GENERATIVE MEDITATIONS:

Exploring Generative Art From the Perspective of Tibetan Buddhist Philosophy

BY

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I. Abstract

the purpose of this thesis is to document and explore the subjective struggles I have encountered in my own practise as a generative artist rather than to provide an objective overview of computational generative art. Hopefully this process will give some context from the ground up (from an artist's perspective) to some of the larger questions that I and others in the field are asking about generative art.

From the preliminary questions arising from these struggles I begin to explore and develop a generative art practise that primarily focuses on the topics of human experience and ideas directly related to human experience. This is opposed to using generative processes to explore ideas fundamentally based on computation (a-life, emergence, computational creativity, and data etc..). The foundation of, and reasons behind, such a focus are based on the non-realist and non-materialist philosophical tenets of Tibetan Buddhism, in particular the philosophy of the Madhyamika-Pras-angika school of thought. The purpose of developing a generative practise based on the philosophy and symbolism of Tibetan Buddhism is to find a method to create personally relevant artwork with a firm foundation in a well established culture of art and philosophy. I might add however, that this isn't merely a self-reflective exercise but rather it should be of interest to others in the field of (and study of) Generative art to see how this artistic method might be approached from a vastly different philosophical stance to the materialist view that receives the majority of attention in the field.
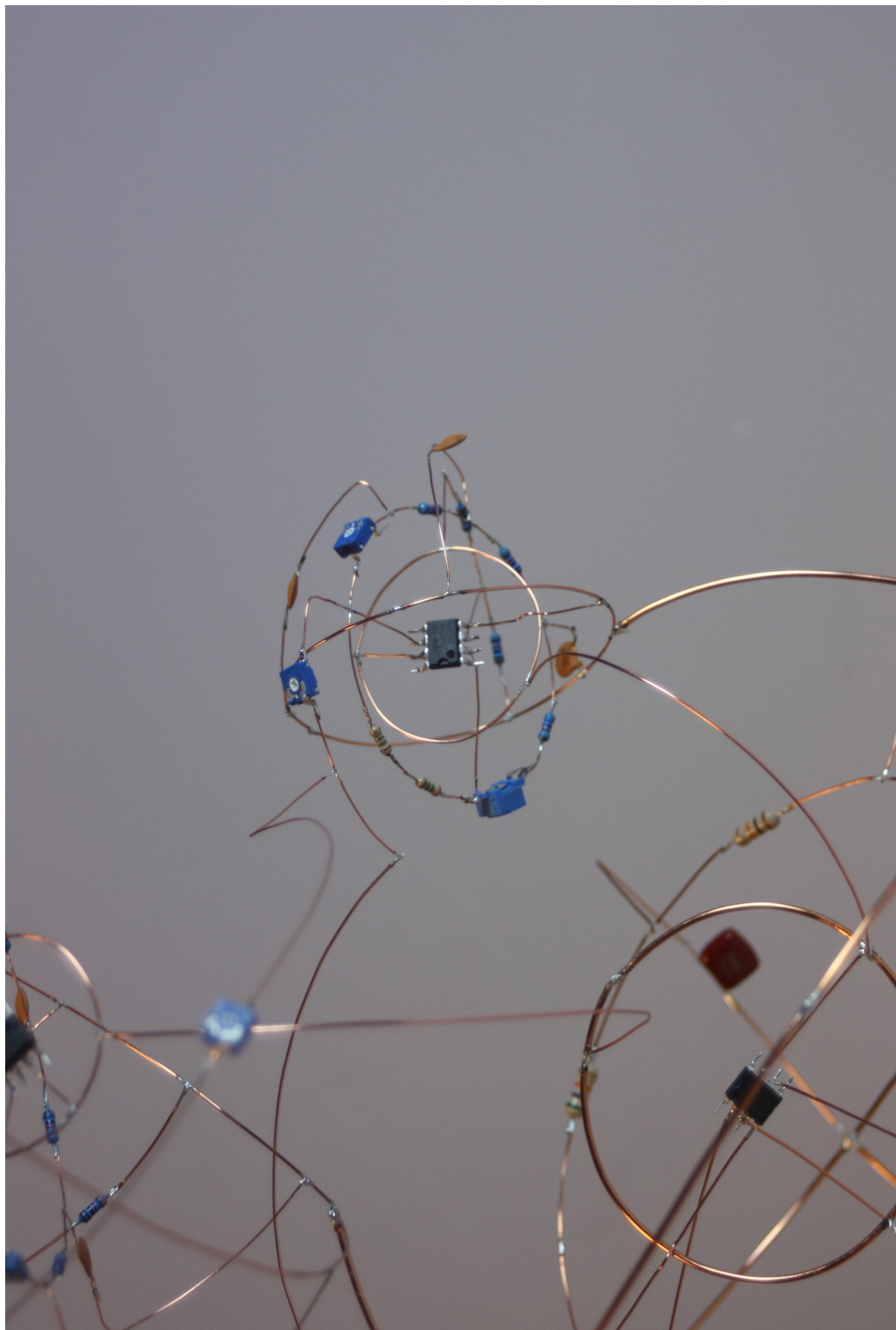
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Figure A. Close up image of "The Signal Mandala"

1. Introduction

The primary purpose of this thesis is to explore how I might begin to develop a generative art (GA) practise that is based on human experience, and concepts directly related to human experience. This goal, however, is not the beginning of the story, but rather somewhere in the middle. The origin of this focus comes from the critical analysis of previous GA and experiments that I and other generative artists have done over the last several years and the exploration of the non-materialist philosophy of Tibetan Buddhism. The main pieces of work pick up from this point, and lead into my current, and continuing work.

The compositions created specifically for this thesis use the philosophy and symbolism of Tibetan Buddhist art as a meaningful starting point in the infinitely vast domain of computational possibilities. The form of Tibetan Buddhist art lends itself to generative processes, being largely rule based and formulaic; The meditative nature of the execution of Tibetan Buddhist art is, however, seemingly at odds with an electronic/computational generative process that removes the artist from the execution of the final work. This tension is addressed in the main composition, "the signal mandala", to celebrate both the generative system and the human qualities and effort of the artist behind the machine.

The structure of this document is as follows: chapter 2 is a brief Literature review. Following this chapter 3 lays out the philosophical background, with discussion about its implications on the practise of generative art. Chapter 4 is a study of the struggles and critique I have encountered in past projects. This chapter is broken into

three main difficulties, each of which include case studies of work of myself and oth-
ers as a means of highlighting how these obstacles can manifest in various genera-
tive artworks.

These three main difficulties are:

4.1 An eternal quest for technical mastery.

4.2 The hunt for a human story

4.3 Infinite possibilities, arbitrary choices.

In chapter 5 I briefly outline five different methods to introduce human experi-
ence and briefly discuss how these relate to past work.These methods are:

5.1 Expressing human experiences

5.2 Invoking human experiences

5.3 Expressing human ideas (directly related to experience)

5.4 Introducing human craft to generative processes.

5.5 Any combination of the above

Chapter 6 is my response to the difficulties discussed in the second chap-
ter, by experimenting with some of the methods for introducing human experience
discussed in the third chapter. To do this I create work that attempts to tackle the
methods that I haven't previously explored in past projects. In this section I have
dipped in and out of the digital medium, and woven non-computational work into my
explorations of generative media. My intention for doing so is to get a wider view of
my work as a computational artist, and to explore how I might find that fine balance
of traditional processes and human qualities (ie. human ideas or experience) within a
generative workflow. The resultant work is simultaneously a celebration of systemic
processes and the human causes behind the process.

Following this, chapter 7 is a brief conclusion and discussion of my current work in an art studio that produces Buddhist images and statues, and how this sets a trajectory for a future computational/generative practise.

For this thesis I have used a practise led research methodology. Based on the critical analysis of the previous work of both myself and others I have undertaken a series of experiments or sketches. Taking as my premise the introduction of human qualities (ideas, experience, craft etc.) to generative art, these experiments combine these qualities in various ways with a generative workflow. The experiments are analysed from a critical perspective and used to refine and direct further experiments. This culminates in a "final" project, and further work which is discussed accordingly.

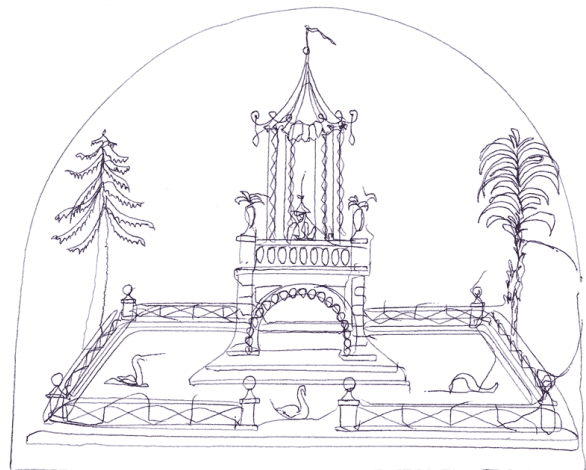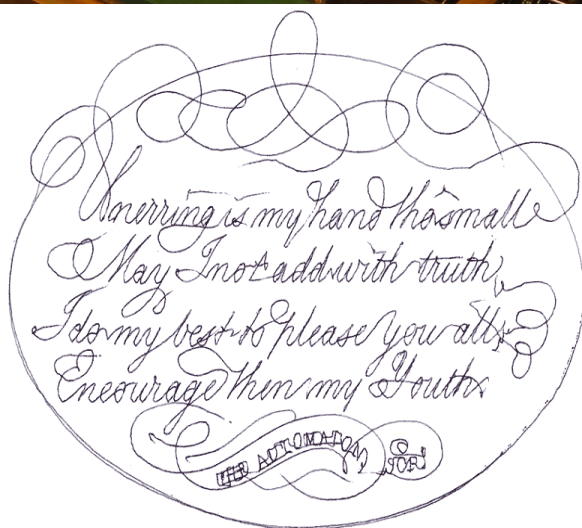Figure 1. Henri Maillardet's automaton and two of the drawings it can produce (Maillardet, n.d.).

2. Literature Review

Although the formal study of generative art is fairly recent, as Galanter (2003) puts it "generative art is as old as art itself" (p.12) . In order to begin this discussion of generative art in general and computational generative art in particular, it will be beneficial to provide a definition. As with trying to find a definition for art itself, trying to define generative art has given rise to a fair amount of contention. Here I use Galanter's (2003) fairly inclusive and often referenced definition:

> Generative art refers to any art practice where the artist uses a system, such as a set of natural language rules, a computer program, a machine, or other procedural invention, which is set into motion with some degree of autonomy contributing to or resulting in a completed work of art. (p.4)

The main point here is the use or creation of a system that functions to produce some output that can be called art.

There are many salient issues when approaching generative artifacts (or the processes that create them) as "artwork". These include: approaching the question of the authenticity of digital media (O'hear, 1995; Boden, 2007; McCormack & d'Inverno, 2014), the possibilities and implications of computational creativity (Boden 1990, 1996, 1998, 2006; McCormack 2001, 2004, 2014; Galanter 2009), The relinquishment of artist control (Lewitt 1967; Cornock & Edmonds 1973), the promises and challenges of emergence and computational evolution in producing creative and unique artifacts (Galanter 2010; McCormack 2001; Monro, 2009), Artificial life (Dorin 2001; McCormack & Dorin 2001; Dorin, McCabe, McCormack, Monro & Whitelaw 2012), to name but a few of the key issues.

