. For image production, no computation is involved. This transformation and materialization or, in a sense, dematerialization (in a sense, as it is not physical in any case) of the signal becomes a post-digital quality. This generative approach brings notions of trust in imagery and belief in the idea that the image is depicting reality, and questions the notion of being both a generative and a produced form of reality.

The importance of the technology and how I used it to feed into itself became a key factor and a crucial component in my exploration of this as a machinic and post-digital project. It became key to exposing the machinic generation process. The result is not only a finalized image (similar to the other projects in the thesis) but a technology-driven project in which the inner workings of the system are used to accelerate its own logic. The complex audio-visual system originated through the process of deconstructing the phenomenon of sampling rate and the generative system into smaller composite elements. By applying this approach we may find new ways of shedding light on building new systems. By explicitly exposing the generative process, the involvement of the audience in the process of knowing how the system works and how it is built is brought to the surface so that the audience can see and follow how the sampling rate works in action. The importance of the formats intertwining in real time, when the analog and digital interchange in various combinations, the audio signal transformed into a visual signal, the software and hardware together generating one outcome, supports the post-digital condition through the critique of laptop performances (Andrews, 2002).

4.3.2 The post digital in *S T R A T I C*

The humanizing aspect, the disenchantment of the digital, convergence of the digital-analog formats and combinations of various processes and techniques is discussed below.

Synesthetic and bodily experience. The aim of this project is to explore and attempt to overcome the separation of the audio signal in visual appearances; mapping and deconstructing its properties into speed, thickness and color qualities.

The general notion of abstraction relates to the rejection of the representation of realistic and visual references in the world. This notion moved the focus from the content of the message to sensual experiences and explores the logic of the formal and minimalistic constructs in the highly synchronized settings of the audio and the visual. This consolidated minimalistic appearance relates to what has been called synesthetic experience – i.e. cross-modal associations creating an involuntary physical experience. “Synesthesia is a condition in which stimulation in one

modality also gives rise to a perceptual experience in a second modality" (Sagiv & Ward, 2006). In *S T R A T I C* performances the audience reflected on a highly perceivable synchronization between the visuals and the sound. Such performances affect the viewers through experiencing the hearing of visuals and the seeing of audio – this is how synesthetic experience comes about in this project. Technically, both modalities – audio and video – arrive instantly and directly from each other and have no delay in presentation whatsoever. The synesthetic experience is discussed in the following terms in the literature: "That is, the stimulation of one sensory modality reliably causes a perception in one or more different senses" (Cytowic, 1995). Bergström discusses the effects of audio-visual stimuli for the audience in connection to more than one modality. He also relates visual music and synesthesia with audio-visual perception: "Most relevant to the present discussion is the experience of sound as animated colours and/or shapes" (Bergström, 2011).

The experienced synesthesia is a bodily and sensual perception of the sounds and imagery entering into a single whole, overlapping and creating a multi-modal experience. The manifestation of the digital in this project brings the digital to the physical world through an evocative experience, involving body and mind, dissolving boundaries of the sensed audio and video.

Another, no less important, quality is brought forward through the particular use of the audio. We use a professional sound to make the bass frequency stand out, transforming it into a powerful bodily experience. This is one of the post-digital qualities discussed by Fleischer (Fleischer, 2009) in which digital sound is amplified using a powerful analog system and the sound is experienced by the audience through their bodily perceptions. The *S T R A T I C* project tries to physically escape the digital dimension – escaping what we could refer to as sonic flatness arriving with the digital medium – by transforming the sound into a strong bodily experience.

The experience gained through processes such as synesthesia, bodily sensations and engagements is of an evocative nature. It is one thing to perform and experience the project's audio-visual sensations; it is another thing to observe the glitch aesthetics that appear and the entire production mechanism. Together they evoke culturally richer experiences.

The exposure of processes in live settings. The post-media dimension (Weibel, 2012) is clearly noticeable in the *S T R A T I C* performances: when one device, for example, the laptop, is capable of dealing with several media at once (Krauss, 2000). "This notion of the media comprises not only the old and new technical media, from photography to computers, but also the old analogue media such as painting and sculpture which have

been transformed and influenced under the pressure of the technical media" (Weibel, 2012). Encompassing hybrid complexities in a post-media condition, raises the question of how processes are being hidden in a "black box". This elevates some issues with the essence of performativity. When Andrews (2002) discussed laptop performances he emphasized the importance of exposing processes and incorporating physical clues that stand for the post-digital qualities in audio-visual performances. The question is not just about referring to the need for purely sensory experiences, but also opening up the generative aspects of the incorporated systems. According to Andrews (2002), hidden processes in laptop performances should be activated and become components of the performance through exposing the processes that are running. He argued that the performativity is completely shielded due to the stillness of the performer and the lack of any other physical clues. The aspect of performativity becomes indiscernible in such performances – nothing else is given to the audience – just a pure sensuous experience (Andrews, 2002).

Making the *S T R A T I C* performance more engaging to the audience and bringing the actual procedures to the foreground by exposing the generative processes to the public, was one of the aims of the project. The devices and processes were made transparent through a machine aesthetic approach (refer to Paper C for details on how this was accomplished).

Media and technology-driven audio-visual performances are not new in the performance art world. These performances bring several concepts of relevance to the work presented here such as: liveness (Engström, 2012; Wang, Mughal, & Juhlin, 2015) – when the performances take place in live settings; immediacy – immediate response and interaction; and indexicality – performances making use of photographic systems. Interactions inspired by these concepts enable post-digital aesthetics. In the *S T R A T I C* project, live performance lets the performer incorporate audio and visual feeds into the creative process. The visual input and output feed become, in a sense, a fusion of the digital and analog, both of which are exposed to the audience during the performance. But the outcome is not just a pure visualization feed, but a result of all the digital processes in the software – the interaction managed on the laptop alongside the analog means being used by the performers on stage, in this case different kinds of hardware and the camera.

The liveness of these performances exposes the immediate responses of the technology and its raw production processes (generative and with no post-production). In this project the immediacy enters the experience, in which the audience's sensations are enhanced. What appears as a

technological fault, resembling a pulsation of electricity in the visuals, is the visual glitch we are aiming for. Such accidental electrical and glitch interventions bring a component to the performance and influence the flow, bringing chance appearances in the visuals. It is not a one-on-one interaction but, instead, chance plays a major role: the technically random signal immediately changes the outcome and the performer has to interpret that emerged glitch and incorporate it into the flow of the live performance. The electrical signal, which has a random influence on the image, is seen as a visual glitch: it appears out of nowhere and at random intervals. This glitch is out of the performer's control. It appears without any real clues and occurs randomly. In this case, the glitch directly comes from the electricity, electronic signal and circuitry, which is the way fault aesthetics emerge in the technological domain (this is explored more fully in the fault aesthetics discussion in the *Panorama Time* project below).

The performance and interaction with technology takes place in the "here and now" and the process that generates these visuals and sounds is exposed. What is happening inside of the "machine" or how the generated sound and visuals are exposed to the audience becomes part of the show. In some performances we also exposed the digital interface of software, so the audience could follow the processes on the software side and see how sound is produced. Or we also had a few additional external devices (not counting the constantly exposed camera and circuit board with pulsating LED) such as physical synthesizers. We present the exposure of the machinic internals so the audience can examine and engage in understanding what processes are taking place inside the executing system and in terms of not being part of the "black box". This refers to the understanding of machine aesthetics through making mechanisms and systems perspicuous and transparent, rational rather than ornate.

Convergence of the analog-digital divide. A combined analog and digital format has been employed in the *S T R A T I C* project: a camera operates on the properties of shutter speed and frame rate; a circuit board with RGB LED and electricity triggering the signal in the board; the digital audio signal is converted into an analog signal to control the light; designed interface in Processing software with exposed sound controllers; and finally, there is a sound system with speakers and a projection using a MAX MSP visual monitor.

What was particularly intriguing to us was how the glitches got derived through the electrical leaps, which emerged from the hardware parts of the system. In a way, it is similar to the process used in the *Metaphone* project in the mixing of colors, but here it occurs via an electric signal. Firstly, an electronic signal directly influences the production and generates the image and, secondly, an electronic signal, which arrives from the

DIY hardware circuitry, is explicitly exposed and apparent in the imagery with its pulsation, leaping, cracking and glitching. This electrical manifestation in the process and in the production of images closely relates to aleatoricism and chance (important artistic processes that we discussed in the *Delete by Haiku* chapter above), as it is disconnected from the control panel and glitches created unintentionally occur.

