California Institute of the Arts

Anatomical Analogies

The evolution of harmony and noise in relation to the self and society

by

Raphael Arar

A thesis submitted in partial fulfillment for

the degree of Master of Fine Arts

in the

Herb Alpert School of Music

Music Technology: Interaction, Intelligence & Design

Supervisory Committee

Dr. Ajay Kapur, Music Technology: Interaction, Intelligence and Design

Mentor

Mark Trayle, Experimental Sound Practices

Committee

Tom Jennings, Art & Technology

Committee

Dr. Norman Klein, Aesthetics & Politics

Committee

Sara Roberts, Experimental Sound Practices/Integrated Media

Committee

Michael Darling, Theatrical Technical Direction

Committee

Abstract

This paper reflects on a body of work dealing with human interaction. How do we understand, communicate and spiritually contemplate in a world where the aspects of harmony are comingled with technological noise? Through a survey of aesthetic objects, the author traces the trajectory of social implications arising from the information age, exaggerated by computational developments. The works are presented in increasing order of complexity of interaction: fixed, responsive and participatory. Through thematic incorporation of symbolic hearts, harmony and noise in the works, the author sheds light on the current social climate and the way in which it affects our daily lives.

Acknowledgments

I would like to thank:

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Chapter 1

Art and Design: A Dialectic Relationship with Symbolic Overlap

Humans and human civilization are constantly in flux. As living creatures, we are never stagnant from either a physical or metaphysical standpoint. We are constantly growing, thinking and formulating ideas. A testament to the constantly evolving nature of humanity can be seen by certain iconic moments in history including the Renaissance, the Industrial Revolution, and more recently, the tacit Digital Revolution. Throughout these periods, technology has served as a lens to highlight evolving aspects of human identity and social interaction.

Stemming from Classical Antiquity, philosophers have noted that humans are by very nature social creatures. In **Politics**, Aristotle states:

> *Man is by nature a social animal; an individual who is unsocial naturally and not accidentally is either beneath our notice or more than human. Society is something that precedes the individual. Anyone who either cannot lead the common life or is so self-sufficient as not to need to, and therefore does not partake of society, is either a beast or a god. [1]*

As an extension of Aritstotle's thinking, human beings are complex and made of collective emotional, physical and cerebral qualities. Thus, psychology and sociology work hand in hand in the development of an individual, which emanates to society and propels humanity in directions far from individual control.

What does it mean to be human in the 21ˢᵗ Century? Today's world is an obscure web of signals as both tangible and intangible connections. The Western world in particular has become a complex, connected entity, and the prevalence of digital outlets, especially the Internet, has affected the fundamental question of human existence. Capitalism continues to fuel new developments (e.g., robotics, smartphones, wearable computing, etc.), which continues to impact our sense of selves from both interpersonal and intrapersonal standpoints. This paper serves as a reflection on the author's work and research that seeks to explore the evolution of interaction connected by common conceptual themes including: heart, harmony and noise.

1.1   A Personal Definition of Art

Many notable artists, historians and thinkers have pondered over the question, "What is art?", and the interpretations are vast. Defining art on a global level is an intermingled web of associations, which has enabled a variety of definitions, interpretations and theories that are well out of the scope of this paper. In this paper, the author will reflect on a handful of works created through his practice from 2012-2014. In order to provide the reader with context, this section will describe a definition of art that resonates with the author and his practice.

Throughout history, many interpretations of art have influenced the author. The following views are particularly impactful in both research and approach:

> *Art is not, as the metaphysicians say, the manifestation of some mysterious idea of beauty or God; it is not, as the aesthetical physiologists say, a game in which man lets off his excess of stored-up energy; it is not the expression of man's emotions by external signs; it is not the production of pleasing objects; and, above all, it is not pleasure; but it is a means of union among men, joining them together in the same feelings, and indispensable for the life and progress toward well-being of individuals and of humanity. [2]*

Art is essentially the affirmation, the blessing, and the deification of existence. [3]

In interpreting the first idea, art can be seen as a vehicle, connecting individuals on an emotional level. Thus, the idea of art has been removed from a directly individual response to have collective, emotional resonance as a means to propel society forward. In the second, art can be seen as not only a tool but also a way of life, which can allow us to transcend human existence by enabling potential to create additional values that in effect redefine our daily lives. The synthesis of these two ideologies formulate the basis for which the author begins to reflect upon interaction by way of questioning the paradigms that arise by way of technology's effect on interpersonal and intrapersonal communication.

1.2   A Personal Definition of Design

Design, although a multifaceted and convoluted entity in itself, has historically enabled more concrete definitions than art. The word 'design' is quixotic in nature since its outlets branch into both tangible and intangible realms (i.e., interface design, industrial design, interior design, etc.) and describes both process and product. Computer scientists and researchers Paul Ralph and Yair Wand have recently summed up the concept in a comprehensive definition:

> *DESIGN: (noun) a specification of an object, manifested by some agent, intended to accomplish goals, in a particular environment, using a set of primitive components, satisfying a set of requirements, subject to some constraints. [4]*

This concise definition sums up design as it manifests itself in the author's work. Thus, the intended goals would be the conceptual basis of the work and/or inherent questions set forth for artistic exploration, whereas the requirements and constraints are purely set forth by the concept at hand. Chapter two presents a further elaboration of design principles as they relate to the execution of the work presented in the remainder of this paper.

1.3   Themes

Various thematic elements pervade the works presented within this paper. Three in particular are recurring: anatomical hearts, harmony and noise. These subthemes act as unifying elements of

the works, each one representing dualities including analog/digital, nostalgia/novelty, physical/metaphysical and self/society.

1.3.1 Anatomical Hearts: A Multifaceted Symbol of Humanity

The anatomical heart is a symbol imbued with multiple meanings. How does a heart represent humanity and how does this symbol evolve as it relates to aspects of semiotics and people? The author carries the symbolic aspect of the anatomical human heart throughout the works presented in this paper in order to represent individuals as members of society. The heart, taken out of context of the human body, is mostly seen in medical and entertainment contexts (i.e., horror films and special effects). However, historically the heart has represented a variety of emotions, particularly the duality of both pain and pleasure, especially as it exists in film and literature. In fact, many aphorisms, idioms and phrases revolve around the heart as an organ that embodies emotion[5]. The works presented in this paper show the heart in a multitude of meanings and dualities—from individual/society to analog/digital and extending to greater concepts of life/death.

1.3.2 Harmony

How does inner reflection and spiritualism evolve when technology, particularly computation, demands more of the self? This question is a recurring thematic element in this paper and a key conceptual aspect of the author's thought process. The work at hand explores the duality between ancient and futuristic symbolism and their perceived intersection. With the exponential developments of computation, partially explained by Moore's Law[6], human beings can now offload more of the mundane, simplistic tasks (e.g., budgeting, planning, etc.) as well as the complex processes (e.g., data analytics, biological tests, forecasting, etc.) to machines. By transferring this processes to machines, humans can theoretically be cleared of tasks that affect stress levels and mood. The question then lies: how does progress affect aspects of inner peace? Are humans more stable or volatile by way of these advancements? The author's interest in these questions relating to intrapersonal interaction acts as a driving mechanism in the creation of aesthetic objects.