The study and practise of generative art offers a fairly unique perspective on art, creativity, and the role of human agency in the creation of artwork. Because the artist's hand is usually hidden behind a thick curtain of computational, mechanical, and often randomised processes, the resulting artifact becomes an unusual product whose authorship and authenticity becomes a source of debate (Bodin 2007; McCormack et al. 2014). When viewed from the philosophical perspective of materialist artists and scholars who, if not directly admitting it, would assume or imply that consciousness is a product of brain function (Bodin 2006, McCormack et al. 2014) it seems reasonable to anthropomorphise the computer as an equivalently capable and (theoretically) creative machine given enough computing power. Due to the assumption that creativity comes from a computational brain, this school of thought seems to imply that a sufficiently complex computational entity should thus be seen in the same or equivalent light as a human artist. As put by McCormack et al (2014): "we can see no reason to dismiss outright the possibility of a machine and a human sharing experiences that result in something meaningful and worth communicating." (p. 136)

Computational generative art is often dismissed outright and with great conviction, by those who essentially consider it essentially computational plagiarism (O'hear 1995). O'hear (1995) for example views computational artworks as "parasitically meaningful, deriving their meanings from the techniques and conventions which human artists had developed in their works" (p.149). For O'hear artwork is necessarily a communication of meaning from one human to another, and thus the output of a digital system can never fulfill this requirement even if it is sufficiently rendered so the viewer can't tell it apart from an original "hand-made" artwork. McCormack et al.

(2014), ask the question "What is it like to be a computer that makes art?" (p. 136), clearly this would have to be understood in order for there to be some meaningful exchange between computer and human viewer, but to know the subjective experience of something vastly different to our self isn't possible.

This debate seemingly cripples the computational generative artist's ability to be taken seriously in the arena of fine art. An example of this is the highly critical, and even vehement, response to David Cope's music compositional programme "Emmy" by critics, musicians, and other composers. This is an obvious example of how computational artists are often completely obscured by the machines upon which they work (often intentionally). "Emmy" is a piece of software that analyses the style of certain composers and fairly convincingly composes new pieces in the style of the selected composer. According to Cope (1996) The reception of the music by musicians and critics was so vehement he found it difficult to find professional musicians to play it. It would seem that this response comes from the principled view that computers are essentially non-emotive objects and that any emotional qualities of works produced by digital generative means are merely empty reflections of the emotional content of the works from which they are based.

Essentially this argument boils down to the question of authorship, is the computer the author of the artifact or is the artist behind the computer to be considered the author? This question is tackled differently by different artists, some wanting to create independently creative entities or at least explore the possibilities of such digital creativity (Galanter 2009; Dorin 2013; McCormack et al. 2014). Others such as Cope (2006) view computers as more of a collaborative partner in the work produced yet find their creative hand largely ignored by many critics.

Suppose we consider the latter case from the point of view of the 1800's example of Henri Maillardet's incredibly intricate mechanical drawing automaton (see figure 1, p.8). This automaton could draw four different drawings and write three poems in beautifully decorated script. In this example Maillardet's artistic integrity wouldn't be questioned for a moment, even though the artistic "outputs" of the machine are not produced by him directly. If his automaton could endlessly produce infinite possible variations of the same quality it would possibly be even more impressive to the average viewer or critic. It is interesting that the same appreciation isn't given to Cope, whose digital automaton could produce infinite variations of compositions in the style of any composer. It would seem that because the complex inner workings of computer software is a complete mystery to most, hidden from view in a "black box", and ubiquitously taken for granted, that the creativity and ingenuity of the artists behind computational work are ignored. Because the artist's presence is so hidden by technological mediation the appreciation of the ingenuity and creativity of the artist is seemingly displaced by the aforementioned philosophical debate around whether or not computers can "create art".

The concealment of the artist and the following debate about the possibility of a computer to be creative (or as Bodin (1996) diplomatically puts it: "at least appear to be creative") doesn't only load the artillery of computational generative art's critics. Computational generative artists themselves often use the question (posited in the affirmative) as the source of inspiration to fuel their own investigations. Using the ideas of A-life, evolutionary algorithms, and emergence as a starting point many generative artists are actively seeking to imbue computers with the ability to autonomously and creatively generate art and even artificial life itself. It is often the direct

intention of the artist to step back from the work in order to access the creativity and

art of the computer.

Figure 2. Je Tsongkhapa, one of the primary scholars who elucidated and explained the Madhyamika-Prasangika view in the 14th Century. (Downs, 2013)

3. Philosophical background

In order to establish a theoretical foundation for the following work, it is necessary to explore some of the fundamental underpinnings of the philosophical system from which I am working and how this relates to current explorations in the field of Generative art.

The philosophical system I am working within is the Madhyamika-prasangika philosophy, one of four main philosophical schools within Buddhism. This school of thought was mainly elucidated through the works of Nagarjuna (approx 150 CE), and was further clarified by Chandrakirti (600-650 CE), and later Je Tsongkhapa (14th Century). This thesis largely relies on translations and commentaries by Kelsang Gyatso (1992, 1995, 2011, 2012, 2013). It is important to comment that as with any religion, in Buddhism there are many different schools of thought. Some of these schools have completely different views to the ones presented in this writing. I only seek to explain the Madhyamika-Prasangika view within the context of Tibetan Buddhism. Using a single author to reference may seem like a lack of thoroughness, but rather it is traditional practise within Buddhism; Traditionally students after exploration of different schools, would choose one according to their disposition and be encouraged to study within that lineage in order to not confuse conflicting approaches, views, or practises.

It must be made clear that this thesis is not intended to be a critique of current generative art, or the research of such art. It is not my intention to try to refute or deny the validity or quality of the work and explorations of other generative artists, or

even to try to argue for this philosophical standpoint. It is simply the purpose of this

chapter to outline the fundamental philosophical differences between this view and

the materialist view that receives the majority of the attention in the field of compu-

tational generative art. Outlining these differences should hopefully make clear the

considerations that underpin the creative decisions I will be making henceforth. The

main priority of this work is to establish how, as a practising Buddhist, I might estab-

lish a generative practise that is philosophically in-line with my fundamental views

and firmly grounded in a cultural and philosophical tradition.

      This chapter is broken into three sub sections:

            3.1 non-materiality

            3.2 dependant relationship & mere imputation

            3.3 implications on generative art.

3.1 Non-materiality

One of the fundamental defining features of the madhyamika-prasangika philosophy is it's postulation that all phenomena arise in dependence upon the mind (Gyatso 1995, 2011, 2012). This is the direct opposite to a materialist viewpoint which assumes that matter (commonly assumed to be the brain) is the source of mind. It must be made clear that this is not a dualist view that posits mind and body are fundamentally different phenomena, but rather that all phenomena are mere appearances to mind (including the body).

To differentiate this view from solipsism (also the Cittamatra school of Buddhist philosophy), which believes that only the mind exists (or that we can only be sure that the mind exists), it is necessary to mention that although it is posited that all phenomena arise in dependence upon the mind, as mere appearances to the mind, one can-not say that a mind exists separately, or independently, from the phenomena that it perceives, or from the infallible law of cause and effect. In this way the mind and the appearances to mind (all phenomena) are co-dependant. Because of this co-dependence it is posited that neither mind or phenomena exist independently from the other, in other words they lack independent or inherent existence. According to the madhyamika-prasangika philosophers there exist no "things in themselves", but rather all phenomena exist as "mere name" imputed (or labelled) by a valid mind. The mind itself is also merely an imputed label and not independently existent.

It is often mistaken that this view of a lack of inherent existence of all phenomena surmounts to ontological nihilism, the assertion that nothing exists; This is a also a misunderstanding. Although inherently existent phenomena are negated, phenomena are said to exist nominally. This nominal existence is mere imputation (or con-

ceptual designation) by a mind that perceives a valid basis of imputation (a collection

of causes and conditions that, having arisen, can be validly labeled or named as a

certain phenomena).

To illustrate this view of non-materiality it is helpful to contemplate a dream;

In a dream we assume the dream-world we currently inhabit exists, from its own

side, made of materials which we can see, smell, touch, taste and hear. While in this

dream we assume that materials exist "out there" waiting to be discovered; we could

measure them, perform experiments that give predictable results, stub our toe on

them, look away and turn back to find them still there and so forth. We even experi-

ence other "people" with whom we engage in conversation. In this dream, however,

the objects that appear to us so clearly do not exist from their own side; When we

wake up they disappear as they were merely appearances to the mind with no exis-

tence separate from the mind that perceived them. We also can't say that they are

completely non-existent, as they clearly did exist in the form of appearances to the

mind of the dreamer. According to this perspective, just because there is seemingly

more continuity in our waking world does not provide sufficient reason to assume

that this world is any more "solid", "real", or "inherently existent" than the world we

experience in our dreams; rather it is posited that they exist in exactly the same way.

Gyatso (2002) surmises this viewpoint:

> "In king of concentration sutra Buddha clearly explains the true nature of phe-
>
> nomena:
>
> In a dream a boy meets a girl and sees that he is dying.
>
> She is happy to meet him but unhappy that he is dying.
>
> We should understand that all phenomena are like this (p. 59)

3.2 Dependant relationship & mere imputation

Dependant relationship, or cause and effect, is the basis from which the emptiness (a lack of inherent or independent existence; the basis of the non-materiality already mentioned) of phenomena is logically deduced. According to this view, all phenomena arise in dependence upon causes and conditions which is the opposite of positing inherent, or independently existent phenomena. There are five ways in which phenomena can be dependent related: phenomena depending on its: causes, name, parts, basis of imputation, and mere imputation by mind (Gyatso 2012).

It is posited that without its causes, name, parts, basis of imputation and mere imputation by mind no phenomena can come into existence, however none of these things upon which the phenomenon rely for its existence can be said to be the phenomena itself.

The most significant form of dependent relationship within these five in regards to the purposes of this thesis is the last point, dependent related phenomena relying upon mere imputation by mind. Essentially what this is saying is that the existence of all phenomena relies upon conceptual designation. If we examine a rope for example, there is nothing that inherently gives the rope it's "rope nature". Rather it is a collection of causes and conditions, and parts and so forth that upon observation can be correctly labelled "rope". This labelling is a mental process; The mind upon coming in contact with a collection of causes and conditions applies a label to the phenomena, and that label is all that constitutes the "existence" of the object; The object is mere name (as are the parts of the object, the parts of those parts and so forth).

3.3 Implications on generative art

The purpose of this section is to define the main differences between a materialist and non-materialist approach to artistic computation and to provide reasons why human experience is provided such emphasis in this thesis.

The philosophy of emptiness (a lack of inherent, or independent material existence) has profound implications on the way generative art is approached and viewed. Where a materialist might assume that the mind (or brain) is fundamentally a computational device that can be replicated digitally or mechanically, a proponent of the Madhyamika-Prasangika view would say that the mind is fundamentally an imputational device that creates all phenomena by applying labels to patterns of cause and effect. This argument reflects the old philosophical question "if a tree falls in the forest and nobody is around to hear it, does it make a sound?". Initially one might reply "of course it does", but considering that sound is a human (or animal) experience separate from the phenomena from which it arises it is necessary to at least reconsider the answer (an experience of sound is a mental phenomena completely different to the vibration of air particles). from this view it is the mental labeling of the basis of imputation (in this case maybe the vibrating air particles) that we call "sound". The question could be theoretically re-stated "if a computer processes an algorithm producing a million henceforth unknown emergent properties and nobody bothers to look at them, do they really have any meaning?".