On the visual side, the final outcome of the project is a constantly transforming visual image. It is generated by the electronics and has little to do with a principle of designing the outcome as the entire process takes place through the signal and, inbetween the input and output, the outcome is rendered by the constituent components of the system. What is also important to acknowledge is that the image is produced without any digital computation. The image is directly generated inside the camera and by its own means. The digital audio signal feeds the LED, the camera captures the light and the rolling shutter captures the pulsating light by scanning across the scene and eventually the sampling rate converts the pulses into lines. The continuous light signal is reduced to discrete units via the sampling process (Kerlov & Rosebush, 1986; Manovich, 2001). In the system, the digital comprises sound and monitoring of the visuals, but the entire generation of visuality and its appearance is produced via analog means.

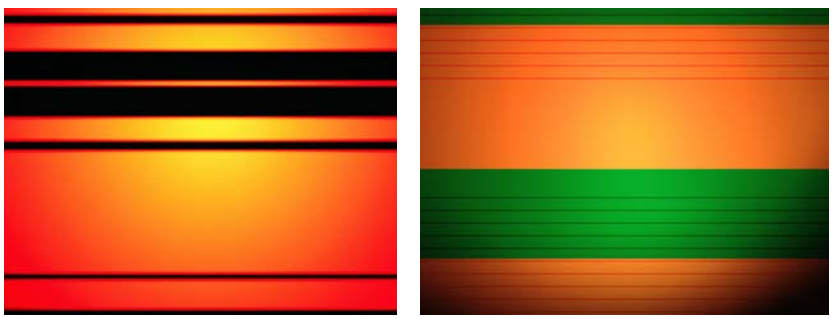


Figure 30. Images of various lines thicknesses.

The *S T R A T I C* is an example of the idea of interpretative digitality discussed in the Background chapter above. As described above and in Paper C, the sampling rate takes control of the incoming electronic signal and shapes the visual outcome through the thickness of the lines (Figure 30). The thickness of the lines literally represents the discrete, countable units and the value of the particular performing sampling rate in the moment. These formal elements expose the process of digitalization and abstract the logics of the generative production behaviors and encodings.

Physical manifestations of the glitch

One form of exploring the realms of the digital and the physical is through the physical manifestations of the digital, including exploring through physicalization (Jansen et al., 2015), i.e. making data and information physical and supporting its physical representations. Another way could be, for example, digital fabrication or 3D printing (Devendorf & Rosner, 2015; Devendorf & Ryokai, 2015; Fuchsberger et al., 2016; Landwehr Sydow & Jonsson, 2015). But how do we materialize a digital image displayed on a projector?

In our project we conducted experiments with various screen surfaces that explored so-called "digital paintings". The shape of the screen, the materials onto which the projection is projected, the reflections emerging from the surfaces, the texture of the fabrics, the size of the screen, it all brings the digital, or more precisely, both the digital and analog manifestations, to a form of physicality. The project explored three types of physical manifestations: 1) "digital paintings", 2) multiple-image screening and 3) digital printouts on paper.

Figure 31. *S T R A T I C* visuals at DKTUS.

Screening experiments – "digital paintings". Projecting digital video onto various physical surfaces with different textures engenders different sensations and manifests the digital in the physical realm. It is one thing to project onto a perfectly flat screen with a front projection (R1 – Reactor Hall, Stockholm; H2O_6 in Riga; ACE 2015 conference). A slightly different quality is achieved by having a rear projection (CHI Interactivity exhibition 2016). A completely different characteristic is achieved by the uneven, rough and convex wall (DKTUS art space) on which straight lines become twisted and, through the movement of lines, start to look as if they are vibrating (Figure 31). Another projection of the *S T R A T I C* was beamed onto a specially produced three-dimensional geometrical shape, a spherically-twisted screen (Power of Zero) that created a distorted feeling of twisted moving lines – the opposite of the straight lines generated by the sampling rate with its "digital look".

Figure 32. Reflections of *S T R A T I C* visuals in Dome of Visions.

The challenging materiality issue became particularly acute when we projected the *S T R A T I C* onto a snow surface on a dome-shaped glass roof in an installation at the Dome of Visions. It created visual reflections within the room (Figure 32) and the visual signal was beamed through the layer of snow to the outside, resulting in an illumination of the entire dome building. The most extreme case of exhibiting the project was on a building facade, a huge urban screen, a massive wall built from RGB LEDs (FILE festival, digital gallery SESI-SP at FILE LED SHOW 2016, see Figure 33). This was the FIESP building in Sao Paulo, Brazil. These experiments[26] sought to find new ways of converging the digital-physical. While these installations differed greatly from each other, they all dealt with the same issue of bridging the digital with the physical.

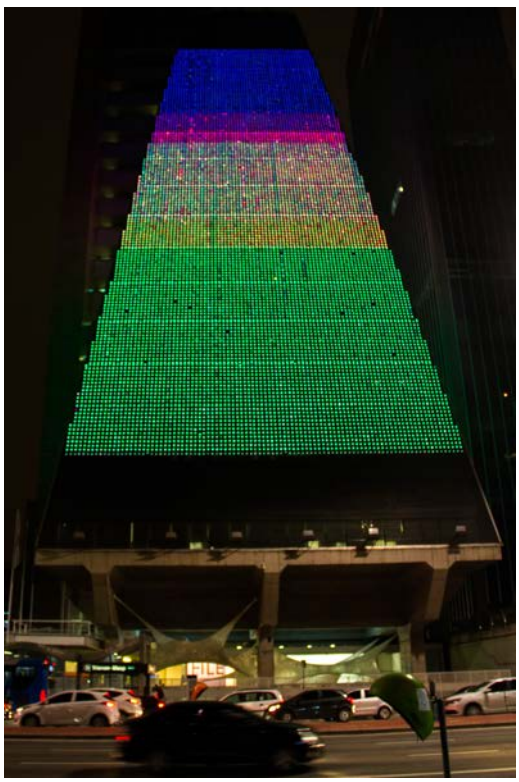


Figure 33. *S T R A T I C* at FILE festival on FIESP building, São Paulo, Brasil, 2016.

[26] The smaller – monitor screened – installations are not discussed here of its non-interactive way of exhibiting (RIXC exhibition, FILE festival exhibition, Power of Zero – Gallery Weekend edition, ISEA 2017, Live Cinema Festival in Rome, etc.) and in these instances it was mostly the video film *STRATA* exhibited.

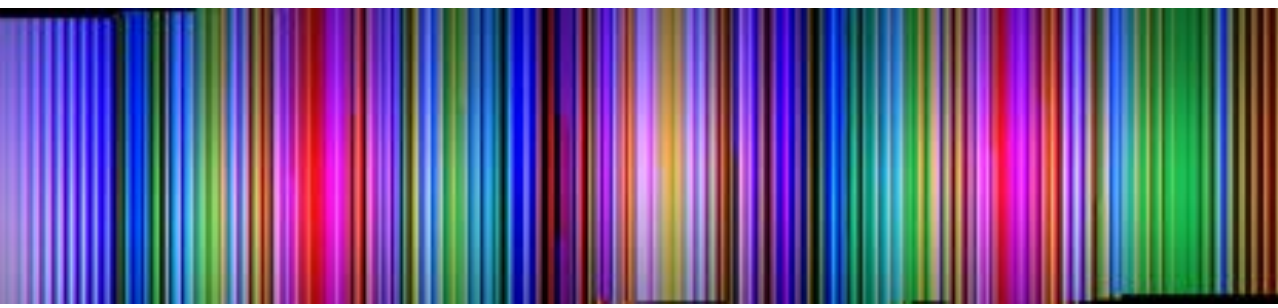


Figure 34. Top: *S T R A T I C* multi-image screening at Södra Teatern, Stockholm, Sweden.
Figure 35. Bottom: *Stratascape* photograph.