1.3.3 Noise

How does communication noise affect humans from both an intrapersonal and interpersonal standpoint? In an article entitled "A Mathematical Theory of Communication" from 1948, Claude Shannon describes the basic elements of communication[7]. First, an information source produces a message. This message is then transmitted to create a signal that is sent through a channel, which in turn, carries the signal over to a receiver. The receiver transforms the signal back into the message intended for delivery to a destination (either a person or a machine). Shannon created a formal concept of a 'channel' as one that carries symbols and noise (Figure 1. Shannon's Communication Model). Both Shannon and Alan Turing point out that the number of symbols must be finite; as they proliferate they become increasingly hard to discriminate, and noise blurs one into another. By dealing with an intermediary device, the opportunity for noise, obfuscation and detachment increases in this model. Whether this form of communication is interpersonal or intrapersonal, the presence of technology presents an interesting shift in our instinctual abilities to communicate—we must now adapt to our devices in order to clearly delineate our messages. The author's interest in the evolution of Shannon's original model of communication by way of computational progress exists as a pertinent theme in the conception and execution of works delineated in this paper.
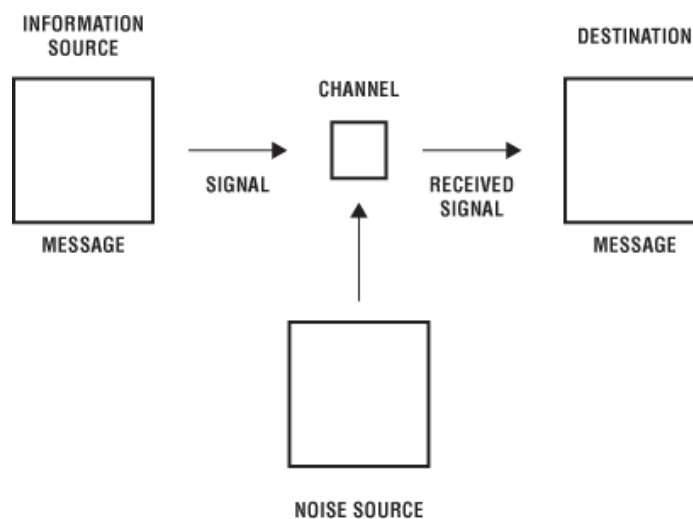

Figure 1. Shannon's Communication Model

Chapter 2

Design Principles in Art

Although many sources stress that art and design are naturally conflicting [8], both entities go hand-in-hand in the commencement and execution of the author's practice. In fact, art and design congeal to form a unique, fused duality. Similar to aspects of Yin and Yang in Daoism [9], art and design are counterbalances that allow for interconnectedness in the creative process. Design and its principles, a far less open-ended entity than art and its rhizomatic branches [10], must be established in order to discuss the relevance of this duality in other influential artists as well as the author's works.

2.1   Principles of Design

A baseline definition of design as it relates to the work presented in this paper can be seen in Chapter 1. Many principles for describing the design process have been set forth by theorists, scientists and engineers throughout history. Don Norman, a cognitive scientist and engineer, has pioneered many ideas surrounding user-centered design[1]. Based on his research that forms the basis of *The Design of Everyday Things*, Norman outlines a handful of relevant design principles:

- Visibility—can a user see the state of a device and its possible actions?
- Feedback—what is the object (tangible or intangible) doing? How does the user know the effect of an action?
- Affordance—what are the perceived and actual properties of the object that give clues to its operation?
- Mapping—what is the relationship to the controls and their effect?
- Consistency—how can objects be designed that are intuitive to the user?

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[1] The idea that design should "make sure that (1) the user can figure out what to do, and (2) the user can tell what's going on." [11]

These principles form the basis of Norman's user-centered design methodology. While the most apparent associations with these principles lie in interactive objects, such as interfaces both physical and digital, they can be extended for implicitly interactive objects. Even if a work itself is not interactive, these principles can be employed in the process of creating a fixed and/or non-interactive object.

Industrial designer Dieter Rams' iconic work in the 1980s led him to be at arms with the world as he related it to "an impenetrable confusion of forms, colors and noises [12]." This dilemma spawned his ten principles of good design:

- Good design is innovative
- Good design makes a product useful
- Good design is aesthetic
- Good design makes a product understandable
- Good design is unobtrusive
- Good design is honest
- Good design is long-lasting
- Good design is thorough down to the last detail
- Good design is environmentally friendly
- Good design is as little design as possible

Although these principles refer to commercial products and the capitalist institutions at play, their application is relevant in the creation of aesthetic objects, be they literally or more abstractly interpreted. The following sections take these baseline principles and definitions in order to shed light on influential artists (both their work and processes) followed by discussion on the author's hybridized art-and-design/question-and-answer approach to his practice.

2.2   Related Work

Artists throughout history have distinct processes, which enable them to uniquely contribute to society in terms of process and result. Four artists in particular have been selected in order to provide contextual relevance by shedding light on their processes and demystifying their implicit dualities involving art and design. The following section provides a brief, chronological overview of their key works and ideas.

2.2.1   Jean Tinguely

Jean Tinguely was a Dadaist artist best known for kinetic sculpture, which was given the umbrella title of Meta-mechanical sculpture by Pontus Hulten [13] as a way to serve an analogy with the metaphysical implications of his work. Of his more notable pieces, Tinguely's **Homage to New York** (Figure 2. Jean Tinguely and Homage to New York) created in 1960 signified a shift in the more conventional forms of sculpture at the time—the sculpture was time-based due to its self-destructive nature. The flow of the work, in this case, transcended the medium of sculpture and incorporated aspects of design in both its creation and end result. In a sense, Tinguely's question could be phrased as: how can a work exploit the true nature of New York City in both its power and fragility [14]? As a 'designer', Tinguely executed a sculpture that was grandiose in nature, but its self-destructing qualities lent itself to be fragile. Despite the serendipitous nature of his kinetic sculptures, his execution incorporated mechanical precision in its use of gear systems and repurposed parts, which serve as a testament to his painstaking design process.

Figure 2. Jean Tinguely and Homage to New York[2]

2.2.2   Nam June Paik

"Skin has become inadequate in interfacing with reality. Technology has become the body's new membrane of existence." — Nam June Paik

Nam June Paik is a unique character in the history of new media art. He has been touted as the "Father of Video Art" in his pioneering work with technology-based art [15]. Paik began his artistic journey as an avant-garde musician and eventually landed in New York to study with John Cage and other Fluxus artists. The Fluxus movement served as a catalyst to his transition to more radical forms of art—a departure from his more traditional musical training. He was one of the first artists to collaborate with engineers, such as Shuya Abe, which spawned the creation of the notable **Paik-Abe Video Synthesizer** (Figure 3. Paik-Abe Video Synthesizer Schematic), which was both a tool for artistic creation and a work in and of itself. Paik was also one of the first artists to explore the dualities between analog and digital, past and present and the harmonious divide between seriousness and whimsical [16]. He strove to make technology more human by exposing its playfulness and whimsicality often allowing for interactivity and viewer participation. The inherent interactivity in his works and incorporation of aesthetically-minded technology shed light on his design process in the execution of his works. As an artist, Paik questioned the progression of technology and its implications, and as a designer, he sought to comprehensively answer this question by implicitly adhering to design principles including visibility, feedback, affordances, constraints and consistency (or the departure from it for aesthetic effect).
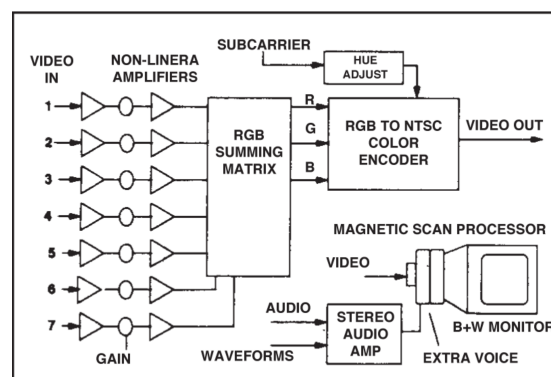