It is a logical conclusion from the Madhyamika view that imputation (or application of a conceptual label) is what gives "meaning" to information. The information itself is merely a collection of causes and conditions that when observed can have some label applied; this is opposed to the traditional idea that the information has

some intrinsic qualities from it's own side that are waiting to be discovered. This doesn't imply that mathematical analysis can not be undertaken on such information, but rather any "meanings" or "objects" that appear from such analysis come from the mind of the person undertaking or viewing the results.

Because of this the output of the process of computation has no meaning in itself, rather the meaning comes from a mind coming into contact with the information (usually in the form of a matrix of tiny red, green and blue lights) and applying some meaningful contextual label based on various conventions and previous experiences to the pattern it is viewing. This view is in stark contrast to materialist, or emergentist philosophies that believe there is some inherent meaning, pattern, or property within the informational output waiting to be seen.

The primary implication of these ideas on the field of generative art relates largely to the choice of subject, which is based on the position one takes on the questions of computational creativity, and the possibility of computers creating original and authentic (as discussed in the literature review) artworks.

The study of computational creativity, emergence, evolutionary algorithms and A-life, for example are not provided the same importance as they are from a materialist viewpoint. For materialist or realist artists these fields are fascinating and meaningful topics of study; If it is true that there is a material basis of the mind then it is definitely valid reasoning to assume that a-life could offer meaningful insights into human life and eventually be considered as equivalent to life. It would be an unavoidable logical conclusion that "strong AI" could be developed that we as humans could converse, share and learn valuable things about the nature of being from. The creativity of computers could indeed be equal to that of humans given enough com-

plexity, and completely new unexpected emergent "life forms" could be given birth to by tech-savvy artists. If we contrast this with a view that holds that all phenomena is merely imputed by mind we can see that ideas based around the concept of "strong AI" are impossible. This is because from this view the mind does not have its basis in materiality, but rather materiality is merely an imputed experience of mind. Because of this it is impossible to create consciousness from material or computational processes.

For many scholars in the field (Boden 1990, 1996, 1998, 2006; McCormack et al. 2014), it is conceivable that given enough complexity a computer could theoretically exhibit "creativity". McCormack (2014) for example says "Can human aesthetics be formalized? Unless something uncomputable goes on in the brain, the answer in principle is "yes." (p.136). If however we take a look at Bodin's (1990) definition of creativity: "Creativity is the ability to come up with ideas or artefacts that are new, surprising, and valuable." (p. 1) it could be said that although a computer running some algorithm can produce many millions of "new" ideas, the attributes "surprising" and "valuable" are a subjective experiences of the mind perceiving them rather than an objective quality of the produced artifact.

Bodin (1990) posits that a machine can at least "appear to be creative"; Based on the philosophical assumption that the mind and consciousness is somehow produced by the brain it is a perfectly logical conclusion that if a computer can appear to be creative, one might as well say that the computer is "being" creative. However if you take the opposite assumption, that the mind (and thus creativity) isn't a product of brain-function, saying that a computer "appears to be creative" isn't sufficient grounds to say that a computer is "being creative". Rather the perceived creativity is

an illusion, the "new and surprising" object doesn't come from the side of the com-

putational entity, rather it comes from the imputation of meaning upon an inanimate

chain of causality similar to the creation of pretty rock formations or "animals" within

clouds. Although the computer can endlessly rearrange symbols, both the symbols

and the possible domain of their transformations have been initially defined (if not

completely intentionally) by the programmer. Furthermore it is the viewer who under-

stands and imputes meaning upon, and applies context to, the otherwise meaning-

less and contextless symbolic combinations.

The more general equivalent of Boden's question "can computers appear to

be creative" is Alan Turing's (1950) question: are there machines which would do

well in the imitation game?, asked as a way of avoiding the difficulties of the ques-

tion "can machines think?" (in the same way Bodin is understandably avoiding the

ill-defined question "can computers be creative"). In this imitation game Turing sup-

poses that if a computer can fool a human into believing that it is human through its

responses to natural language questioning, then that is sufficient grounds to propose

that machines can think (again, following the assumptions of a materialist view this

is a logical argument). However Searle soundly refutes this with his Chinese room

argument (1980); In Searle's thought experiment, a non-Chinese speaker is present-

ed with an algorithm (in that person's language) that takes chinese symbols as input

and instructs them on how to take other chinese symbols and compose them into

a response (let's say that it is the same algorithm that is run on Turing's "thinking"

computer). Searle's point is that although the chinese speaker who is "conversing"

with this person might be sufficiently fooled into thinking that the person in the room

is conversing with them in Chinese, that person is merely blindly following instruc-

tions on how to reorder symbols and has no understanding of the meaning of what is being discussed (and thus likewise Turing's "thinking" computer).

Referring to the proven ability of computers to convince human audiences with creative (musical and visual outputs) and this philosophical debate Boden (2010) says:

> "Whether this justifies us in speaking of genuine art/creativity with regard to computers depends on highly debatable philosophical arguments. But these have nothing to do with the actual performance of the computer – which was the main focus of Turing's (1950) paper." (p.412)

These "highly debatable philosophical concepts" might indeed be irrelevant from the perspective of a cognitive scientist; from the perspective of the artists engaging with and creating the algorithms and artifacts, however, the positions one takes on these philosophical arguments is an essential foundation for the following work they undertake.

It is clear then that from the point of view of the non-materialist view of the madhyamika-prasangika, there is little value in exploring computational outputs as a way of understanding human creativity. Similarly the study of artificial life and evolutionary algorithms, yield little insight into the human condition from a non-materialist's perspective.

Another field of interest for many generative artists is emergence (McCormack & Dorin 2001; McCormack, Dorin, & Innocent 2004, Monro 2009; McCormack et al 2014). Emergence describes the appearance of macro behaviours based upon the interaction of many singular micro interactions between individual units. From the Madhyamika-Prasangika perspective this can be seen as the function of the mind

to impute distinct phenomena upon a series of individual parts. The emergence of a certain "group behaviour" would be viewed in the same way as the mind imputing "forest" upon a group of individual trees. If one were to inspect every individual tree looking for the forest they would not find it within the individual trees. Nor can it be said there is a singular entity called forrest within the collection of trees. To say that a collection of individual trees which are NOT a forest could spontaneously trans-form into an objectively existent entity called a forest is logically implausible. if many objectively existent non-forests (a tree being a non-forest) could somehow transform into an objective entity completely different from themselves (a forest) then there would be no continuity of cause and effect. Rather the mind merely imputes the label "forest" upon a collection of trees and the only way the forest exists is as this label imputed by mind. Likewise the emergent properties of systems are "mere labels" imputed by a mind that perceives a collection of causes and conditions.

The purpose of these comments is to highlight some of the fundamental dif-ferences of a materialist view and the madhyamika-prasangika view in regards to computational entities. It can be seen from these statements that from the view of the latter, mind (inseparably combined with cause and effect) is regarded as the source of phenomena. Thus the exploration of mind is a much more direct route to explore the nature of experience and likewise the exploration of human experience is a much more direct way to explore the nature of the mind. Thus from this perspec-tive it makes sense to make human experience the focus of attention when exploring generative art.

It might be asked then, why bother with computational art if human experience can be so effectively communicated through more traditional mediums? One

possible answer to this question is that the focus on process rather than artifact, is analogous to phenomena being mere name imputed upon cause and effect. In this way computational entities are particularly suited to describing the philosophy of cause and effect, impermanence, and ultimately the lack of existence of inherent phenomena. It is insightful to contemplate that the image you see on the screen isn't actually (for the sake of example) a cat but rather just an endless flow of electrons through billions of transistors, resulting in some tiny lights creating an illusion that the mind simply labels "cat". This is in itself becomes a particularly effective meditation on the fundamental truth according to Tibetan Buddhist philosophy, as all phenomena are viewed in exactly this same way (illusory appearances based upon an endless continuum of cause and effect).

4. The computational past

struggles and critique of past generative work

Over the few years I have experimented with generative art I have frequently run into the same difficulties, questions, and critique. A few of these difficulties and some associated work are discussed here. The explorations that will be discussed in this section generally fall into a subset of generative art called computational generative art (CGA). Here the system produced is either computer software, or a combination of software and hardware that functions to produce an artistic output.

This chapter is broken into three of the main obstacles I have encountered. These obstacles aren't necessarily directly related to the non-material philosophy previously outlined, but rather having encountered them in my own work they directly lead to the exploration of different frameworks from which to work.

4.1 An eternal quest for technical mastery - or how the breakneck speed of technical advancement can lead to being trapped continually making technical "sketches" rather than producing meaningful artistic gestures.

4.2 The hunt for a human story - Because computational generative art more often than not strips the artist from the resulting work, the human story behind the work is often completely lost. This can lead to work that is devoid of any meaningful exchange between the work and the viewer (or the artist and the viewer) if no attempt has been made to base the driving idea on human experience.

4.3 Infinite possibilities, arbitrary choices - even if there is a human experiential basis for the computational generative work, because of a lack of constraint within the digital medium any choice the artist makes can easily become arbitrary and meaningless.

4.1 An eternal quest for technical mastery

Anyone who applies himself from his early youth, to the practise of graphic techniques may well reach a stage at which he begins to hold as his highest ideal the complete mastery of his craft. Excellence of craftsmanship takes up all of his time and so completely absorbs his thoughts that he will even make his choice of subject subordinate to his desire to explore some particular facet of technique.

I myself passed many years in this state of self delusion. But then there came a moment when it seemed as though scales fell from my eyes. (Escher, 1992, p. 5)