Multiple-image screening. Another important step in the materiality discussion concerns the multiple-screen experiments, regarding precisely where the *S T R A T I C* project became projected. One was the Dome of Visions exhibition mentioned above. Another interesting multi-image installation was exhibited at Södra Teatern, see Figure 34. At this venue, three projections were stitched together vertically to create one continues image, i.e. continuously extending from one image into another, but at the same time showing three duplicates of the same image. The image was repeated and multiplied for the purpose of creating larger flowing imagery. With this installation and its experiments in extending an image through its repetition, an idea referred to as digital dispersion (Staple, 2008; Steyerl, 2009) was used. Digital dispersion deals with how digital images can easily travel from one device to another or can be viewed on several devices simultaneously. This phenomenon of fluidity and mutability is "visually discussed" in German artist and writer Hito Steyerl's project Liquidity Inc., 2014. Steyerl elaborates on the ideas around a digital image in the article In Defense of the Poor Image (Steyerl, 2009). The discussion around the difference between image and image file gets extended in Boris Groys' (Groys, 2008) article. The digital dispersion or circulation of digital images through algorithmic processes is discussed in the Softimage book by Hoelzl and Marie (2015): "...algorithmic images are operationalized in databases and programmed to be accessed from multiple kinds of devices and screens while operationalizing users in circular operations of data exchange" (Hoelzl & Marie, 2015).

***Stratascape* prints.** In one part of the project – the *Stratascape*, I further explored the materialization of visualizations through creating abstract panoramic photographs taken with a panoramic camera. The *S T R A T I C* project's pulsating light is mirrored in this panorama format. The panoramic camera's feature of stitching narrow vertical frames one by one provides the possibility of working with the dimension of time. Thus, by changing the visual parameters of light, the captured image is slowly able, frame by frame, to grow and change, see Figure 35.

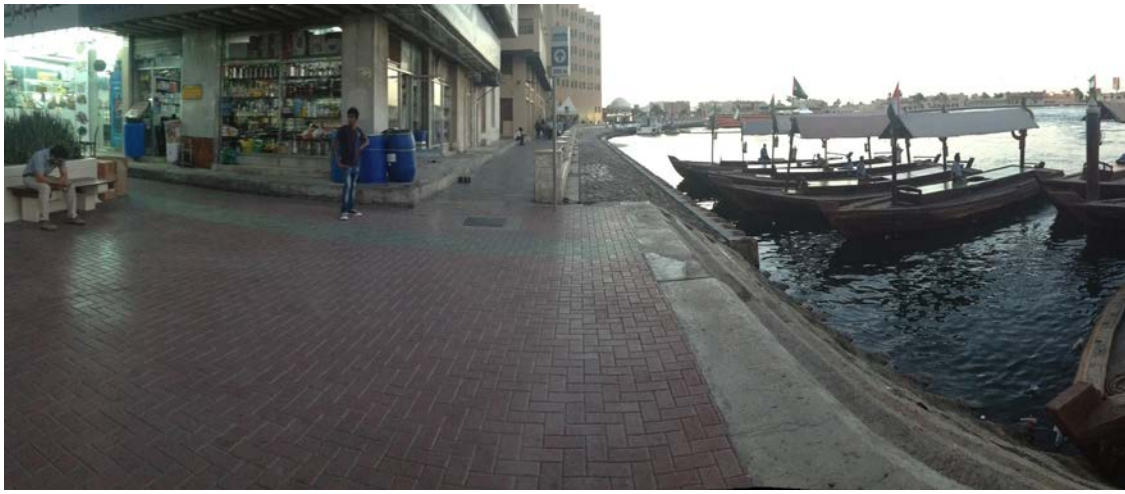
After taking a *Stratascape* photo, the captured image is printed on large paper, making the digital image manifest in a physical form. This process enters the post-digital art, in which digital artworks are printed on paper and not kept in their original form as digital-on-digital. According to Lund (Lund, 2015), a post-digital approach looks for new ways of installing the digital in the physical realm – ways that do not correlate with a traditional digital form and attempt to escape from the original digital environment and instead manifest in a physical format.

Figure 36. Top: *Panorama Time*, deleted parts.
Figure 37. Bottom: *Panorama Time*, duplicated parts.

4.4 Project 4: *Panorama Time*

In my fourth and final project, *Panorama Time*, I explore the appearance of glitches in digital panoramic images. By hacking the use of an everyday device – the photo function on a smartphone – I show how we can achieve aesthetically-appealing but disruptive results. The idea behind a panoramic picture is to create an unbroken view of some scenery. Instead, I emphasize the glitch aesthetics and fault aesthetics that can be created if we move the camera, creating different narratives with post-digital qualities. In a sense, I tweak time and space through this hacking, see Papers D and E. Through this hacking, we learn more about the unknown world of this panoramic photo technique and how it unfolds in action.

As photography in general is a time and space-oriented medium, I have chosen to focus on and examine it from this perspective. This project concentrates on the medium itself, using its features to create the glitch. By choosing a panorama mode, which simultaneously combines two slightly different techniques of one medium – still photography and cinematography (i.e. filming) – we expect to explore time and space, in particular, how a digital panoramic image is captured, and from a technical, formalistic perspective. In this application, time passes noticeably on the screen, and the user can control the process through the time-space dimension by capturing what is relevant to that moment (by freezing the time-space moment), while also embracing challenges and controversies within the time construct, for example, waiting for some scenes to pass without being captured (by letting certain scenes be deleted from the final image). Thus, deletion and repetition become characteristics that frequently appear in the process. See Figure 36 for deleted parts of the photographed object and Figure 37 for the duplicated parts.



4.4.1 Image production through extreme usage-hack

In this project, it is the way in which the panoramic feature is used that picks on the glitch functionality and the desired aesthetics. I take advantage of the rolling shutter in mobile phone cameras and try to enhance those distortions for my artistic goals and storytelling. In this work, I was inspired by the natural distortions and digital glitches that sometimes appear as uncontrolled features, for example, when the stitching of frames is picked up on the movement of a moving object and the algorithm starts adding those stitches automatically. This takes place when the rolling shutter and the stitching algorithm pick up on the moving object and the movement of the object is interpreted as a camera movement.

The panoramic format bridges the digital and the physical in several different ways. Firstly, the scenery in front of the artist or situation that is going to be captured is physical – it is a real situation and includes qualities of liveness, immediacy, indexicality. Secondly, the physical camera contains both physical sensors on the one hand and digital processing on the other. Thirdly, the final product is a photographic digital image of a panorama, which is generated and stored digitally, but the interaction takes place both on the screen and by shaking or moving the camera in an unorthodox manner. The process of creating a panoramic picture is finalized through the digital print that contains various qualities, from both the physical and digital worlds: glitch, stitching of frames, repetition and deletion. This “usage-hacking” technique is interesting in how it makes the underlying process transparent: bringing up and exposing procedural elements such as blending two foreign frames, repeating the same object several times, but in a slightly different moment of time, deleting

Figure 38. *Panorama Time*, a) top image, revolving camera, b) camera rolling on a camera dolly.

unwanted frames, and similar. It is a form of machine aesthetics insofar as it exposes the inner structure of the machine (and the encoded logics) but can also emphasize failure and hacking techniques.

In my work, I came to ask how physical devices and digital programs influence user behavior. Certainly, the camera and panoramic technique already have embedded limitations and restrictions, but how do the physical and digital components come together into one process for the user? Used as intended, the camera operates the sensors, sensing the motion of the camera, in turn sending signals to the algorithm that stitches the photos together. For example, if the camera is made to revolve around its axis to capture an image, the resulting photos can be effectively glued (Figure 38a). An opposite non-conventional usage – a "usage-hacking"-technique – would be to utilize a camera dolly to carry the camera to try and break the precomposed and embedded logics of the technology (Figure 38b).

Figure 39. *Panorama Time*, broken panorama image.

To start, taking my own perspective as an artist and at the same time relating my practice to the others - the user gets to learn how to appreciate the ordinary use of the device, how to appreciate the qualities of the algorithm and hardware sensors inherent in the process of image production and, finally, to think in practical term about how to tweak time and space dimensions and to rethink them in terms of design implications and considerations with regard to artistic ends. All these considerations occur simultaneously in documentary settings and in real time. So, in this regard, a few significant qualities such as sketching, involvement of chance and immediacy lie at the essence of the process.

4.4.2 The post digital in *Panorama Time*

Let us now turn to how the *Panorama Time* project addresses the post-digital dimension.