Figure 3. Paik-Abe Video Synthesizer Schematic[3]

2.2.3   Christian Marclay

Christian Marclay is well known within contemporary art circles for his groundbreaking interdisciplinary artwork incorporating visual, performance, media and sound art [17]. Unlike Paik, Marclay initially studied sculpture and then evolved into performance and sound-based art. His artistic endeavors brought forth his iconic work with the turntable, which led to his ability to transform musical objects into a form of visual commentary on popular culture. His collage-like approach to medium extends to the tangible objects he made: he would cut various vinyl records and glue them back together in different configurations in order to provide new aesthetic meaning, albeit fragmented. As is such, Marclay explores dualities of past and present, varying genres by this very notion of collage. His exploration of sonic noise can be elaborated as a commentary on communication noise on both an interpersonal and intrapersonal level. By subverting the original intent of the turntable, Marclay toys with the listener's aural perception as well as conventions surrounding dialogue between performer and audience in order to shed light on the evolution of noise as society progresses.

2.2.4   James Turrell

As a unique artist exploring light and space, James Turrell creates works that alter viewers' perception in order to enhance spiritual awakening. In Turrell's words, "I want to create an atmosphere that can be consciously plumbed with seeing like the wordless thought that comes from looking in a fire [18]." Turrell's background in cognitive psychology and mathematics informs his aesthetic choices as he executes his work with a designer's eye. **Raemar Pink White** (1969) is one of his most notable pieces; the piece consists of a room painted white where all the corners of the room have been slightly curved to remove aspects of perceived depth, while a hard-edged rectangle in the center of the room emanates an iridescent pink light from outside its inset edges (Figure 4. Raemar Pink White). **Raemar Pink White** is just one of Turrell's works that is created in a very meticulous fashion informed by scientific research and planning based on studies of sensory deprivation and the Ganzfeld effect[4] [19]. Turrell's research in the

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[4] A phenomenon in which individuals who are exposed to uniform stimulation fields—usually a static field of color—undergo a loss of vision as the brain tunes out the unchanging signal from the eyes

execution of his works incorporates key design aspects by ensuring his viewers have an unobtrusive, incisive experience that is not only visible and intuitive but impactful and useful in order to expand upon a greater metaphysical experience.
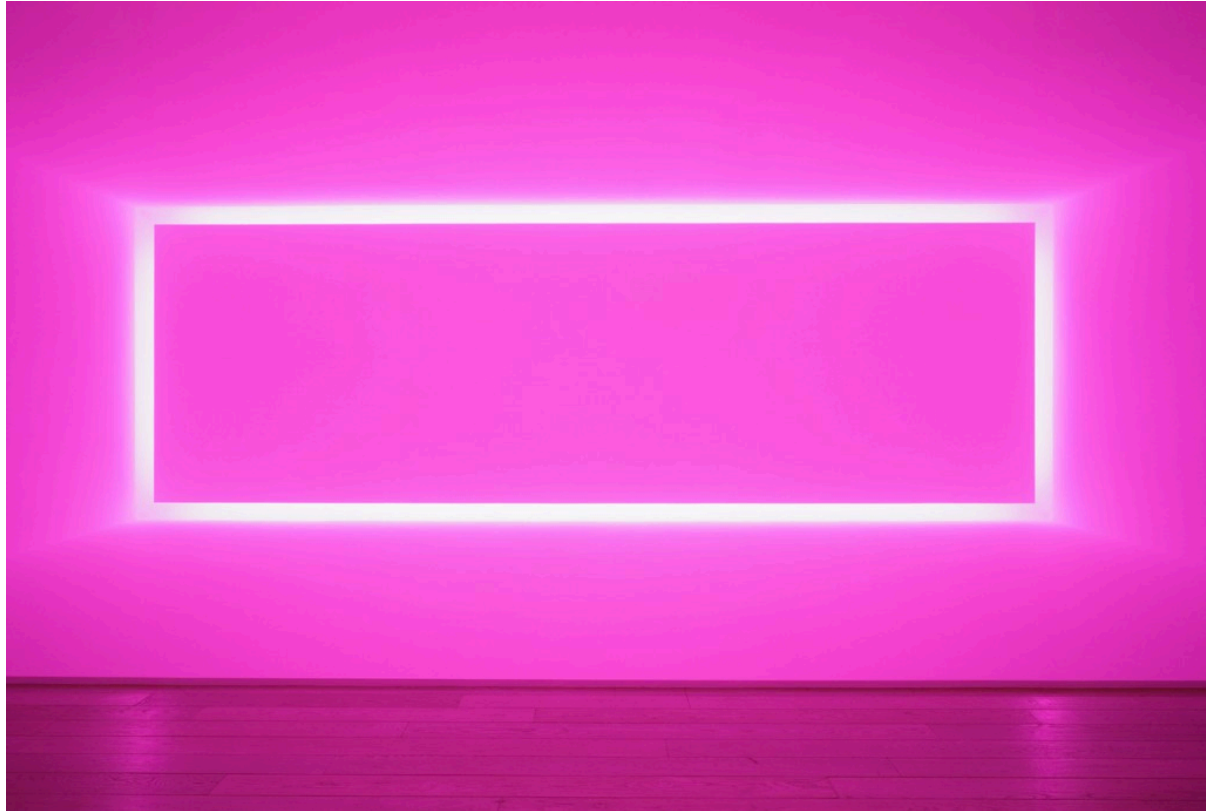
Figure 4. Raemar Pink White[5]

2.3 The Artist as Designer

While all of these artists are unique, the four of them collectively stand as an imperative precedent for the author's work and practice. Art and design can be broken down, dissected and analyzed in a variety of ways; however, as these entities pertain to the author's creative process, art and design are unique counterbalances that exist symbiotically in the creation of artistic objects. Art and design are like Yin and Yang—the former provides mental fuel for aesthetic questioning, inner reflection and creative thinking, while the latter provides mental fuel to

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[5] http://jamesturrell.com/

answer the question set forth in the most unobtrusive, concise and intuitive way possible. This process is by no means linear; there is a natural push-pull dynamic between the artistic process and design process. Iteration and fluidity between the two poles is paramount, and the question-and-answer phases are ongoing. The author's ideation and execution processes are further exemplified by the work described in the remaining chapters.