Computational generative art, like any artistic method, requires the artist to spend some time learning the skills and techniques before attempting grander gestures. I begin this exploration of Generative art by observing this phase of my own practise, and noting that a large amount of artists in this field (although certainly not all) seem to be caught indefinitely in this phase of mastering algorithmic production. It seems that the breakneck speed of advancing technology lays a trap for generative artists where we might get stuck "learning the medium" indefinitely. There is always something new to learn, another programming language, framework, or a new device. This endless process often leaves little time for those grander gestures, the narratives, human endeavours, and ideas that relate to our lived and shared experience. Although any medium provides many possible techniques for one to thoroughly explore, understand and master, computational art is in a unique position where
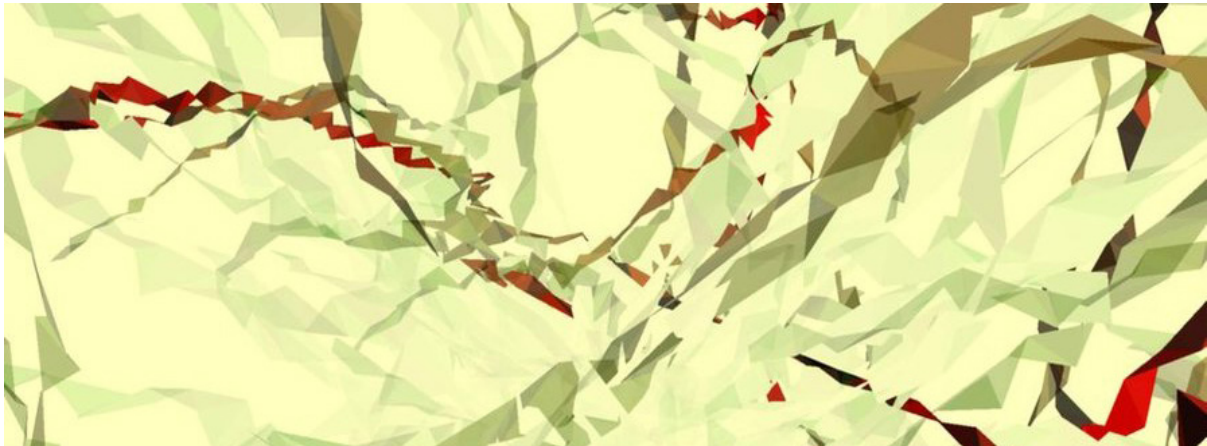
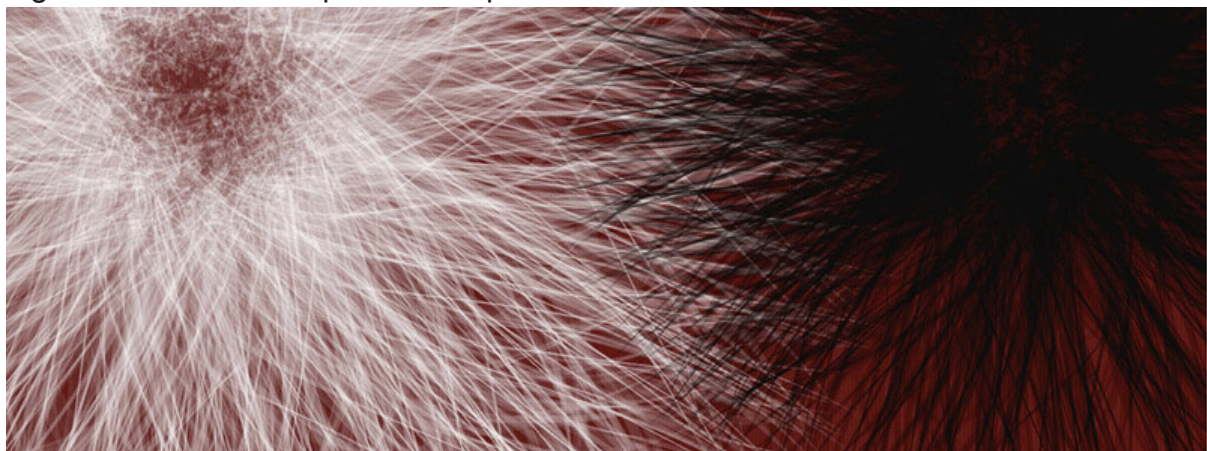Figure 3. "Coloured explosions" A piece of Generative art.

Figure 4. "Inverse kinematic" A piece of Generative art.

Figures 3-7 are a few examples of my early generative artwork. Although they are interesting visual artifacts they don't illustrate any of the human qualities, processes, or experiences that people might empathise with. Rather they are solely abstract digital processes whose lives are lived as electronic pulses on silicon chips. Because of this they have little or no connection with lived human processes or experiences. It took several years of making countless iterations of such work for me to realise that no matter how visually appealing the result is, work that takes technique as its subject without a foundation in human experience will always struggle to have any kind of lasting impact. Although the exploration of the materiality of the algorithm is interesting for some, work that is left at that becomes irrelevant at the advent of new technology or more complex and beautiful algorithms.

there is literally no limit to the possible techniques, languages, frameworks and so forth that one could learn or create. This appeal of completely mastering the medium and of creating something previously impossible seems to encourage the endless creation of beautiful but experientially meaningless tech demos. Although this technique focussed work can be breathtaking in its beauty, (many of the artists that have given me the most inspiration deal almost exclusively in creating spectacular generative "retinal art".) without some guiding conceptual principle it will always lack depth. The works produced become self describing artifacts that tell the story of their own algorithmic creation, but fail to delve into the substantial, experiential and emotional stories that a human might be able to empathise with, or take something from.

These human stories are important because although some might regard the algorithm itself as the art (and by extension would consider that increasing the capacity to create complex and beautiful algorithms is synonymous with improving one's artistic skill), I would argue that a digital algorithm has no power [in itself] to communicate anything of significance to a human being (although through its observation a human might have a new idea of their own triggered). Although it may be a satisfying creative endeavour crafting and perfecting such algorithms, how can an audience empathise with an electrical/logical system that lacks mind and emotion? Even if the algorithm could create work that is indistinguishable from a hand-crafted piece, the work merely acts like a mirror reflecting back to the viewer his or her experience of similar past work. Regarding the difficulty of computer-human communication or empathy McCormack et al (2014) asks "what is it like to be a computer that makes art?" (p. 136); If the experience of the computer that is producing the artifact is unknowable to a human audience what kind of meaningful response can be

expected? And if the algorithm IS the art then what exactly is it communicating ex-

cept from its mere existence?

Figure 5. "Generative-1" A piece of Generative art.

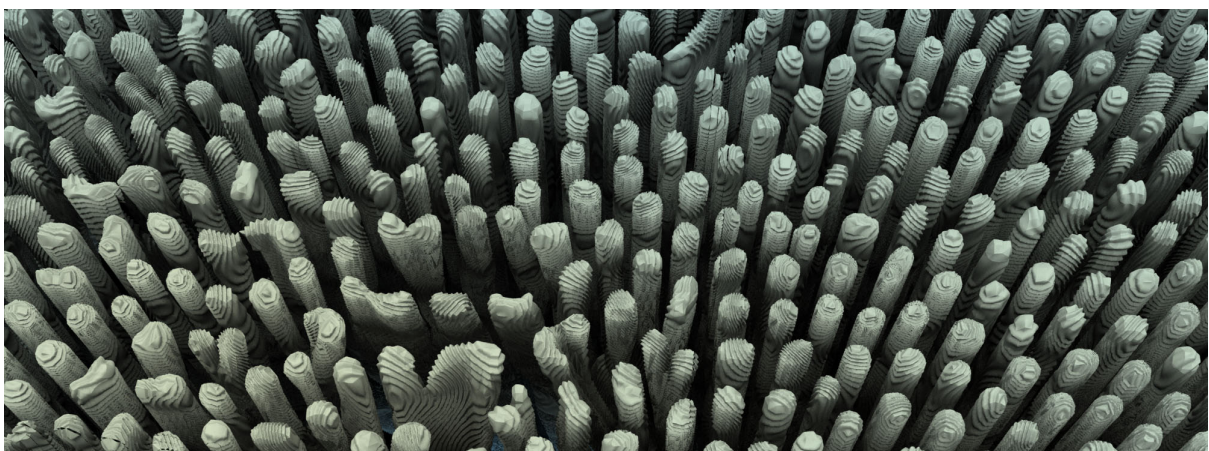Figure 6. "Gravitational sphere" A piece of Generative art.

Figure 7. "Coral generations" A piece of Generative art.

4.2 Finding human subjects for generative art

The subject of generative art I would argue is more important than the subject of more traditional mediums. One reason for this distinction is that in traditional mediums the artists (or their collaborators) are directly involved in the process of mark making. Because of the human involvement in the transcription of the work, the work becomes a manifestation of, or record of the human processes and human experience involved in it's creation. In painting or drawing, the work is a manifestation of the laborious act of mark making, similarly sculpture can be seen as the result of the human processes, effort, and endeavour that created it. Film and photography although aided by machines, tell the stories of the eyes and experiences of the artists behind the camera, and of the world they live in. Even art such as the readymades of Duchamp, although not crafted by the artist himself, tell the stories of the human cultures from which the artifacts came (and the cultures that the objects were intended to challenge). Through the direct application of human labour more traditional work tells the story of human endeavour regardless of the subject of the work.

This story of human endeavour is one we as humans intuitively understand, we know what it feels like to struggle and labor. The novels we read, the films we watch, and the stories we tell are saturated with human effort. Whether this effort be the journey, a conflict, or a relationship, the currency of emotion within these stories it would seem is some form of human endeavour. Looking at an oil painting masterpiece for example tells the story of the many years of training, and in many cases the many years of effort that went into the painting itself. Traditional art-forms are laden with the marks of visible human endeavour.

It is this very visible human story that the critics of generative art, such as O'hear (1995), consider to be the essence of a piece of art's value. That communication from one human to another, if not in the form of an explicit message from the artist, is at least transcribed in their laborious development of techne.

Generative art is unique in it's removal of the artist from the process of execution or mark making. Not only is the artist removed from the execution of the work, usually some randomness is added to the work or other factors outside of the artist's control are used to influence the final piece (Galanter 2003; Dorin 2013). This twice removal of the artist from the "art" (once removed from the execution and twice removed by ceding some control of the output to the system) means that the human behind the work is more often than not completely hidden in the final piece. This is exactly what makes generative art a unique and compelling practise for many; the ability to hide the artist and highlight the process opens the door to a vast range of creative opportunities that would be impossible with non-generative workflows.

Understanding the process driven methods of generative art can also help the artist understand the "intuition" behind traditional workflows. By creating a system to create art, one must necessarily think through all the nuances of the process of creation whilst at the same time building a system to execute it.

The ability of the artist to "disappear" is one of generative art's main strengths. This very strength can, however, lead to work that is shallow and distant from human experience if the subject of generative art-work isn't carefully selected. Generative art that celebrates the algorithm or process as both it's creative process and it's subject runs into the hurdle of human knowability, as McCormack et al. (2014) puts it "If we can never know what it is like to be a computer that makes its own art, then how

could any such participation ever be appreciated or understood?" (p. 136). How can we appreciate computer executed art at more than a purely visual level if we have no comprehension of what it is like to be that computer? Most people know what it feels like to mark a piece of paper or to hold a tool, and by extension know the immense effort and skill involved in crafting a masterpiece. Conversely, the abstract world of flipping bits on silicon chips is as foreign to human experience as the life and experiences of a waterfall.

This unknowability isn't so much of an issue however if, as generative artists, we are taking and describing human experiences as the subjects to be explored with a generative process. Human experience naturally offers limitless opportunities for creating work that can speak to a human audience who live and feel, about subjects that they understand and empathise with. There is a great collection of computational generative (generative is loosely used in this case) work that does explore human experience, a few examples of this include:

Jonathan Harris' we feel fine, in which the "mood" of the internet is explored through data mining and visualisation of emotional words that have been posted on blogs in the last few hours.

Sergio Albiac's generative portraits; These are interesting in their choice of subject, images of the human face even if statistically generated tend to express and elicit certain emotions from the viewer.

Evan Boehm's "The carp and the seagull"; This interactive narrative goes thoroughly beyond the technology used to implement it to tell an emotionally charged story.

These are only a few of the many artists seeking human stories with generative media. It was through seeing these examples and continually encountering a certain shallowness in my own algorithm based work that I began to seek ways to align my practise with a particular philosophical view and explore distinctly human experiences through generative methods.

4.3 Infinite possibilities, Arbitrary choices

The struggle to find effective ways to describe human ideas and experiences through generative art fairly quickly lead to the discovery of another difficulty of digital representation.