The human activity of hacking everyday technology. Through working with *Panorama Time* and the proposed "usage-hacking"-technique, we shift the view towards a broken panorama (Figure 39). Such hacking interaction with technology examines and brings new perspectives with which to view technology in a new light. A hacking approach through opening up the algorithmic logics of internal digital structures captures the notion of neomateriality with "an objecthood that incorporates networked digital technologies" and "reveals its own coded materiality and the way in which digital processes perceive and shape our world" (Paul, 2015). Technical techniques such as reverse-engineering (Murer et al., 2014), tinkering (Jacobsson, 2013) or DIY maker culture (Fuchsberger et al., 2016; Landwehr

Sydow & Jonsson, 2015; Lin & Huang, 2010) also as seen through machine aesthetics in the *Metaphone* paper (see Paper A), question technology from a DIY design perspective. Remix culture is also seen as something to look at from pre-established forms of a new "reverse" perspective (or repurposing in *Delete by Haiku* as seen in Paper B).

We aim to engage people in using their everyday technologies for creative purposes and, in particular, to sketch alternative realities through post-digital nuances[27], and also to make use of them in order to create substantially new results, which might also be inspirational for other fields (the emphasis is on interaction design and how visual imagery can implicate new directions – Paper D). Firstly, the process is important in regard to creating substantial outcomes, which could take a sketching path. Secondly, by exposing the process and its generality, both the process and the results could inspire designers to create their own projects and provide implications for HCI.

Alongside the *Panorama Time* experiments that involve particular tactics for creating novel results, I introduce the three concepts sketching, chance and immediacy in relation to hacking everyday technologies in documentary settings (see Paper D). These are of primary importance to understanding and rethinking how technology becomes humanized in terms of the contrast between documentary (liveness) and glitch aesthetics (as disruption), in a way, merging technology and real-life settings, and through such a meeting bridging the gap.

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[27] In this case, digital reality with glitches can create stories, which will never happen in real life, only through mediated technology.

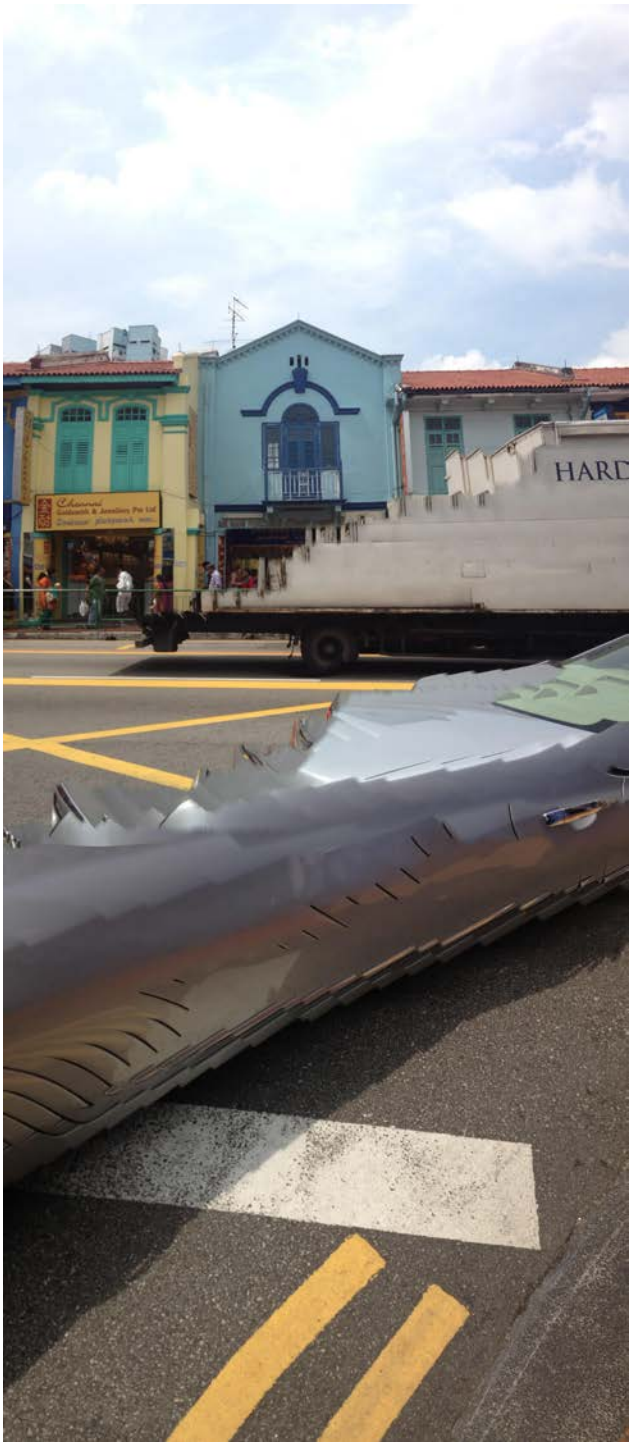

Figure 40. *Panorama Time*, a moving cars example.

The experimental practice illustrated through *Panorama Time* displays aspects of collage techniques (Wolfram, 1975) and remix culture (Gunkel, 2015). It is, in a sense, a collage in real time and a remix of real situations and environments through their immediate appearance. Immediacy, when the action happens in the here and now, in front of the photographer, in this project, documentary meets its antithesis – glitch. The glitch enters the scenery and disrupts the natural appearance and traditional documentary and storytelling approach of photography. It distances the natural and immediate appearance of the scene for the photographer. It also adds new digital glitch features and shifts the focus onto the glitch aesthetic parameters. The immediate situations open up and unfold in front of the photographer; they demand immediate reactions and seek aesthetic decisions. In Figure 40, the temporal dimension of the situation requires lively improvisation and moving objects to be followed – in this case, moving cars – to create forms that are somehow glitched and extended. Glitch in this case extends the photographic experience with its own disruptive practice and the photographer interprets potential glitch occurrences.

This particular hacking approach to the use of photography is appreciated as both a kind of rethinking of digital images as well as illustrating different ways of considering how time and space can be depicted. As such, the images have a unique quality that make them intentionally difficult to evaluate in terms of more traditional photography (in the way of documentary and storytelling), but this presents them in terms of how this can be of benefit and not detrimental to other fields, such as interaction design. A few significant qualities were taken into consideration in the process, elaborated in the Paper D. In particular, the important concept of repetition, which is approached differently in digital and physical realms, is explained below.

Repetition. Deletion and repetition run concurrently and support each other in the *Panorama Time*. We have seen the elaboration of the concept of deletion in *Delete by Haiku*, now we will discuss repetition in relation to deletion.

Iman Moradi describes visual glitch characteristics as follows: fragmentation, repetition, linearity and complexity (Moradi, 2004). Most of these characteristics appear in our project. However, we argue that non-linearity is more important than linearity as, in our case, we break the linear view and linear way of thinking, both from a time and a space perspective. While linearity is not particularly important, fragmentation and repetition are key to our practice. Fragmentation manifests in the freezing of time and in how some frames and parts of the scenery are deleted from the final image. Or we add and repeat certain parts of the scenery and create a sense of repetitiveness. Here, I would like to add deletion as an im-

Figure 41. *Panorama Time*, clouds get replicated, but closer object are deleted.

portant characteristic of the whole compilation of glitch qualities. As we see in *Panorama Time*, deletion is inseparable from the process of repetition – they run concurrently with each other. In this process, through the repetitiveness of particular parts of an image, other parts are deleted. For example, this interchange of roles could take place in one frame, when the objects in front of the image are deleted, the middle objects are kept, but the farthest objects (such as the clouds in example Figure 41) are replicated. This association between deletion and repetition and other post-digital qualities abstracted from my projects will be elaborated further below in the section on post-digital concepts.

The importance of time and space and their combination with liveness and indexicality in the project is essential: capturing the same object or repetition occurs at different times (Deleuze, 1968). In the case of *Panorama Time*, we are not duplicating the same object mechanically, but the repetition takes place live in real time. The next captured frame (which is similar to the previous one) in a panoramic photograph is actually different as it is taken at a later point in time. The object is repeated with a slight difference over time and that difference is noticeable and, most importantly, controllable.