All of the artists and designers in this section show prowess with their skill set. Not only are their concepts and works technically proficient, but also they are contextually relevant in their interaction models. For example, Norman & Rams create and/or consult with firms to make sure products are functional, since they are directly interacted with. On the other hand, Tinguely, Paik, Marclay and Turrell use context to either create work that has either indirect or direct interaction models (i.e., active versus passive engagement). The author utilizes a hybridized approach from the designers and artists outlined in order to explore contemporary society's many dualities (i.e., individual/society, analog/digital, life/death) through works incorporating fixed, responsive and participatory interaction models.

Chapter 3

Aesthetic Duality: Fixed Form

The world can be seen as a collection of dualities. From the simplistic and mundane light and dark, to the more complex and intertwined physical and digital. Using a macrocosmic lens, the crux of the author's practice has explored the notion of duality in a variety of ways: this and that, then and now, analog and digital, art and design, etc. Fundamentally, these dualities boil down to choice. **Gemini Heart** is a work, which reflects upon notions of choice in a fixed-format, allowing the viewer to reflect upon an experience requiring no interactivity or participation aside from mental engagement. The visual contrast of black and white coupled with the repetitive pulse of a solenoid reflects on the duality of choice amidst a sonic duality of noise/harmony. These dualities of harmony versus noise and black versus white are left as experiential choices to the participant.

3.1   Gemini Heart

Contemporary societies face a multitude of decisions. Everyday, humans are presented with choices. Many of these choices have decisive, lucid answers, while others tend to be ambiguous when moral ethics do not align with a clear right-and-wrong solution. When these difficult choices arise, many refer to this ambiguity as "gray area", an idiom for an undefined situation that does not seem to conform to known categories or rules. The installation **Gemini Heart** is an interdisciplinary work, which reflects on choices as a series of black-and-white decisions. Despite the importance of analyzing gray areas, **Gemini Heart** stresses that every decision is inevitably black-and-white and a choice between this or that despite context.

3.1.1 Prints

Two screen prints make up an integral part of **Gemini Heart**. These prints use an identical stencil: an illustration of an anatomical heart along with a symbolic emblem based off the golden ratio (Figure 5. Gemini Heart Prints). The palette of these prints has been kept monochrome. One print is set to the left side of the installation and incorporates black ink on white paper, while the other print is set to the right side of the installation incorporating white ink on black paper. As a result, the pair of inverse screen prints seeks to reflect upon the notion of choice and duality. Furthermore, these prints encase a sculpture between them, which analogizes the gray area in decision-making, since the object, described in the next section, is imbued with ambiguity and a series of metaphorical choices.

The symbolic elements incorporated in the screen prints extend initial ideas and paradigms outlined in Chapter 2. The anatomical heart is a rich symbol that can be interpreted in many ways and in both positive and negative connotations. From this standpoint, the symbol is saturated with duality (e.g., life and death, pain and pleasure, positivity and negativity, etc.), which solidifies its relevance in relation to the piece as a whole. On the other hand, the emblem based on the golden ratio has dual purpose: a trademark symbol of the artist's work as well as its symbolism regarding balance and symmetry in nature. The relevance of the golden ratio can be exemplified by the following quote from Keith Critchlow:

> *We are born into a world which appears as an indefinite dyad, a duality, a 'myself' and 'others,' until such time as we reach a maturity which can be called 'relationship.' This reveals itself as the unity that is the true case and we can realize it through the 'golden mean' of people's relationship with all others, including the environment.*

Thus, as a symbol, this emblem touches on the dualistic nature of the individual in relation to society and humanity as a whole.
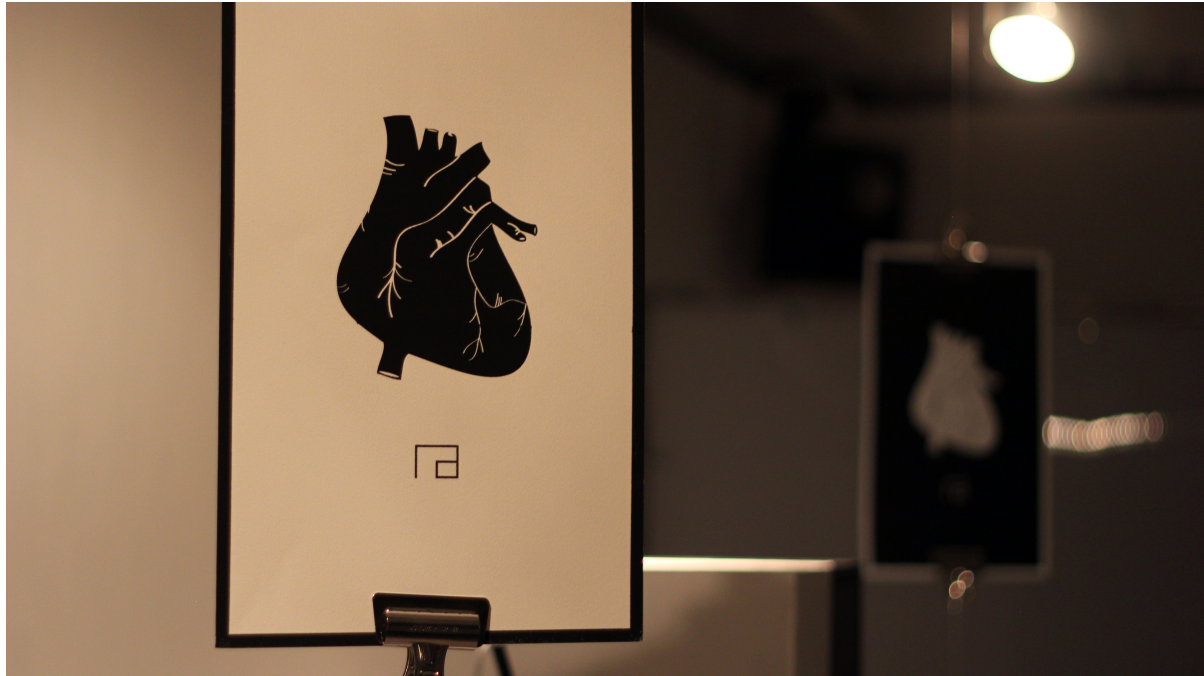
Figure 5. Gemini Heart Prints

3.1.2   Sculpture

In between both prints, a sculpture rests on a pedestal. Functionally, the sculpture is comprised of an infinity box (an optical illusion in which the content within the box is infinitely reflected). A two-sided mirror has been placed towards the front of the box and a one-sided mirror at the back. In between the mirrors rests a spring-suspended ceramic heart. One half of the heart has been glazed black, while the other half has been glazed white. The resulting effect of the mirror placement causes the heart to be reflected an infinite number of times. On opposing sides of the inside of the box are two machined steel shafts that hold small solenoids on opposite ends. These solenoids have been programmed in a circuit, utilizing a microcontroller that mimics a functioning human heartbeat at rest (Figure 6. Gemini Heart Sculpture).