Taking human experiences and bringing them into the digital world inevitably involves data-mapping. Data-mapping consists of taking some data, interpreting it, and then presenting it in some new sensory form. One could quite fairly argue that this is the greatest strength of the computer. It is the very thing that has landed us in the "information age", the ability to take vast swathes of information and present it in new understandable ways. Because all digital information is essentially the same (numbers represented by binary) It is possible to map any kind of informational input to any other kind of output. In the sciences this has lead to huge advances in the analysis of scientific data. In art, however, although it has lead to amazing new creative opportunities it also creates a rather large obstacle. As Manovich (2002) puts it:

"By allowing us to map anything into anything else, to construct infinite number of different interfaces to a media object, to follow infinite trajectories through the object, and so on, computer media simultaneously makes all these choices appear arbitrary

– unless the artist uses special strategies to motivate her or his choices." (p.9)

Because of the infinite space of possible mappings it can be difficult for a generative artist to choose a meaningful way to represent the data they have at hand. This more often than not results in making choices solely based on visual qualities,

these are usually fairly arbitrary and can easily lead to work that comes across like a

veneer box rather than something thoroughly grounded and substantial.

following is a couple examples of this in my own previous work:

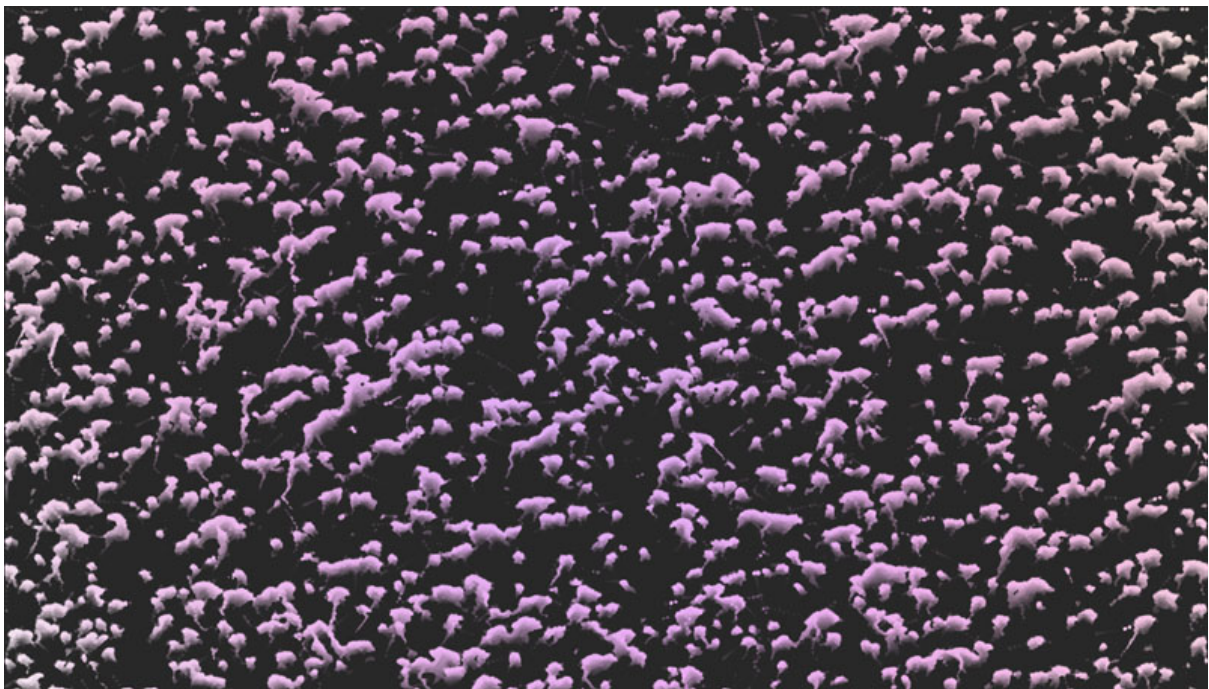Figure 8. "Elucidating feedback" installation. https://vimeo.com/16329472

Figure 9. Screenshot from "elucidating feedback" installation.

In my 2010 work "Elucidating Feedback" i was exploring the act of attention. In this interactive piece the user would wear an EEG headset which would provide real-time information on how focussed and how relaxed the user was. As an exploration of the Buddhist idea that we create phenomena through conceptual imputation (or paying attention to it), the installation would, depending on the state of attentiveness of the user create audio-visual patterns and forms out of a field of static. This would create a feedback loop where as the user got more focused, more would appear to focus on. In this installation there were several patterns that were emergent properties of the particle system itself (modelled on descriptions of slime mould behaviour), and several pre-defined patterns that the system would cycle through. Although this predefinition of possible patterns might seem like a shallow and arbitrary way to assure visual diversity, the difficulty of taking two numerical variables (that indicated the user's attention and relaxation) and turning them into a meaningful audio-visual installation becomes apparent.

Having exhibited this publicly several times, the question I was most frequently asked is "Is my mind creating those images?". This question is loaded with implications, what exactly does one mean by created? No matter how complex the system is, or how involved the user is in changing the variables, it is still the artist who has to make the decision how to map the various variables to various sensory outputs (and the computer that executes the artist's instructions). So from this the question arises how does one make those choices of mappings meaningfully? In the case of elucidating feedback the illusion and experience seemed effective enough to hide the arbitrariness of the patterns that were chosen from the audience, but from an artist's perspective it still felt like a work-around rather than a genuine solution to this issue.

Figure 10. "Visualising brainwaves in 3D" a project that creates a growing lamp from users brainwave data. (Rodriguez & Jack, 2012)
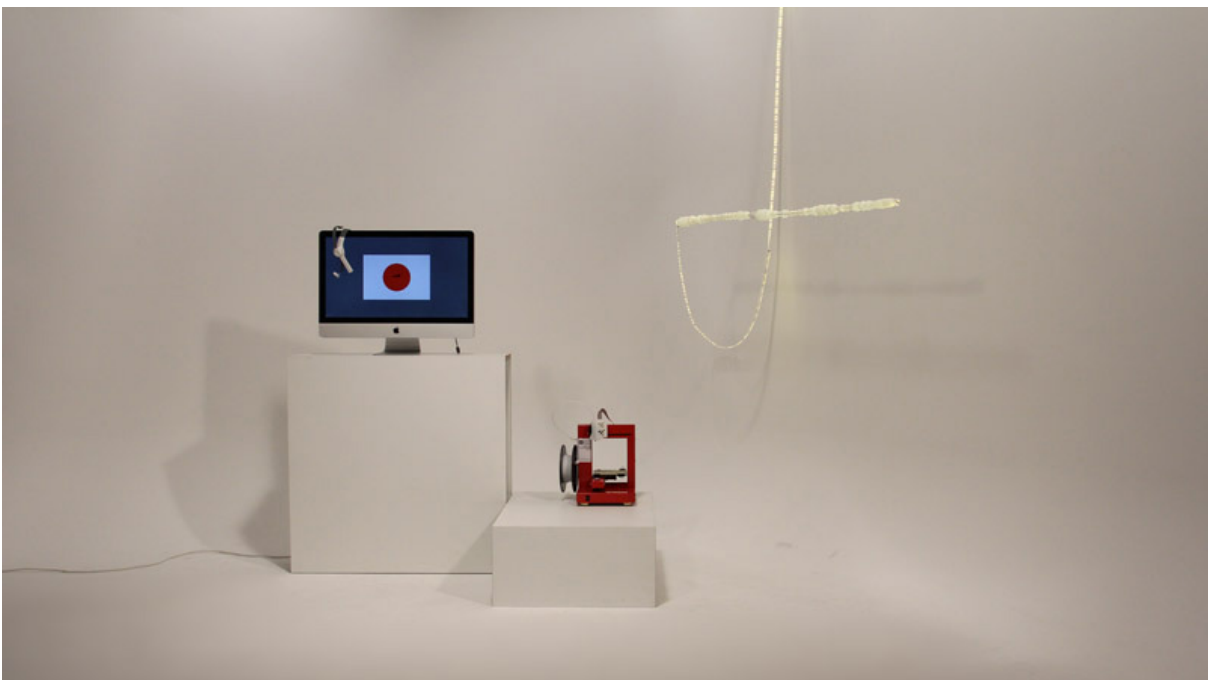

Figure 11. "Visualising brainwaves in 3D" installation. (Rodriguez & Jack, 2012)

This next piece was a collaboration with Edgar Rodriguez that used the same EEG hardware as elucidating feedback. In this work the user's attentiveness and relaxation would mould the form of a lamp segment that would then be 3D printed. How relaxed the user was would define how thick or thin the segment was, the attentiveness would define the radius of the segment and the texture was manipulated by the user's gamma rays which are linked to tactile experiences. Here there was some very simple logic defining how the variables mapped to the form (eg, if the user was stressed it would be thin and brittle, relaxed it would be thick and strong) but the form itself was still in the end somewhat arbitrarily plucked from an infinite ocean of digital possibilities. Having received some particularly pointed critique about how arbitrary the choice of the final form was at a design conference that it was shown at, I saw that there needed to be some kind of foundational framework which applies clear boundaries and creates a set domain to work within. Within such a framework it will be possible to make meaningful decisions regarding the forms, mappings, and decisions made.

Concluding thoughts

The three main obstacles that I have encountered in my previous work have manifested in various ways throughout my explorations of generative art. Having sought subject matter that overcomes a fixation on technical mastery, the absence of direct human presence within the work became a new hurdle. The absence of human qualities, which are naturally present with more traditional methods of art making, would often create work that although based on interesting ideas would none the less still seem separated from lived experience and human effort. Finally to overcome this a more pointed effort to express human experiential stories became the main focus. This still leaves the difficulty of making meaningful mappings between variables (whether interactive, environmental, based on data etc..) and sensory outputs. This final obstacle might be overcome by more firmly grounding work within a philosophical and cultural framework. I proposed in response to this that through referencing the iconographic, symbolic and philosophical lexicon of Tibetan Buddhism it would be much easier to construct meaningful and relevant mappings.

5.Human Stories

methods to introduce human experiential stories into generative art.

The previous discussion on some of the difficulties of a generative art practise led to the decision to make human experiential stories the primary focus of attention. Having made this decision, it is necessary to then contemplate the various methods one might use to do such human explorations. A few options are listed here, this is an initial attempt to enumerate the possibilities and to mention previous examples of such work.

5.1 Expressing human experiences digitally

To express a human experience digitally is to take some human visceral experience as subject matter and to use generative media as a medium for storytelling. previous work that does this includes:

Cyril Jr (Ben Jack).

Cyril Jr was an experiment in using a digital form linked with a physical controller to see how digital form might express the intonation of human sentences. This project sought to find digital methods to express the emotional subtexts within spoken english.

Figure 12. "Cyril Jr" an interactive paralanguage puppet. an experiment in visually

codifying the intonation of spoken english. https://vimeo.com/68459524
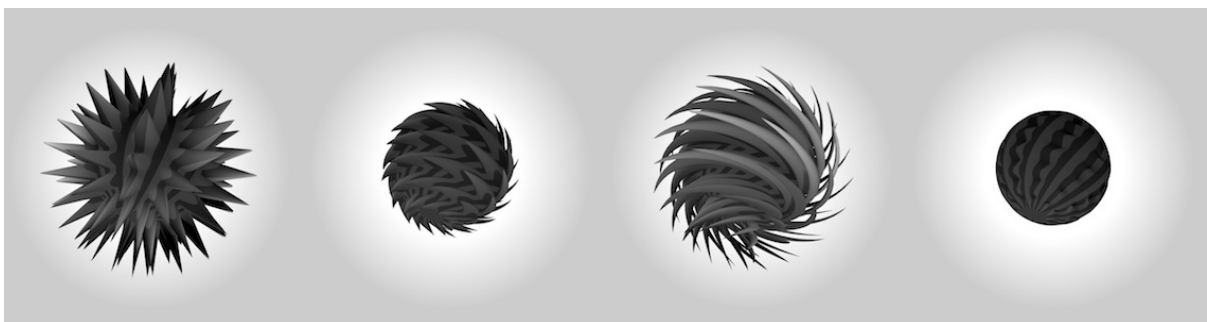
Figure 13. various different forms of "Cyril Jr".

we feel fine (Harris & Kamvar, 2006)

we Feel fine takes a vast collection of current emotional data from the internet in the form of blog posts containing words linked with certain emotions (happy, sad guilty etc). It then visualises these within a series of "movements" or different ways of displaying this vast collection of emotional data. This visualisation expresses the feelings of a vast number of people, with the ability to read some of the more intimate episodes from individuals lives as they put them on the internet.