Fault Aesthetics and Glitch Aesthetics. In this work, I am intrigued by the way results appear. The first experiments were made by accident. In the process, the artist has to somehow capture such moments that come about by accident, identifying the glitch and running with it. It just happens. It is, to some extent, about appropriating the technical fault,

malfunction or error, for one's artistic pursuits. We call the results pursued from this unintentional process fault aesthetics. Glitch aesthetics relates to design and craft practices in a slightly different way, in which the artist focuses on a particular technique by knowing it in advance, and by incorporating the scenario, the scene and the view into the production process. However, there is no clear dichotomy in the process of the two contrasting aesthetic values: fault and glitch aesthetics merge into an assemblage in the final art project.

The use of technology in both fault aesthetics and glitch aesthetics, in which one is a technological fault and the other is used in a deliberate design process, aligns with a heterogeneous approach and the materiality of the digital in relation to the concept of the post digital. In both cases, the design emphasizes disenchantment with the divide of the terms "digital" and "analog" relative to their colloquial meanings (digital = electronic, analog = non-computational).

Performing with a device in relation to real situations. As a mobile phone and its camera already employ a particular way of interacting, both screen-based and analog sensors (also, the camera as a sensor), its use is not limited to what is provided at hand. Such a handy device as a mobile phone is both a post-media device, capable of dealing with various media and techniques simultaneously and also a device that encompasses a post-digital condition in which the hybridity of formats is more than accepted.

We might also find it intriguing to see interaction with such complex technology capable of documenting situations and environments as a performative act. Three principles arrive from the performance with a

mobile camera in the project: limitation of technology, affordances arriving from interaction with the environment, and the relationship between deliberate interaction and technical malfunctioning in order to create a glitch. Firstly, such a performance with a mobile phone depends on the technological limitations of the device and software. The technology shapes our performances by the affordances it provides. Another aspect is our behavior in the situation in which we act, which is documented by the camera in live settings, for example, following the skyline of the landscape with a camera. Such affordances relate to the environment we are capturing with a camera. And thirdly, the control issue of the glitch processes that appear through glitch aesthetics and fault aesthetics. This brings both principles firstly as our skills interacting with our devices and secondly as an effect arriving directly from the technical instabilities. Such unorthodox interaction introduced with an ordinary mobile phone, whose main and conventional interaction is via a screen, brings new perspectives of seeing the post digital in our everyday lives. We operate with our post-media devices in a more complex way, we do not depend on their exclusively digital platform or format. With a usage-hacking approach, we extend their use to some other post-digital applications. The digital provides us with a source of creating richer experiences.

Such post-digital manifestation of materiality through performance and the use of digital and analog simultaneously operate on a level on which humane conditions open up in front of the technology. It could be called a performative interaction in which particular actions are evoked through the technological affordances, but most importantly to the reactions to the real situations. In this case, it could be the scene in front of the camera and the wish to create something substantially new. The digital evokes tangible interactions and bodily reactions to what is actually happening in front of the camera. Various techniques introduced in the *Panorama Time* project: shaking the camera, freezing and deleting frames, or finding patterns and residues of the movement of passersby, giving the user a chance to improvise and perform in conjunction with a live situation in front of the camera. By creating alternative realities using such techniques, ordinary users of everyday technology become engaged in creative processes with the aim of questioning their perception of reality, but also influencing and changing it through the process and the results that appear.

Summary

In summary, through my four art projects, I have introduced a range of concepts relevant to introducing the post digital into HCI as well as introducing concepts from the early formalism and machinic art traditions into the post digital. The concepts developed above were: machine aesthetics, digital upcycling, aleatoricism and chance, deletion, repetition, fault aesthetics and glitch aesthetics. Next, let us turn to the discussion about these concepts in relation to the post digital and how my research program supports the humanization of technology, and what we can learn from this.

5. CONTRIBUTIONS: ULTIMATE PARTICULARS & CONCEPTS

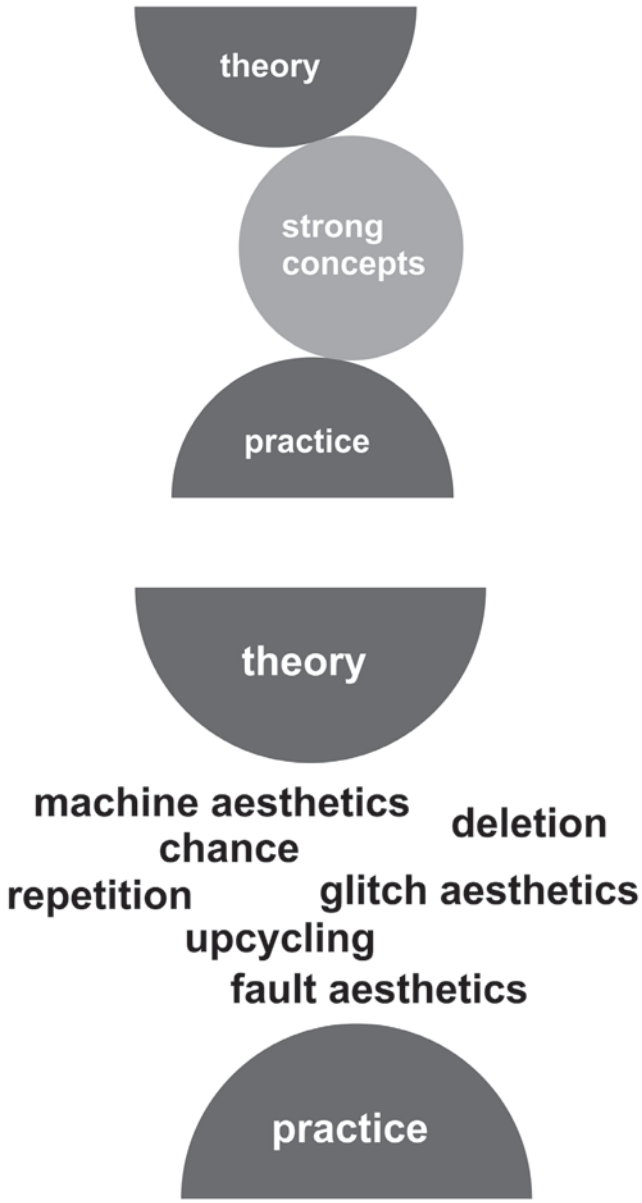

Figure 42. Upper image, a) is intermediate-level knowledge strong concepts in relation to theory and practice, in the below image, b) my concepts in relation to theory and practice/ ultimate particulars.

5. Contributions: Ultimate Particulars & Concepts

By disrupting technology through a post-digital perspective, my hope is to bring technology closer to what it means to be human. We shift away from cold digital perfection, precision and cleanness and instead embrace imperfections, glitches, paving the way for surprise and delight.

The method I have adopted has been through engaging in art projects. The overarching method in these projects has been based on three general approaches: hacking, disrupting and accelerating technology from within. This has, in turn, exposed glitches in the technology which, in turn, have spurred the creative, aesthetic process. In a sense, I inject and/or re-inject components from these three approaches into my work. For example, deletion is already a part of mobile messaging, but through the re-injection of deletion as an upcycling process in *Delete by Haiku*, a new aesthetic possibility arises.

Earlier, I discussed how my contributions can be broadly framed as, on the one hand, ultimate particulars (Stolterman, 2008), i.e. specific art projects, exhibited and experienced in specific settings, with a specific group of participants. I also argued that together they form a program, as discussed by Redström (2017), populating a design space that starts from a set of specific aesthetic axioms. The ultimate particulars fill the program with content, prototypical examples, but also conceptual contributions. I regard my conceptual contributions as potentially strong concepts (Höök and Löwgren, 2012)(see Figure 42a). While my work started with ideas about authorship (and traces of these issues are still being explored in my work), the post-digital concepts came to play a greater role in my creative practice. While authorship questions drove some ideas and explorations, ultimately, the aesthetic axioms of my program focus on introducing concepts from formalism, structuralism and constructivism into the post digital.

In this section, I aim to elaborate on and discuss the concepts that have resulted from the explorations in my program thus far. I regard these concepts as strong concepts (Höök & Löwgren, 2012)(Figure 42b) because of the key role they play in my thesis work, including practical work and theory, and in their contribution to the post digital and HCI. Let us consider and discuss each concept in turn.