Figure 6. Gemini Heart Sculpture (http://raphaelarar.com/gemini-heart/)

Conceptually, this work extends upon notions of choice outlined in this chapter, and each reflection of the heart serves as a microcosm of the analogous choices presented in the work as a whole. The digital age has brought forth a wealth of information, and as a society, we are thus presented with more choices, since there are now more outlets. Inevitably, this results in increased communication noise, and the reflective qualities of the piece seek to serve as a metaphor for the multitude of choices, many of which may be redundant.

3.2   Discussion

Gemini Heart relates to themes outlined in Chapter 1 especially due to its incorporation of dualities—from the visually apparent black/white to the sonic interpretation of harmony/noise. This work sheds light on technological evolution and the resulting options and choices.

3.2.1   Heart

As it relates to the *heart*, this work reflects on what it means to be an individual in the 21st Century—a time imbued with computation and a growing digital culture. While there is the potential for personal growth, there is also a potential to lose the sense of self. The duality between man and machine becomes obfuscated as technology becomes more and more of a crutch to exist in the Western world, which ultimately questions the idea of being an individual in society.

3.2.2   Harmony

The work touches on themes of *harmony* in both literal and figurative ways. Literally, the solenoids pulse the ceramic heart in a steady, rhythmic heartbeat, which sonically lends itself to aspect of harmony due to its monotonous, repetitive motion. The piece can be extended to discuss aspects of harmony on an individual level—when presented with more choice and their respective digital ramifications, is an individual more at peace due to the security of the scale of a decision, or is there inherent anxiety in the multitude of outlets for choice? Along these lines, the digital emanation of choice has the potential to result in more noise, obscurity and confusion.

3.2.3   Noise

Gemini Heart contains visual, sonic and electrical qualities that analogize communication noise. Visually, the reflections of the heart become not only more miniscule but warped, which questions the integrity of digital and computational echoes. Suspended on springs, the complex periodic motion of mass (i.e., ceramic heart) on spring is at once caused by solenoid impact and

affects the timing and location of subsequent solenoid impulses resulting in sonic variations. This imbalance in electrical perfection and mechanical quasi-chaos also questions the synergy of human-made machines and their potential for error, and as a result, ultimately creates more noise due to the miscommunication between the implicit signal streams of technology.

Chapter 4   Aesthetic Duality: Responsive Form

Industrialization has brought forth yet another duality: human and technology. As a product of human design, technology has produced a wealth of information and material in an effort to simplify aspects of our lives in order to enable us to progress as a society. Many devices and applications now exist as aides for productivity. Mobile computing has spawned a ubiquitous application market, and many of these mobile applications promote themselves as productivity boosters. Despite adding productivity, one can argue that these applications contribute to psychological noise and obfuscate inner balance and peace treasured by many ancient spiritual writings. Inspired by this duality, the author sought to reflect on intrapersonal communication, particularly as it relates to inner spirituality and harmony in a work titled **Anatomsa**.

4.1   Anatomsa

Anatomsa is a responsive installation (Figure 7. Anatomsa) that emerged from the question: how does an ancient mystical symbol of protection, strength and inner harmony evolve into the current Western climate imbued with technological noise? The *hamsa* is a highly stylized, palm-shaped amulet that is prevalent throughout ancient Middle Eastern and North African cultures[6]. As a symbol, the *hamsa* predates Judaism, Islam and Christianity. However, it is prevalent throughout the Kabbalah as a symbol to ward off the evil eye. Its Islamic references point to its symbolic use of the number five: there are five pillars of Islam and five fingers on the amulet. This analogy serves to extend the notion that the five pillars represent the duties of a Muslim and lay the foundation for spiritual foundation and function.

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[6] http://www.hamsameaning.com/

Figure 7. Anatomsa (http://raphaelarar.com/anatomsa/)

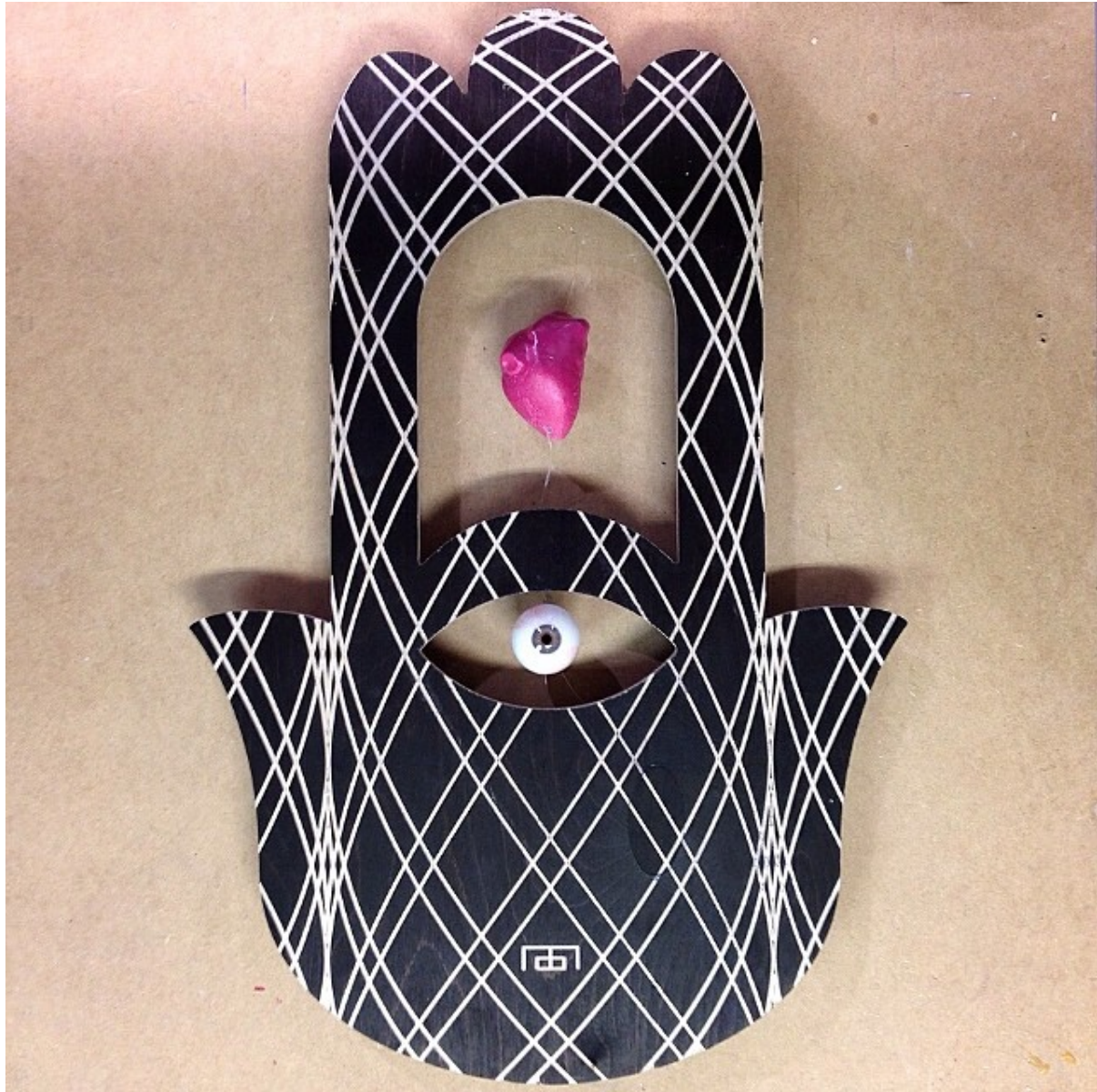The work utilizes the symbolic elements of the *hamsa* in order to shed light on its transcendence into the digital afterlife. How can technology seed itself in a spiritual, metaphysical symbol that predates industrialization let alone the digital age? **Anatomsa** reflects on notions of spirituality and harmony by commenting on the nature of intrapersonal interaction utilizing technological responsiveness.