5.2 Invoking human experiences digitally

This is to place the viewer in a situation where they might find themselves experiencing some intended feeling or experience. This is much more difficult to address satisfactorily. Often Interactive work is geared toward this, however careful attention has to be paid not to make the interaction a "gimmick" or "hook", but rather an integral and meaningful part of the piece. previous work that does this includes:

Elucidating feedback (Ben Jack):

Elucidating feedback was an installation designed to develop a sense of awareness and focus on one's environment. The installation used an EEG headset that read the user's attentiveness and relaxation levels to create a feedback loop. when the user would start to pay attention form would start to coagulate out of static, giving the user more to focus on which would in turn create more form and so forth. In this way the installations purpose was to both invoke a concentrated state and also to give the users some insight into the function and feeling of attentiveness.

the carp and the seagull (Bohem, 2012):

The carp and the seagull uses traditional storytelling combined with simple interactions and computational geometry to tell a moving story of a lone fisherman, his encounter with the spirit world, and his fall from grace. The story elicits both compassion and contempt for the protagonist.

5.3 Expressing human ideas/concepts digitally

in this method it is sufficient to take some experiential human idea (as opposed to an algorithmic, digital or mechanistic idea) and to use a generative process to express this.

5.4 Combining human craft with generative outputs

In this method the expression of human endeavour is reintroduced into generative art by making the process of the artist apparent in the final work. Ideally the viewer can see the system itself, and the output of the system simultaneously. Work that explores this includes:

Exoskeleton (Stellarc, 1998):

The unique feature of Stellarc's work is that he not only incorporates man-made systems into his work, he also integrates his own body to be controlled and manipulated by these systems. In his piece Exoskeleton he stands in a giant six legged machine which feeds electrical impulses into his body which causes involuntary movements. Both the system (the machine and his body) and the generative output (the performance) are simultaneously celebrated.

The Johnny Cash project (Chris Milk, 2010):

This project although not strictly generative (although it uses algorithmic processes to organise its frames) is a great example of combining human mark making with digital systems. This music video invites the public to submit frames of an animation, drawn using simple drawing software. It then combines all of these frames to create a music video that is a collection of many people's effort of manual drawing.

5.5 any combination of the above

Any of these methods could theoretically be employed together to create work that has a solid foundation of human experience.

6.Generative meditations

Using Buddhist philosophy as a foundation for generative explorations.

6.1 setting an intention

"Two monks were about to have a debate; one monk to test the other's wisdom asked whilst standing with one foot inside the door and one foot outside, 'am I about to come into the room or am I about to leave?'. The other monk calmly looked at the first and replied: 'well that depends on your intention. If you intend on coming in, that's what you'll do and if you intend on leaving you'll do exactly that.' " - Buddhist parable

As with any practise in the Tibetan Buddhist tradition it is customary to begin by setting a good intention; Because every action is necessarily preceded by intention it is regarded that it is largely the quality of the intention that defines the quality of the action. Thus in setting my intention from the outset may any small virtue I create through these contemplations, compositions, and writing lead to the development of permanent inner peace for all living beings.

6.2 introduction

In order to impose constraints, and to give myself a personally meaningful foundation from which to develop the following works, I have chosen to base these explorations on the philosophy and iconography of Tibetan Buddhism. This framework provides a vehicle to attempt to express the distinctly human experiences involved with a meditative tradition. Furthermore it provides a cultural, historical, and philosophical context from which it is possible to make meaningful references and creative decisions. Contrasting such an ancient tradition with technological processes far removed from the culture of Tibetan Buddhism might also generate some new meanings; meanings that mediate between such an ancient traditional artform and a contemporary art practice.

This chapter is broken into two main subsections:

6.3 Mantra - this project seeks to explore "expressing human ideas". Using computational generative techniques I create a generative animation based on the ideas of mantra, impermanence, and breathing meditation.

6.4 The signal mandala - this project veers off my standard practise of computational generative art in order to explore "combining human craft with generative outputs". By creating an electronic sound-sculpture based on the concept of a mandala I seek to unite meditative Buddhist practises and generative systems in a piece that celebrates both simultaneously.

Figure 14. Buddha Shakyamuni. Every aspect of his form and posture has some

symbolic meaning. (Downs, 2009)

6.3 Mantra

A generative exploration of mantra, impermanence and breathing meditation

To begin these explorations I have started out with familiar processes. This project consists of a program written in C++ (Cinder), OPENGL, and GLSL. It is an example of taking Ideas directly related to human meditative experience, and rendering them in a visual way.

This project is discussed in two sections:

6.3.1 Concept

6.3.2 Process

6.3.1 Concept

Every aspect of Tibetan Buddhist art is highly symbolic; If for example we examine the image of Buddha Shakyamuni (see figure 14) every aspect of his form and posture has some meaning. For example his topknot represents his reliance on his spiritual guide, his right hand gesture represents his overcoming of Mara (obstacles to enlightenment). His robes represent moral dicipline etc.. Every detail has a meaning.

Buddhas themselves are not to be viewed as objectively existent beings (remembering that according to the Madhyamika-prasangika view nothing exists objectively), but rather they are symbolic aspects of enlightened mind. for example the Buddha Avalokitesvara represents the compassion of all Buddhas, Manjushri is a representation of the wisdom of all Buddhas, and Vajrapani is a representation of the

Figure 15. Buddhas Manjushri (top left), Avalokiteshvara (top right), and Vajrapani.

The Buddhas that symbolise the minds of wisdom, compassion, and spiritual power.

(Downs, 2010 2011 2012).

spiritual power of all the Buddhas. Symbolic references and the appearance of our subjective reality however are considered to be very closely related, as both exist as mere name imputed by mind.

From this perspective it makes sense that when using computational generative methods to create new animated Buddhist imagery it is necessary to consider each aspect of the composition, from the imagery and symbols used, to the animation and movement itself.

The main symbols that I begin with are the Sanskrit syllables OM, AH, and HUM. OM is the most fundamental representation of the body of all Buddhas, Ah is a representation of the speech of all Buddhas and Hum is a representation of the mind of all Buddhas. The colours white, red, and blue, are similarly representative of these aspects. These syllables also represent the fundamental "objects of refuge" for all Buddhists: Buddha, Dharma (Buddha's teachings, or his speech), and Sangha (the spiritual community). Choosing these particular symbols is an intentionally strong statement, It frames the work firmly in traditional iconography and unashamedly delves into the heart of the Buddhist belief system.

Mantras according to the (Mahayana/Vajrayana) Buddhist tradition are the sound that the internal winds of a Buddha makes. These winds are similar to the Chinese concept of Qi, they are subtle energies that move mental awareness around the body. By reciting these sounds, our own winds become closer to those of a Buddha. It follows from this that because mind is mounted upon winds, if we develop pure winds, pure and peaceful minds develop accordingly. Om Ah Hum is the mantra of all Buddhas' body, speech and mind. "There are many different mantras but they are all contained within these letters" (Gyatso, 2013, p.139)

By beginning with symbols of the basic objects of refuge, the fundamental similarity of Buddhists of all traditions, deciding to visually depict the concept of impermanence as experienced through breathing meditation is an appropriate starting exploration being common introductory topics. These three topics are inextricably linked, by relying on the three objects of refuge (Buddha is the source of these teachings, Dharma instructs one on how to train the mind, and sangha provide support and assistance), and by developing single-pointed concentration over time through meditation, one can directly non-conceptually experience the truth of impermanence.

Impermanence

There are two kinds of impermanence, gross impermanence and subtle impermanence. Gross impermanence is the obvious acknowledgement that no phenomena will last forever. Subtle impermanence however is a much deeper topic, but one that animation in general and computational animation in particular is particularly suited to describing.

Subtle impermanence is the observation that for every moment of an object to exist the object of the previous moment must completely cease to exist. There is no way that the object of the last moment can still exist in the next moment, for if it did every moment would create new instances of that object leaving trails of static objects in its wake. If we deny subtle impermanence and posit that there is some inherent object that continues to exist from moment to moment then it could not possibly change in any way, and thus would not function through time and space. Lets take for example the very basic coded animation of a circle moving across the screen (and looping when it reaches the end)
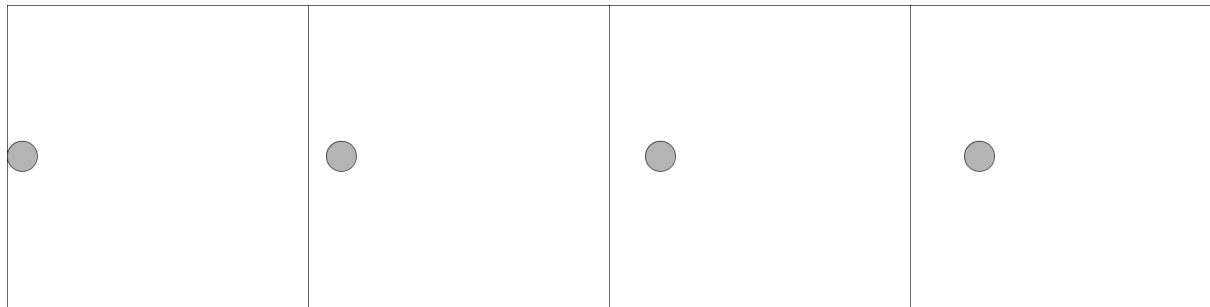
Figure 16. four consecutive frames of the animation of a "singular ball moving across the screen".
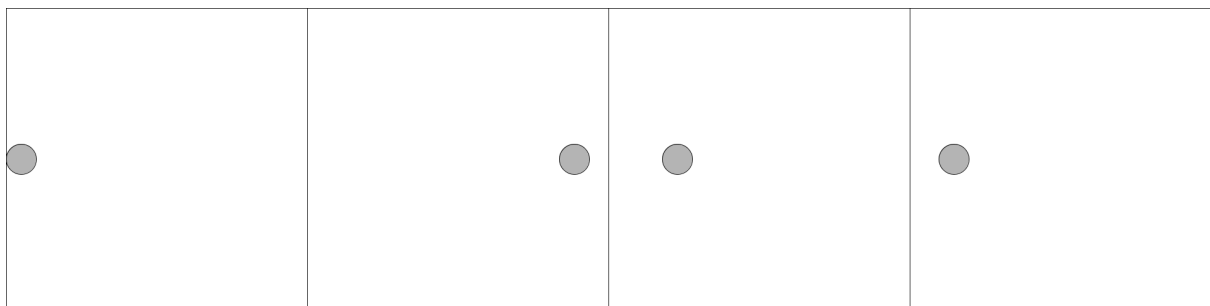
Figure 17. If the x position is made random the illusion of continuity is broken and it appears as if many random balls are appearing and dissapearing.
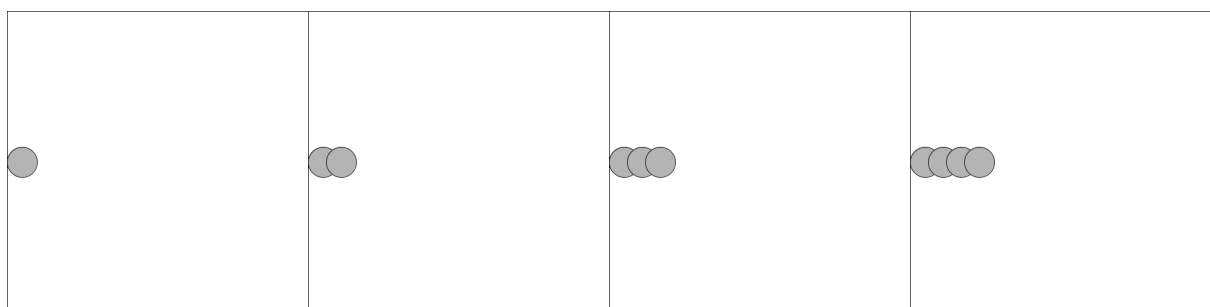

Figure 18. When `background();` is removed the previous frames do not dissapear. The illusion is broken as it is easy to see that it is actually multiple different circles being drawn consecutively. The only difference between this and figure 16 is that in figure 16 the previous circles are removed each frame.