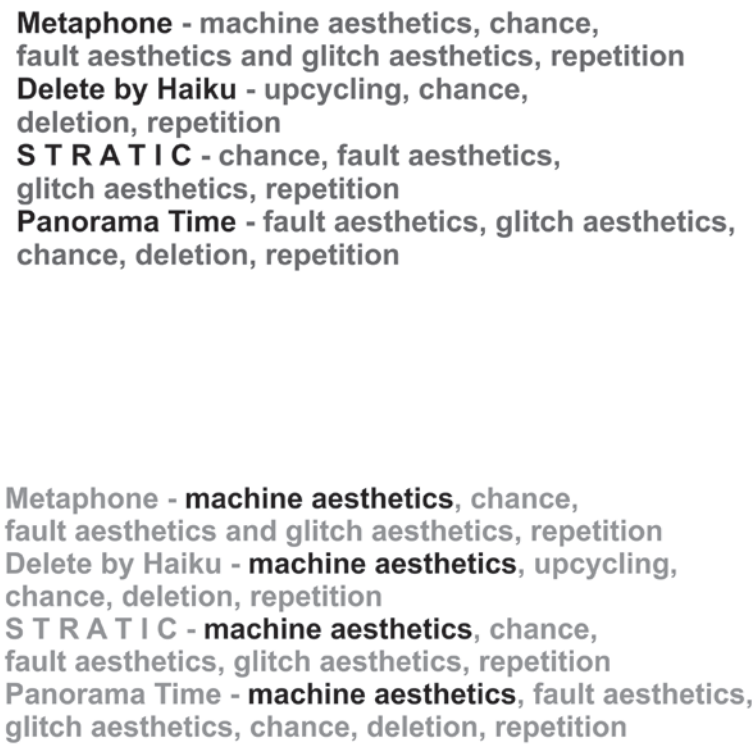

Figure 43. a) map of my concepts in relation to projects.
In the image below b) shows the machine aestehtics covering all of my projects.

The concepts I have already introduced above in the description of each art project in one way or another overlap in my projects, see Figure 43a.

5.1 Machine Aesthetics

Machine aesthetics emerged in the early industrial age. Today, as I have shown in my work, the machinic meets our present computational technologies with their autonomies and agencies creating for novel expressions. The idea of the machinic may enter and engage with, for example, the machine-learning field, in which computers abstract our lives through data mining. Today, our computational technologies go beyond old mechanical or analog machinic devices, even if they retain a machinic core.

Machine aesthetics covers most of my work (Figure 43b). It was initially introduced in the *Metaphone* project and articulated in Paper A. However, the machinic conception is included in all my projects in this thesis work: in *Metaphone* takes place through sound mapping and the exposure of the machine's interior and, in *Delete by Haiku*, through randomness in the algorithmic selection used to create machinic poetry. *Delete by Haiku* exemplifies how machinic algorithms and software can work with text. In the application, it is visualized through the deletion process and randomness exposing words falling in a Tetris-like manner as the user of the app can see which words are deleted and how they are rearranged – exposing the inner machinic workings inside the algorithm.

The *S T R A T I C* exposes the raw mechanics of audio-visual machinic production; the circuit board and a camera are exposed on a desk, so everyone can take part in understanding the logic of such audio-visual generation/production along its multimodal, "synesthetic" trajectory. Machine aesthetics reveal itself in the process of sampling rate, which is exposed in the visuals through the thickness of lines and is crucial to the project as well as to the logic of the machinic.

I also examine machine aesthetics in relation to what I have characterized as digital glitch. Digital glitch derives from an analog with "noise behavior". The machinic can be understood as having arrived with earlier epochs of futurism and machines that produce analog noise. Glitch aesthetics arose from these older forms of machinery. In *Panorama Time*, the explicit exposure of glitch through fault aesthetics and glitch aesthetics brings the machinic to the surface of digital image production.

Machine aesthetics can be perceived in many different ways: one way is through how the machine logic of operation is turned inside out like in *Metaphone* or in *S T R A T I C*, explicitly exposing production processes in performances. And even more direct way is by exposing the actual digital

processes or interfaces by explicitly monitoring the code on a line-by-line basis. But, in my view, the most important aspect of machine aesthetics in relation to the digital is to expose digital qualities in other non-digital and tangible ways. Such a post-digital manifestation of digital qualities can be conveyed through, for example, soundscape. In some of my work, the machinic logic can be perceived through drone-like soundscapes (Metaphone and S T R A T I C) that communicate the machine aesthetics through ambient perception. Evoking machinic experiences is one of the main aspects of my work – I view the machine aesthetic experience as a core aspect of the post-digital condition.

5.2 Digital Upcycling

Digital upcycling is an experience achieved by repurposing design processes as discussed in Paper B, creating what may be seen as a higher value compared to the materials used to achieve it. Such an approach is relevant to the whole body of work presented in this thesis.

The upcycling principle stands for the upgrading of value in art projects. It is not of a digital or technological nature per se but a principle that yields certain experiential qualities. Upcycling might be seen as a transformation from the design object to the upgrade into an object of art. If we think of art (Bertram, 2016) as a broader notion involving context, historical aspects and transformation through experience, as well as qualities beyond the object itself, we should consider the shift from a mere design object to an object of art as a full upgrade in value.

But how can we transform a design object into an art object? In my work, this question becomes a question of how we can add value and upgrade existing values of the design object. Briefly put, upgrading/upcycling in my work takes place not only through the properties of the object but, more importantly, through emergent values within the interaction experience. This approach is present in my projects and described further in my Artist Statement.

In *Delete by Haiku*, upcycling is conducted through a sensitive poetic approach to data as a vehicle and critique to a form of qualified-self[28] discussions. The upgrade of experiential qualities is a core feature of upcycling. As we wrote in our paper: "...we wanted to create ways of experiencing the project through upcycling and the addition of new value". We see upcycling as part of an active user exploration, or as we wrote: "the upcycling aesthetics mostly refers to the end-user experience, which is

[28] Qualified-self is discussed in the *Delete by Haiku* paper (Paper B) and acts in opposition to the more famous quantified-self movement (Sellen & Whittaker, 2010).

shaped by inviting users to take an active and creative stance" (Paper B).

The *Metaphone* project explicitly exposes technological mechanisms through the notions of trust of technology in our interactions and through evolving evocative experiences. The bio-sensing technologies used in the *Metaphone* interrupt established notions of interaction as understood through direct control to challenge conventional interaction with machines.

The *S T R A T I C* project explores humanizing through a journey in which, through the overlap in audio-visual modalities, the aesthetic experience yields a rich and complex synesthetic experience. The major implication of the project in regard to upcycling is the aesthetic synesthetic experience in the project's complex environment. Such experience brings a bodily and sensual perception of the sounds and imagery, in which sound and visuals converge into a single coherent whole of multi-modal experiences.

In the *Panorama Time* project, we enhance our photographic images through applying the notion of liquidity in digital images (Hoelzl & Marie, 2015; Paglen, 2016; Steyerl, 2009). The panoramic technique is exposed through a form of glitch aesthetics. In doing so, we open up possibilities for creating and telling new stories based on broken imagery. By integrating glitch in the digital panorama, we transform the imagery through technological fault aesthetics.

5.3 Deletion

In our *Repurposing Bits and Pieces of the Digital* paper (Paper B) we came to see deletion as an activity, and also as an interaction design quality and a means of aesthetic experience. In the commercial world, we note how Snapchat can be seen as offering automatic deletion as it automatically deletes photos once they have been sent. Some might think of this as a "negative affordance". Both of these articulations (aesthetic experience and negative affordance) indicate some measure of ambivalence and frustration with deletion in digital technology – contradicting the fact that deletion in the digital world is effortless: just press a button and a message, file or complete archive is gone.

By picking up on such a strong and unique technological quality as digital deletion and integrating it back into our interactions through an art project, we might achieve richer experiences and deeper reflection. It exemplifies what I mean by the deconstruction of a system by its own means, harnessing its dynamics and energies. By picking deletion, we emphasize one element of the system, sending it back into the system to disrupt it.

In *Delete by Haiku*, the upcycling and repurposing-oriented design provides a means of coping with the masses of information that we generate without losing its sentimental value – a form of qualified-self instead of the quantified-self movement (Espeland & Stevens, 2008; Sellen & Whittaker, 2010). Our aim here was to harness deletion in aesthetically appealing ways through revisiting old memories in *Delete by Haiku*. In *Delete by Haiku*, the agency of the machine is expressed less, so users experience a certain amount of control over the deletion process. This case reflects glitch aesthetics with some measure of user control over the deletion process.