The work consists of a fabricated, wall-mount wood panel that has been designed as a formal representation of a *hamsa* in shape and proportion. The face of the panel has been engraved with a variety of lissajous curves (Figure 8. Lissajous Curves), which serve to exemplify complex harmonic motion based on properties of physics, visualized by technological means [20]. As a result, mathematical and physical harmony plays directly into spiritual and metaphysical notions of harmony, spirituality and order.
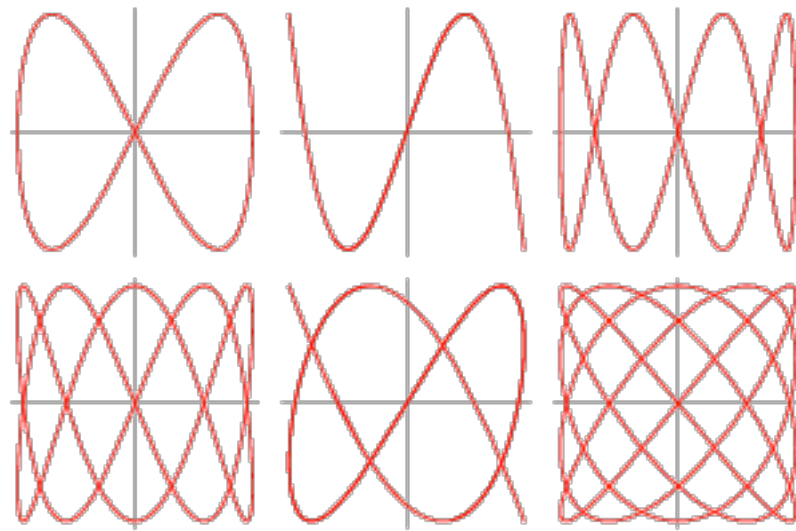

Figure 8. Lissajous Curves[7]

A modified version of the emblem based on the golden section appears in **Anatomsa**. In this case, the symbol has been altered and mirrored, which lends itself to a visual dialogue with the symmetrical and harmonious aspects of Lissajous Curves.

Within the larger cutout of the wood panel rests a ceramic heart. The heart, produced from a slipcast mold, sits suspended between the wood panel and the wall. Monofilament secures the heart using a tension system firmly secured among three copper pipes, which also exist to secure the entire piece to the wall. A bare solenoid mounted onto another copper pipe attached to the wall rests directly behind the ceramic heart. The solenoid pulses to mimic a heartbeat as it strikes the ceramic object.

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[7] http://mathworld.wolfram.com/

Moving on, a modeled and fabricated eyeball secured to a servo sits within the smaller cutout of the wood panel. The servo operates to move the eye in a continuous arc that follows participants. A microcontroller mounted to the back of the panel sits directly below the servo. A webcam mounted on top of the microcontroller peers over the bottom ledge of the cutout to survey participants.

Responsiveness is a key component of the work. The incorporation of technological aspects in art, especially hardware, software and their intersection, has paved the way for novel aesthetic implications of art. Responsive artwork allows for work to have comprehensive feedback with the participant, which is a direct extension of a critical design principle [11]. In this case, the microcontroller controls the input and output to lend **Anatomsa** its responsive characteristics. The webcam tracks participants and finds the closest one in order to track location and distance from the piece. The microcontroller, running a Linux Operating System, utilizes this data to control the actuators (i.e., the solenoid and servo). The rate of the solenoid pulsations increases the closer a participant is to the work, whereas the servo-controlled eye follows the location of the participant. As a result, a reactive dialogue with participants emerges, and an ancient symbol has now been extended to the present, breathing life into its mystical, spiritual and harmonious overtones.

4.2   Discussion

Responsive artwork is in direct dialogue with viewers. The systemic nature of **Anatomsa** incorporates themes including the heart, harmony and noise in a unique way. Responding to user input, **Anatomsa** comments on these three themes explicitly—from machine to human.

4.2.1   Heart

The symbolic aspect of the heart manifests itself in the interplay between man and machine. The piece explores notions of privacy in a metaphysical stance. When aspects of spirituality become automated, how does an individual react? Spirituality becomes the subject in question as the

hamsa becomes an animatronic character, imbued with movement and more literal aspects of protection and watchdog behavior in response to an individual's interaction. The installation takes on a robotic personality by orienting the gaze of its eye based on the closest participant's location and alters its heart rate based on this participant's proximity—the closer the participant, the faster the heart rate.

4.2.2 Harmony

Harmony is the most prevalent theme within **Anatomsa**. Spirituality and mysticism can be seen as a black box. As areas largely untouched by science, ancient mystical symbols such as the *hamsa* lend themselves to be uniquely interpreted by every individual. However, when the *hamsa* symbol is expanded, embellished and exaggerated it begins to challenge traditional notions of harmony present in spirituality. As an inanimate object, the *hamsa* can be interpreted in many ways; yet, when it becomes animated, personified and responsive to participants, its suspicious characteristics lend itself to skeptical qualities. As a result, original ideas of harmony brought forth by the symbol become subverted in a way that may cause participants to realign their preconceived connotations with the implied symbolism.

4.2.3 Noise

Anatomsa reflects upon communication noise from an intrapersonal standpoint. Living in the 21st Century, humans are bombarded with information from various signals. While many of these sources are intentionally accepted into popular culture (e.g., laptops, smartphones, televisions, radios, etc.), others are unavoidable (e.g., wifi signals, radio waves, satellite data, etc.). Inevitably, humans are affected by these sources, which can result in psychological impact on an intrapersonal level that may have ramifications on sociological fronts.

Chapter 5   Data-Driven Art: Content   Creation   in Participatory Form

Recent contemporary artwork has exemplified the aesthetic possibilities of manipulating and incorporating pre-existing data sets in both digital and post-digital ways. These data-driven works have set a precedent for novel ways to not only manipulate data but also create it in real-time. With mobile computing and robotics, it is now possible to incorporate aspects of content-creation and data in the mechanics of kinetic sculptures and installations driven by participatory smartphone applications. Two works in particular, **Metal Hearts** and the **(+/-) Pendulum**, utilize data to add a collaborative and participatory element to kinetic objects in order to explore dualities ranging from individual/society and analog/digital.

5.1   Metal Hearts

Metal Hearts consists of three nearly identical objects; in each, a bare solenoid strikes an aluminum-coated 3D-printed model of a human heart (Figure 9. Metal Hearts Installation & Smartphone Interface). A fundamental biological human process has now been simulated by an electrical circuit serving as a reflection on human autonomy in light of technological progress. Collectively, the hearts beat in harmonic motion to delineate a mechanization of individuality.