This code snippet is provided in the processing (JAVA) language for the sake of simplicity.

```
int x = 0;
void setup(){
    size(500,500);
}
void draw(){
    background();
    circle(x, height/2, 50,50);
    x = (x+1)%width;
}
```

The purpose of this example is to show that for "functionality" ie the circle moving, in every moment (in this case a moment is synonymous with a frame) the previouscircle has to cease to exist. This is the purpose of "`background();`" it causes the previous moment of object to completely and irrevocably cease. (compare figures 16 and 18 for what it looks like with and without "`background();`") A completely new ball is then created in this moment using various causes and conditions that exist within the continuum of causes and conditions of the last moment of ball (in this case the variables). The next stage is that the continuum of causes and conditions is propagated in some way by further conditions (in this case a mathematical statement that causes the x variable to increase in size, and loop back to zero when it reaches the width of the screen). We can see from this example that the

appearance of "a moving ball" is merely an illusion created by the mind perceiving

many individual moments of individual balls as a singular entity existing over time. to

make this clear, all we have to do to break the illusion is to change the line:

```
x = (x+1)%width;
```

to

```
x = random(width);
```

(see figure 17)

through this simple change the appearance of a singular entity existing

through time and space is broken, and what now appears to the mind is many indi-

vidual "balls" randomly appearing and disappearing (which was the reality of the first

example also, but through conceptual designation we mentally impute "singular mov-

ing ball"). (see figure 16)

The Buddhist notion of subtle impermanence applies exactly the same logic

to all phenomena. to take an example particularly close to home, for one moment of

"human" to exist the previous moment of human has to completely and irrevocably

cease to exist. If this were not so, then it would be impossible for "baby" to change

into "child", for "child" to turn into "teenager" and so forth. If there was some inher-

ently existent unchanging essence or soul, how could it possibly function through

time and space? How could it possibly be said to interact with the fundamental law

of cause and effect? How could it be produced, and how could it possibly cease?

Where did the child go when the adult appeared, and where does the adult go when

it too disappears? All that can be said ties each moment of existence together is that

the current moment of human is in the same continuum of cause and effect as the

last. To take this concept deeper, if there is some fundamental unchanging partless

"matter-particle" that exists in the universe then how could it possibly interact with other instances of it? If interaction is some form of exchange what is this partless particle exchanging?.. energy? How does that energy interact with it, if it is partless (it would seem that if it is partless it is necessarily impenetrable) how can the energy possibly impart something to change it? and if the energy somehow does change the particle the previous moment of that particle has to completely cease to exist in order for the new changed version to arise. Thus how could some fundamental partless unchanging matter possibly give rise to functioning phenomena?

This work expresses this digitally using a vertex shader to pull apart and animate the 3D models of the letters, the animation expresses breathing form from emptiness. In what moment do the particles become letters, where in the animation can one say "Letters exist", and when do they cease to exist? Where do they come from, and where do they go? In breathing meditation one observes the breath moment by moment. Similar questions can be contemplated giving rise to an understanding and experience of subtle impermanence "when does one breath cease and another start? Where does the last breath go once it has ceased? Where does the next breath come from?" and so forth.

6.3.2 Process

This project initially started with the creation of a personal creative coding library built on top of Cinder (C++). The aim of building this library was to assist the creation and generation of geometry, and simplifying the process of applying and experimenting with shaders. what follows is a series of images showing the process undertaken.
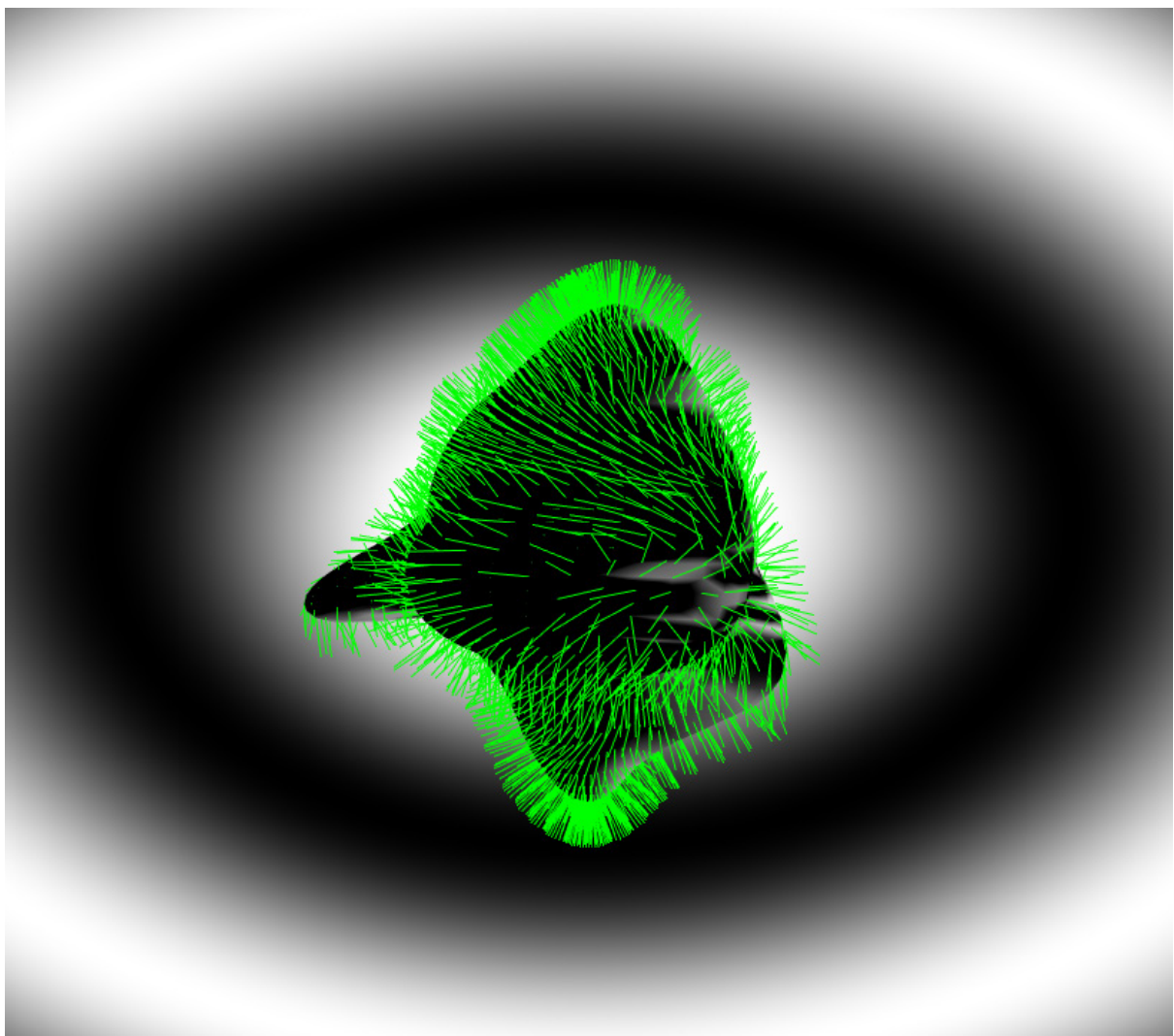
Figure 19. Creating systems to load 3D files, break up their vertices, create normals and apply shaders with a streamlined process.

Figure 20. Creating a vertex shader that would animate every individual face of the

object, "breathing" the object into and out of existence.

Figure 21. Prototype that loades in the letters OM AH HUM using testing shaders.

Figure 22. a test Using UV coordinates and texturemaps to ease colour application.

Figure 23. Creating a post effects application system in this case to apply a bloom

shader (glow effect).
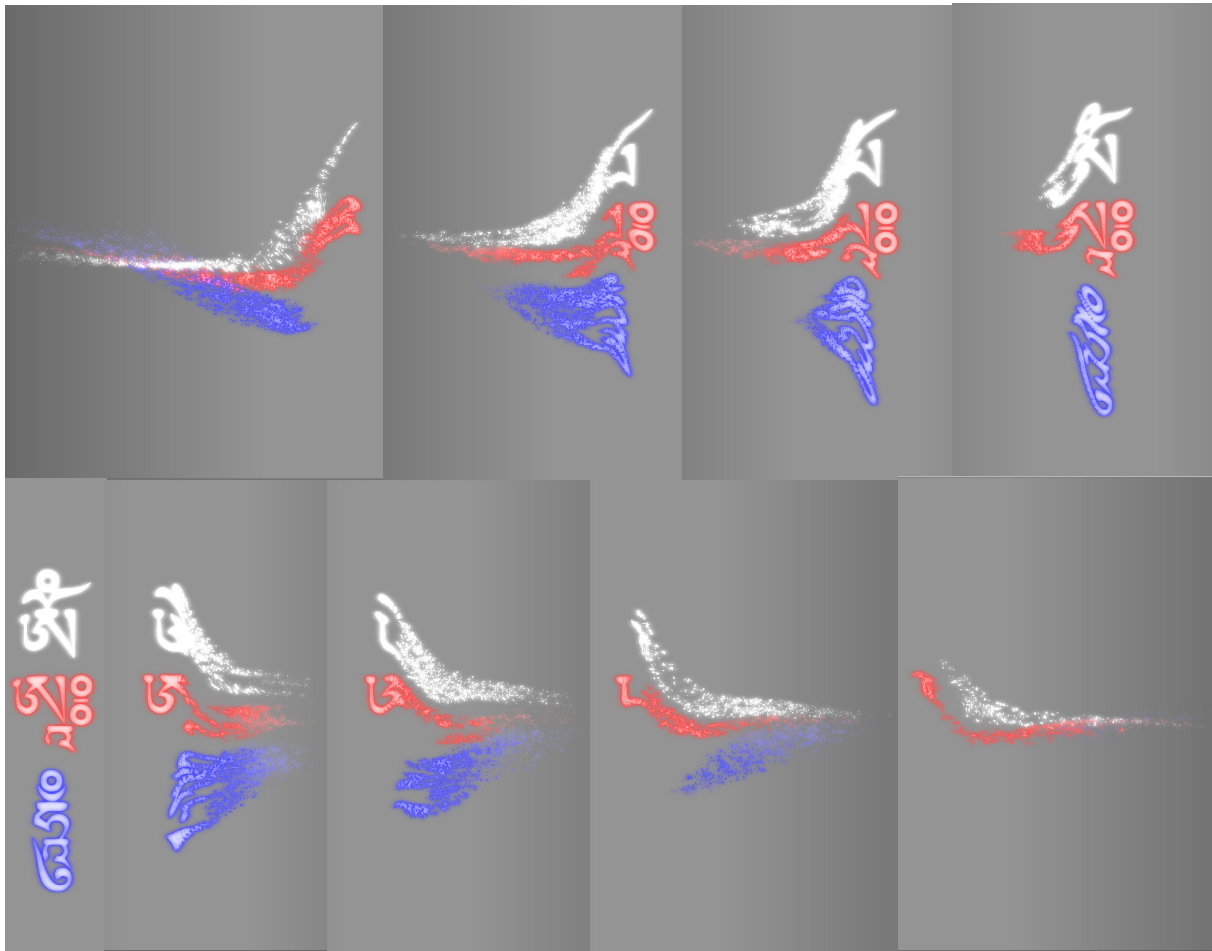
Figure 24.The final procedural/generative animation. This series of frames shows how the animation progresses ofer time.