Deletion is discussed in the *Delete by Haiku* paper but is also present in *Panorama Time* where the glitch acts as a form of deletion. In *S T R A T I C*, glitch appearances break the visual view. However, it is hard to notice glitch in the sound of the performance as the entire soundscape comprises drone music with a bewildering profusion of glitch-like sounds. This accidental glitch arriving from the electrical charges appears out of nowhere, there is no control over this process and such appearances literally delete information.

5.4 Repetition

As I show in the discussion section of the *Panorama Time* project text, deletion and repetition can be used together for aesthetic effects. When parts of the image are deleted, replication and repetition might take over and fill in the missing spots. The glitch overwrites the existing (and deleted) information. In deleting one part, one reinserts and substitutes it with its components through replication and repetition. Repetition can be seen as the opposite of deletion as it has an additive nature; it is about collecting, storing and hoarding, instead of deleting and letting go.

Repetitiveness can be a valuable asset in many applications, for example, in music as part of a melody and other harmonic nuances. However, in this thesis, I explore repetition as a disruptive attribute, which supports more extreme cases. By extreme cases, I mean, for example, cases of the principles of remix culture, which deploy scratch techniques (Hansen, 2002) instead of traditional melodic composition. I focus on non-linearity and disruption instead of classical harmony. The extremeness can be seen as cases of defamiliarization (Bell et al., 2005).

The visual glitch approach in *Panorama Time* builds on different directions (which are elaborated on in the paper *Time and Space in Broken Panorama* – Paper D) with repetition utilized to create “broken” visual storytelling. The monotonic machinic movement in *Metaphone* exposes the repetitive qualities of the mechanical machine. The digital layer is

reinterpreted and exposed in relation to repetitiveness through sonic depiction. An algorithmic randomness used in *Delete by Haiku* drives the process of – the partly repetitive – selection of words and combination of words in the final poem. But this strange repetitiveness of words could be improved using a manual feature in the app and the deliberate interaction of users. The *S T R A T I C* performance with its monotonous audio and visual rhythms is a platform for the explicit appearance of repetition.

Using predominantly digital qualities from the technological domain to disrupt systems from within and by their own means is one approach to hacking technology. But here is also another way of hacking. In the next section, I bring chance as a concept with which to work as a means of humanizing technology.

5.5 Chance

In my work, the use of chance in interactive technology is based on the concept of aleatoricism (Hedges, 1978)(see also Paper B). Chance does not have much precedence in the engineering-technological world in which the normal praxis is to attempt to rule it out. Algorithmically-generated randomness might be the closest digital equivalent to chance in the world of digital technology.

One way of seeing chance could be from the perspective of a malfunctioning system. When such instances of chance occur, we might, for example, not know exactly what data will be deleted.

In my work, the spectrum of chance is broad and encompasses randomness in mechanical and computational algorithms, but also, to a great extent, because of its natural unpredictability. The machinic monotony might be partly predictable because of its tedious repetition but, in my work, it will still contain a great degree of chance. I discussed this issue in Paper E in relation to the Deleuzian notion of repetition.

All my projects rely heavily on chance as a design element and, as such, express an endeavor to approach humanizing relations to technology. My use of chance provides a confrontation with the technological domain of control and determinism, and from this perspective, it brings a destructive element, an acute moment, to the understanding of technology. Incorporating chance in the technological domain is a way of enriching technology, its interaction and control issues, with contrasting qualities, as well as shedding a critical light on it. What happens if chance takes a predominant position in technological agency? We may examine chance as a human endeavor to encounter technology and hack it. We might then discover that chance could blend with the technological nature of randomness, or stay as a more human phenomenon, liberated from machinic workings.

5.6 Glitch Aesthetics and Fault Aesthetics

Incorporating most of the above-discussed concepts and qualities in the interactive technological domain, glitch aesthetics and fault aesthetics are key expressions of the post digital with historical roots in Cascone's reference to the glitch as a major artistic quality and resource (Cascone, 2000).

From a hacking perspective, new forms of glitch aesthetics originate from the constant acceleration of technological development. Software-driven artists generate glitch aesthetics through data bending and pixel bending practices by corrupting digital code or physically manipulating electronic devices.

As discussed in the contribution section on *Panorama Time* (in Paper D), there is a clear distinction between two aesthetic principles: glitch aesthetics and fault aesthetics. This is, however, happens more on a theoretical level as both aesthetic principles merge together in practice. In glitch aesthetics we observe the involvement of deliberate human actions in relation to technology and the creation of glitch, while technological malfunctioning directly generates fault aesthetics without human involvement. An interesting feature of *Panorama Time* is linking the glitch processes with an indexical approach. When using a camera, we tend to believe the scene was happening for real. However, the glitch distracts our attention and shifts it toward its own, more artificial, elements. This indexical glitch synthesizes two things: the pictorial reality in front of the camera and the glitch produced by the unorthodox use of the camera.

And finally, with respect to *S T R A T I C*, I previously discussed how electrical glitches could be seen as being along the lines of fault aesthetics. Such glitches in *S T R A T I C* play a micro-interventional role in the performances. As such, they contribute to the general glitch aesthetic experience of the whole performance. It is almost impossible to repeat the glitches or learn how to make them through deliberate use of the system; the glitches here have strong accidental natures and build on chance procedures.

Such above discussed glitches are of a technical fault and accidental nature (as in fault aesthetics). As such, they break the normal controlled behavior (glitch aesthetics), except in the case of *Panorama Time*. But control in *Panorama Time* is not related to knowing the tool and acting in accordance with its conventional use. While the *Panorama Time* glitch offers some degree of control, the participants cannot learn to control the glitch in *Metaphone*, *Delete by Haiku* and *S T R A T I C*.

6. HU-MANE FU-TURES THROUGH ART

6. Humane futures through art

As discussed in the introduction, my contributions are, on the one hand, practice-based research and, on the other, the written thesis with its conceptual work and articulation of insights.

To reiterate, the core of my thesis comprises a discussion of my practical work through the concept of disruption in relation to the post digital. I draw, in particular, on two main goals of the post-digital concept: the first is the humanization of technology and the second is the convergence of the digital and analog. To address these topics, I have developed a hacking approach. Firstly, I select a process from our contemporary technological world, and then, by utilizing a disruptive attitude, I try to hack it, tear it apart[29] and look at it from the inside. I try to accelerate it from inside with its inner forces and use those forces to run the systems on disrupted paths, in unexpected directions. My work contributes to the post digital through the concepts of machine aesthetics, digital upcycling, chance, repetition, deletion, fault aesthetics and glitch aesthetics. These manifest in my art projects and are articulated and substantiated in this thesis.

The approaches presented and applied in this thesis are mechanically destructive. In a sense they are non-human and aim to break or hack the system by its own means, such as digital deletion, machinic or glitch, in which all these concepts derive from the technical world and are put back to disrupt the technical systems. These are ways of subverting systems through their own energies and tools. Yet chance, in the way I have deployed the element, has more of a humane nature.

In my thesis and in my understanding, the concept of destruction (as used in this thesis) arrives from the arts – not from HCI or the technology industry. Despite the concept's negative connotations, destruction can be used creatively, as a constructive process towards comprehending systems or the world at large. We may deconstruct/dismantle things into smaller pieces and rethink their existence, thereby arriving at something new. By understanding our destructive forces, our sensitive, bodily and human origins are brought into focus. We need something destructive in our lives, to see the world in a brighter light: to reboot the system, or to kill it completely, with a clear aim or belief that it will be reborn anew.

Acute factors such as deletion and repetition in relation to our sensitive data and memories, the introduction of chance in relation to recent

[29] It is important to remind that the system for me is not only a technical device, but it could be a larger system in a broader context and that the hacking process is not only through dismantling a device or hacking a code, but hacking or taking over through conceptual and critical means.

technologies, glitch as an ordinary artistic means, inversion of the "black box" with its internals; all these factors show how my work is based on a destructive attitude to our contemporary world. Through such a destructive attitude, I look for a critique of systematic situations. In my work I search for antitheses to systems and, through subversive relationships, turn them against each other to bring about a change.