The installation's driving mechanism is based on participatory data. Its intent is to serve as a starting point for the creation and collection of participant data. Participants are able to download and install a smartphone application that captures heart rate and stores it in a database. The master clock of the installation defaults to an average pulse of 72bpm. With each

new addition, the average of all heart rates collected over time is distributed to the installation, which adjusts the phasing and computational diastoles of all hearts. Every five minutes, the database is queried and a new average is collected.
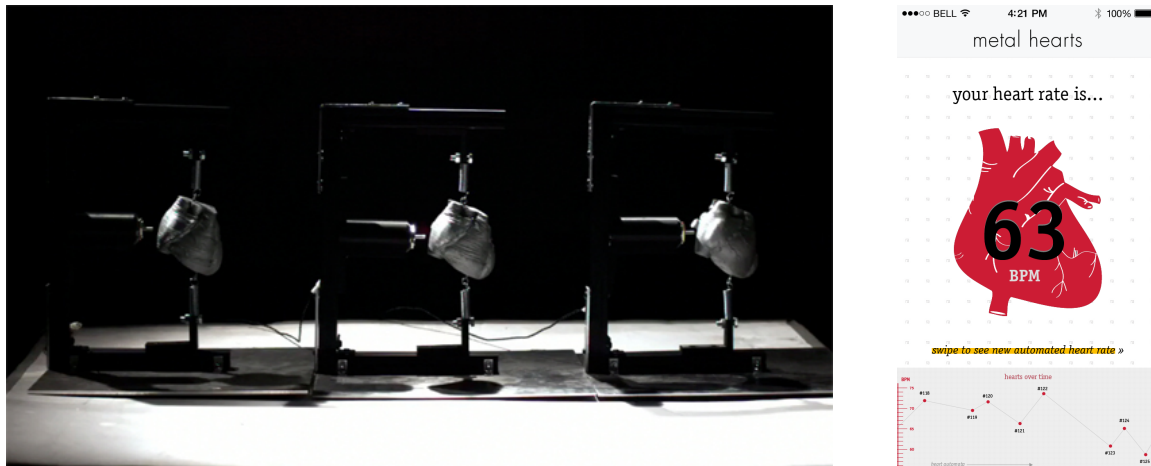

Figure 9. Metal Hearts Installation & Smartphone Interface
(http://raphaelarar.com/metal-hearts/)

Although the physical manifestation of this aggregate data is not seen at large since only the average is computed and experienced, the smartphone application contains a data visualization of all heart rates collected over time. On the one hand, data is used for purely aesthetic reasons in the sculptural aspect of the work; it is a starting point intended to pique curiosity in the participant. On the other hand, participants have the opportunity to interact with all of the data collected over time in the smartphone application.

5.2   (+/-) Pendulum

(+/-) Pendulum is another participatory installation (Figure 10. (+/-) Pendulum) created in the same data-driven vein as **Metal Hearts**. The work is meant to serve as a microcosm of the intersection of our digital and physical selves. The basis of the installation is founded on the mechanics of the Foucault Pendulum. Unlike a conventional pendulum, the arm of the installation operates horizontally using the same physical properties as if gravity is still impacting it. The conceptual basis of the work is to reflect on the intersection of our digital lives with our physical lives. The Foucault Pendulum was created in the mid-19th Century to exemplify the

Earth's physical properties (i.e., the fact that it is round and rotates) [21]. Many may prescribe to the idea that we now live in an era where the Earth's physical properties are of little importance. As a result, the operation of the **(+/-) Pendulum's** rotation is based on participatory user input from a smartphone application, which asks the question "Where do you want to be?" From collective user input, the average of all data points orients the pendulum to a collective desired location, which seeks to show that our world is not flat, round or oblong—it is malleable and democratic in the digital sphere.
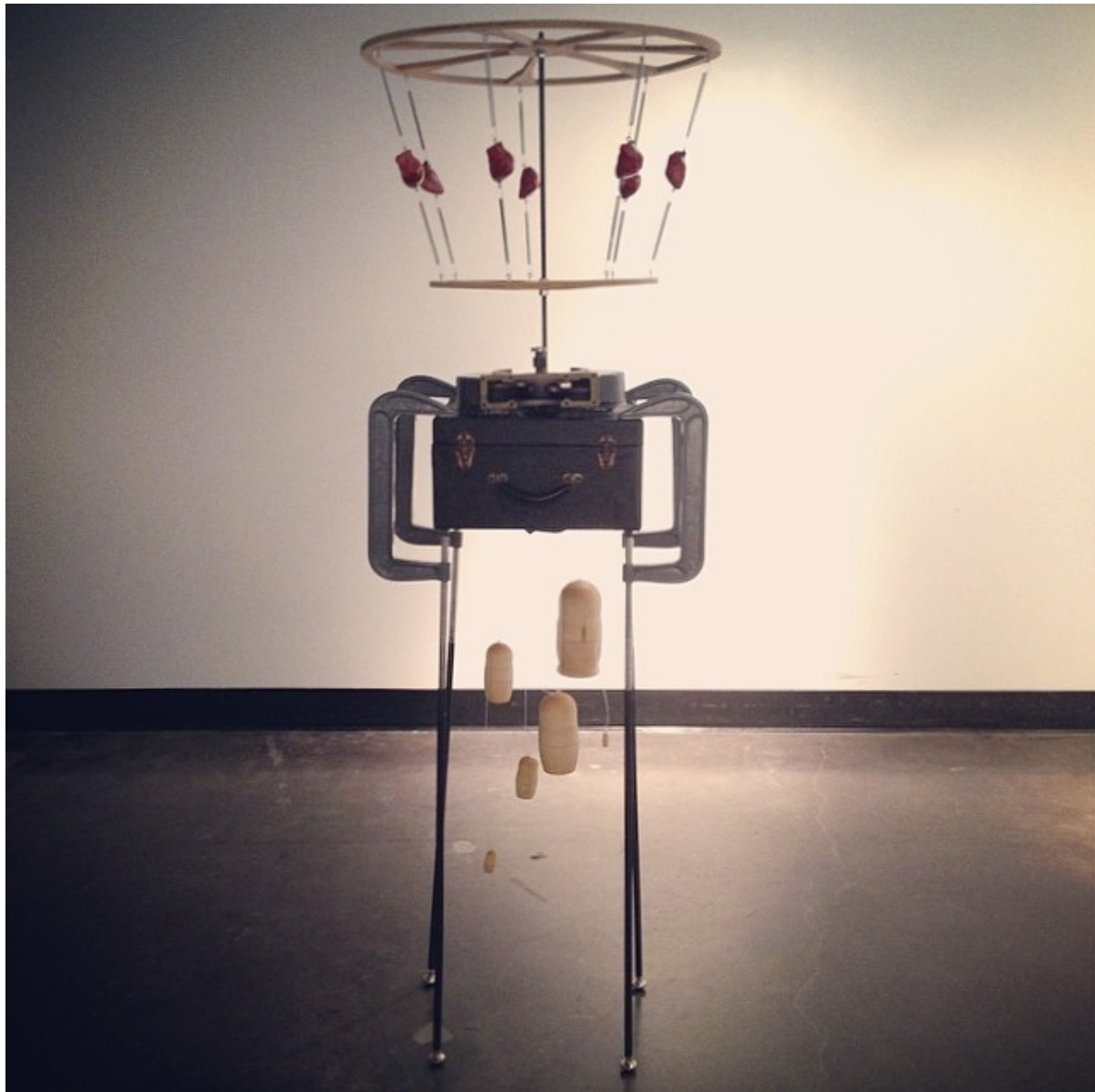