Art questions, provokes, criticizes and rethinks reality through its various manifestations and its groundings in conceptual, material or immaterial aesthetic pursuits. The digital has eventually become established in the world not just on its own, but through the lens of the post digital in relation to old technologies. I am concerned with the digital and its qualities. I experiment with the digital and incorporate it into other media and formats to see it in relation to the others, not discerning particular formats, but in general relating to media, electronics, or signals. In my view, old technologies are more "humane" to us as we have already grown used to them. By juxtaposing the older, more familiar and more highly-trusted technologies with the new technologies, my projects point to possibilities of making even the new digital technologies more humane. In this sense, machine aesthetics juxtaposes "black box" technologies – with their hidden corporate, patented and copyrighted secrets – with those machinic processes in which the machine is turned inside out. Digital upcycling stands for upgrading experience through repurposing materials in designs so the old parameters of old designs are presented in new forms. This contradicts the design notion of "form follows function" by having function follow form – the core feature of repurposing. Expanding on this notion, I argue that we can talk about function as a type of form, and that functionality, which is a core of machine aesthetics and is exposed through operational functions and processuality in my work, becomes a means for design as well as an aesthetic value. Chance, present in many of my projects, is a factor taken from aleatoricism in the arts and reincorporated as a contrasting element in my understanding of technologies that are typically deterministic. Repetition – very mechanical action is brought to more extreme extents through which glitch (S T A T I C), broken image (Panorama Time) or aesthetic patterns (Metaphone) are produced. Deletion may function as an acute and unexpected action, which can frustrate us in relation to personal data (Delete by Haiku) or visual information (Panorama Time). Fault aesthetics and glitch aesthetics highlight relationships between the technological and the human and, through them, I attempt to create aesthetically-appealing results.

Methodologically, I have been primarily engaged in two practice-based methods, one taken from visual art practices and the other from design: Research through Art and Research through Design. These two became

merged in my practice and research as: Research through Art and Design. This method enabled me to look at my work from the perspective of production procedures, which, together, were accompanied by theory from conceptual art. This sort of praxis – theory realized in practice or practice lead by theory – is common in the arts. Such strong ties are often necessary to work in the complex art world in which material and aesthetic concerns are closely related to conceptual underpinnings and to the actuality of contemporary issues.

What could designers take from my work? One approach, on a material-design level, is to engage in design work based on the ideas I have articulated in this thesis. Another approach, closer to art my art practice, is to engage with the concepts and relate them to technology or, more broadly, to utilize the methods and approaches in this thesis, to search for systems and accelerate them with the aim of building new and more humane systems. A third approach is to work more closely to the experience level and find ways of upgrading experiences aesthetically. And finally, by conducting work grounded in the traditions of both art and design, as informed by research, one might consider more abstract ideas and rethink the foundation of the reality we live in.

The insights of my thesis and the presented projects feed into two fields: firstly, they contributes to the understanding and expansion of the post digital with the qualities derived from my work and results articulated in the thesis. Secondly, the concepts and techniques brought to interaction design and interactive art, i.e. in a broader sense to the HCI field, might open new perspectives from which the producers of art and design can critically look at technologies, but might also provide a few hints regarding how to escape the solutionist-positivist attitude.

My work contributes to a general understanding of the issues regarding humanizing technologies and forms part of the discourse of the post-digital age. And finally, I posit that we cannot escape being human and, as part of our nature, try to accelerate the solutionist-positivist progress. We should open up our creative potential to simple things and look back on our old experiences to create stronger new experiences, revise old concepts and put old technologies back on the table. We should take techniques and concepts from miscellaneous fields to introduce them in new areas, challenge ourselves by meeting confronting sides, or merge the unconvergeable. Why should we do all this? Because the alternative would be to stop a form of inquiry, inquiry as a contemporary critical art practice, with a consequent loss of who we are.

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List of Figures

Selected exhibitions

2017

ISEA 2017, 23rd International Symposium on Electronic Art & 16th International Image Festival, Manizales, Colombia;

COMMA, launch of a hacking project in public space on the streets;

ArtVilnius'17, 8th International Contemporary Art Fair, June 8–11, 2017, Exhibition and Congress Centre Litexpo, Vilnius, Lithuania;

The Art Bank, Gallery Weekend Kaunas, Kaunas, Lithuania;

Šiauliai art gallery, "Valuation" solo exhibition, Šiauliai, Lithuania;

"Art Value: 2% Support" online project - www.MenoVerte.lt (Meno Verte means Art Value);

Video Showcase screening at ACM CHI 2017 conference, Colorado Convention Center, Denver, CO, US;

Solo exhibition "Frozen Fraction" in the Reactor Hall / R1, Stockholm, Sweden;

Mobile Life centre exhibition, Kista, Sweden;

Father's Footsteps, Sts. Peter and Paul church, Omaha, NE, US;

2016

Open Fields exhibition, RIXC Art Science festival, Riga, Latvia;

Impulses. The New Sound Days, Architecture and Media Centre H2O_6, Riga, Latvia;

Live Cinema Festival, MACRO – Museum of Contemporary Art of Rome, Italy;

"Monitors" exhibition of interdisciplinary project Archmediale, the Power of Zero art space (_0*), Vilnius Gallery Weekend, Vilnius, Lithuania;

MANIFESTA 11, The European Biennial Of Contemporary Art, Cabaret der Künstler – Zunfthaus Voltaire, Zurich, Switzerland;

S T R A T I C Space, the Power of Zero art space (_0*), Vilnius, Lithuania;

Art Value: Market, performances in the marketplaces in Vilnius district, Lithuania;

Art Value: Auction, Sodu 4 art project space of The Lithuanian Interdisciplinary Artists' Association Vilnius, Lithuania;

FILE - Electronic Language International Festival, Fiesp Cultural Center, São Paulo, Brazil;

FIESP / Gallery digital SESI-SP at FILE LED SHOW 2016, São Paulo, Brazil;

Cultural R>evolution, ISEA 2016, 22nd International Symposium on Electronic Art, Hong Kong;

Science of the Unseen: Digital Art Perspectives, the Digital Arts Community of ACM SIGGRAPH, Anaheim, California, US;

Interactivity exhibition, CHI, San Jose, California;

Future Identities, International Video Art Festival, University of Kent, Kent, UK;

Art's Birthday, Södra Teatern, Stockholm, Sweden;

Dual Identity, Lithuanian residence in Stockholm, Sweden;
Dome of Visions, Stockholm, Sweden;

2015

Shaping the Future, Medini art space, Iskandar, Malaysia;
Wild Code, HYBRID MATTERs, field_notes laboratory, Kilpisjärvi, Finland;
Art Cinema, Trailer gallery, Gävle, Gravendal, and Malmö, Sweden;
Dktus art space, Stockholm, Sweden;
R1 Reactor Hall, Sweden;
Crossings, CHI Interactivity, COEX, Seoul, South Korea;
Light Bounces: Space and Body, Art.CHI online exhibition;

2014

Location, ISEA 2014, 20th International Symposium on Electronic Art, Dubai, the United Arab Emirates;

Memory Migration, Now&After International Video Art Festival, The State Museum of the History of GULAG, Moscow, Russia;

2013

Southern Panoramas, The 18th International Contemporary Art Festival SESC_Videobrasil, São Paulo, Brazil;
Artist Talk, PIVÔ art space, São Paulo, Brazil;
Art Talks, Jönköpings Läns Museum, Jönköping, Sweden;
Researchers' Night, Debaser Medis, Stockholm, Sweden;
AlbaNova, Stockholm, Sweden;
Hello World! DKTUS art space, Stockholm, Sweden;
Machine Aesthetics, Den Frie art centre, Copenhagen, Denmark;
Changing Perspectives, CHI Interactivity, Palais de Congrès de Paris, Paris, France;
Mapping Future Terrains, European Media Art Festival, Osnabrueck, Germany;
Biotones, Digital Art Centre, Stockholm, Sweden;

2012

Dual Identity, Konstnarshuset, Stockholm, Sweden;
Space and Spectacle, Husby konsthall, Stockholm, Sweden;
Parawise, Mellanrummet, Stockholm, Sweden;
Performing the Common, Husby konsthall, Stockholm, Sweden;
Propaganda, Kulturhuset, Stockholm, Sweden;

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