Figure 10. (+/-) Pendulum (http://raphaelarar.com/pendulum/)

The smartphone application component provides a minimal user interface prompting the user for a desired location in the world. After a successful submission, the user is shown the new location of the pendulum, which is collected as a running average of all data points in the system. The user then has the option to view all collected data points visualized on a map. Similar to **Metal Hearts**, the **(+/-) Pendulum** has the same two-fold approach: the sculptural aspect serves as springboard for content creation from participants, while the digital interface serves as a media container to view and interact with all data points (Figure 11, (+/-) Pendulum Smartphone Interface).
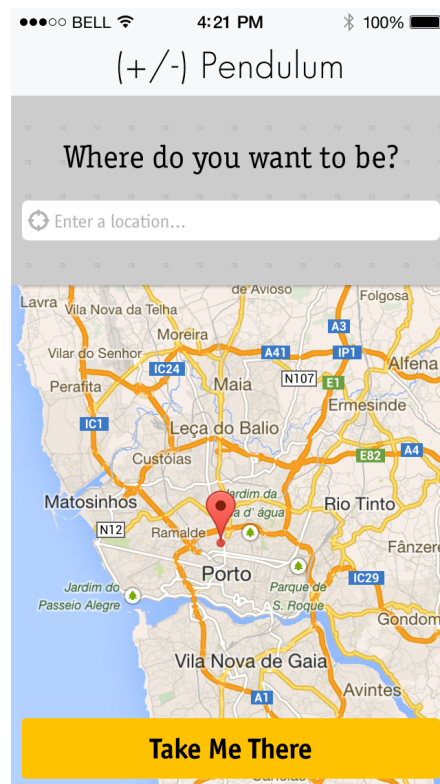

Figure 11, (+/-) Pendulum Smartphone Interface

5.3   Discussion

The 21st Century is the era of big data. Undoubtedly, the implications of mass amounts of data affect the daily lives of individuals. Not only does the digital realm provide more choice, but it

also increases the amount of information. The works presented in this section incorporate data granularly and also allow for its creation by optionally asking users to contribute. In doing so, the three themes of heart, harmony and noise weave their way into both **Metal Hearts** and the **(+/-) Pendulum**.

5.3.1 Heart

In both works, the heart serves as an emblem of an individual, abstracted as part of a larger working system. In **Metal Hearts**, each heart represents an individual, and the automated heartbeat extends the potential to lose a sense of self in light of progress, particularly computation. When many aspects of our lives can be offloaded to our devices, where does humanity and technological progress draw the line between obtrusion and enhancement? **Metal Hearts** seeks to reflect on this question in a poetic manner, using physical, sonic and visual metaphors. Similarly, in **(+/-) Pendulum**, each heart in the piece exists to represent an individual. The metaphor with the heart is more literal, but extends upon the idea that humans are pieces in a bigger, moving entity, and that movement is cyclical, largely out of the control of any single person.

5.3.2 Harmony

The theme harmony manifests itself in both works sonically as well as figuratively. In **Metal Hearts**, the hearts beat in harmonic motion, existing as a lingual double entendre with the metaphysical connotations of harmony. However, harmony is also a poetic element of the work, and each heart exists as a piece of a greater oscillating mechanism that ultimately reflects on society at large. **(+/-) Pendulum** reflects on harmony in a variety of ways. The significance of the number seven is directly tied to the oscillating Russian Nesting dolls. In Pagan Russian times, the Matroyshka was always created with seven pieces in order to represent harmony. Since harmony was closely tied to nature, seven was found to be harmonious in natural phenomena, particularly the seven colors of the rainbow. Thus, seven extends to provide a unifying element to the piece in its use of seven anatomical hearts that represent time values struck by the pendulum.

5.3.3 Noise

Noise is another prevalent theme in both works due to their participatory interaction model. In both pieces, there is a systemic feedback loop that occurs among participants and the kinetic works. Input into a smartphone application transmits a signal to a web server, which transmits a signal to a microcontroller that ultimately drives physical objects. As a result, there are multiple communication streams operating simultaneously with a variety of users. Broken down in Shannon's Communication Model [7], this signal stream can be directly translated to have multiple opportunities for noise to arise. Since each work can be seen as a microcosm of technologically oriented societies, noise has the potential to be a more persistent element of daily life.

Chapter 6

Conclusion: The Evolution of Noise

Machined systems and computation are now vital parts of our daily lives. Many of us cannot live without some form of technology—from transportation to social interaction, complex systems are the clocks that keep the world moving forward. Many of us are unaware at the remarkable growth rate of our global footprint. The works presented in this paper represent the author's reflection on the ways progress has affected daily life.

6.1   Summary

Gemini Heart, **Anatomsa**, **Metal Hearts**, and **(+/-) Pendulum** all reflect on notions of interaction. Inherent in design, interaction fundamentally connects individuals to individuals and/or individuals to themselves. Undoubtedly, technological developments have altered the way we communicate with others and ourselves. The works presented in this thesis serve to reflect upon these rapid changes by synthesizing various dualities, the most apparent one being analog and digital. In order to do so, the author has expressed these changes by incorporating symbols and themes such as anatomical hearts, harmony and noise in the works presented. Furthermore, the works have been presented in an evolutionary order (fixed to responsive to participatory) as a reflection on technology's ability to incorporate greater complexity from user input. Although the works rely heavily on technological mechanisms including computation and embedded electronics, the medium is not the primary message. On the contrary, the medium serves as a lens to magnify and exaggerate the drastic, ongoing evolution by shedding an ambiguous light on technology's ramifications.

6.2   Final Thoughts

By taking a Yin/Yang approach to the idea of analog/digital, individual/society and life/death, the author's work seeks to reflect on the implied balance that must exist in order for harmony to exist in a system often littered with noise. Society at large can be thought of a well-oiled machine propelled forward by a collection of individuals. In the pieces presented in this thesis, anatomical hearts serve as a symbolic reference to an individual as part of a larger entity, while the systems in their various manifestations (i.e., fixed, responsive, participatory), reflect on the interplay between harmony and noise that result from a number of moving parts.

Adaptation and assimilation are remarkable characteristics in human beings. Technology has provided incredible opportunities—new developments are constantly emerging that allow us to not only expand our human reach but also simplify our lives. Industrial progress has enabled society to improve machinery enabling more complex technological developments. However, despite these perceived improvements, the nature of humanity is complex, and the social characteristics of an individual are difficult to overlook. How will the exponential momentum of technological progress ultimately affect the world? As the world churns forward with its new developments, more devices impede our mental and social signal flow resulting in more opportunities for noise to arise in our microcosmic and macrocosmic systems. While prophesizing about the evolution of communication is a complicated feat, the future of interaction is changing drastically and the potential to lose sight of physicality may be on the horizon.

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