Figure 25. Traditional sand mandala. (UK House of commons, 2008)

6.4 The Signal Mandala

generative offerings - The convergence of human and process.

The signal mandala seeks to explore the union of human craft and generative processes. This project breaks away from using computational and programmatic methods. The purpose of using physical labour in the construction of this piece is not only to explore human craft in the context of a generative art practise, but also to engage in a more intuitive and meditative creative process.

This project is discussed in two sections:

6.4.1 Concept

6.4.2 Process

A brief video of this project can be found at: https://vimeo.com/129489121

6.4.1 Concept

A mandala in Buddhist iconography is the representation of a universe; this work is the construction of a generative mandala. In Tibetan Buddhism there are many different representations of mandalas; This piece developed from the common practises of creating sand mandalas (intricate circular images created with coloured sand) and making mandala offerings with a metal base and rice. The idea of making mandala offerings is that by mentally offering the entire universe filled with precious objects, one creates merit (merit, good luck, or positive karma is essentially the idea that one can create mental causes to experience beneficial conditions in the future).

This piece is essentially the construction of a generative mandala offering, the union of a traditional meditative offering and a generative system.

6.4.2 Process

The initial idea was to create analogue electronic circuits in the shape of a mandala. These circuits would generate waveforms that would then be fed to contact speakers that would create cymatic patterns with coloured sand on the shaped plaques the circuits were mounted upon. The circuits and the cymatic sand patterns would be put together into the form of a sand mandala.
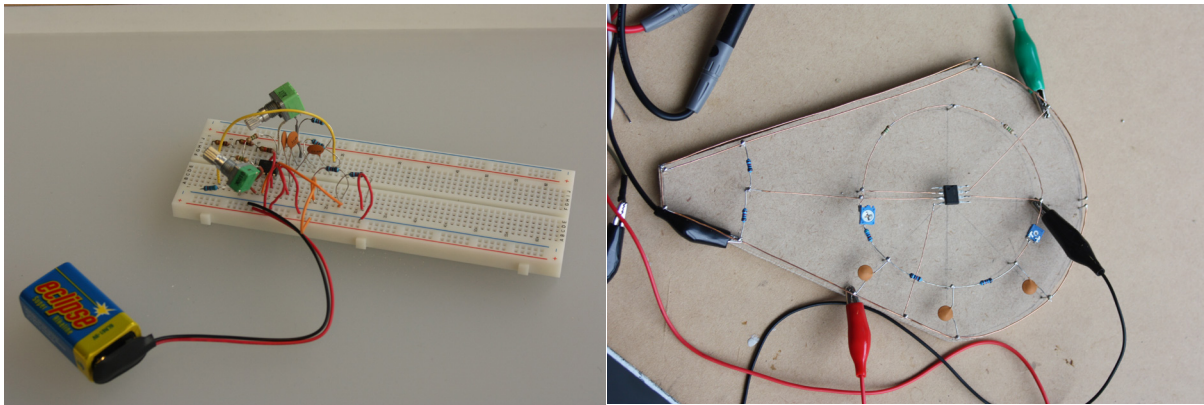

Figure 26. Designing and experimenting with oscillator circuits, these are phase shift oscillators that use an op-amp and basic electronic components to create waveforms that can be fed to speakers.

The design of the circuit on the right is meant to be in the shape of one of the "petals" of a sand mandala (refer to inner petals in figure 24).
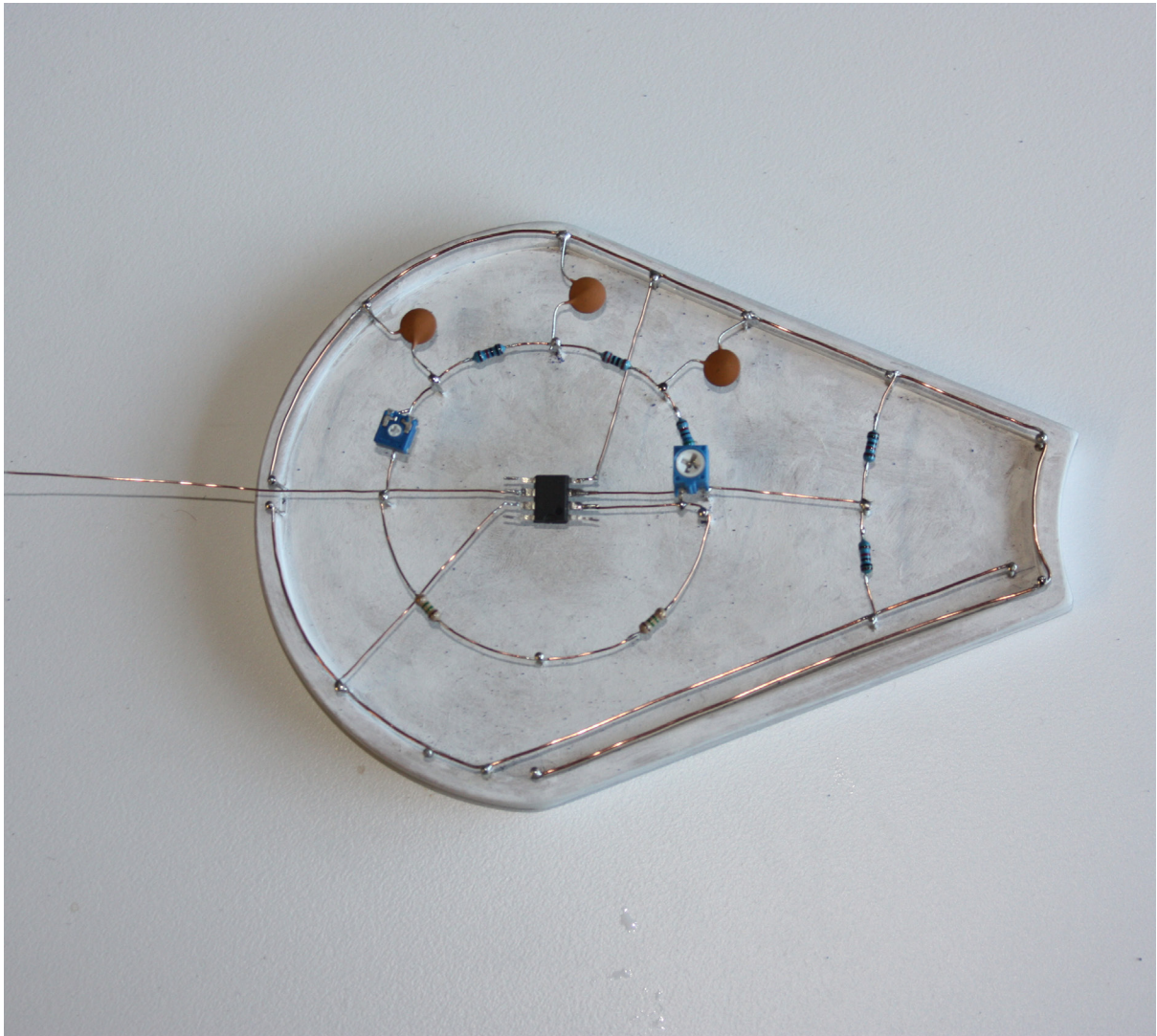
Figure 27. once the circuit functionality was finalised a prototype was mounted on a wooden board with a border to contain sand a contact speaker was mounted on the bottom and wired to the output of the circuit.
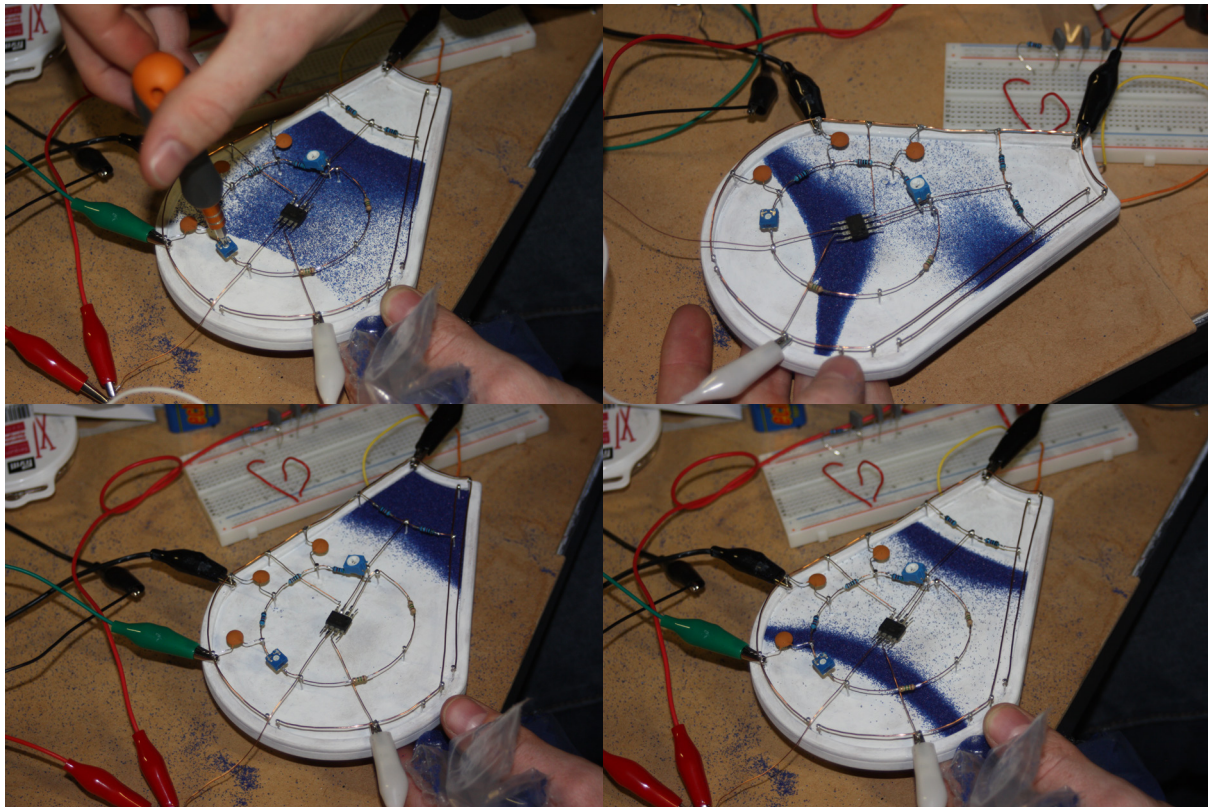
Figure 28. These images show the patterns created by the sound-waves vibrating

the sand at different frequencies (the frequency is changed by manipulating the vari-

able resistors within the circuit). The initial idea was to make many of these in differ-

ent forms that mirror the the forms of a traditional sand mandala. At this point how-

ever, it seemed like some simplification was needed. The materials (the sand and

backing wood) seemed superfluous to the concept, and merely imitating the form of

a traditional sand mandala seemed to be a superficial way of describing the idea of

offering a universe in a non traditional context.
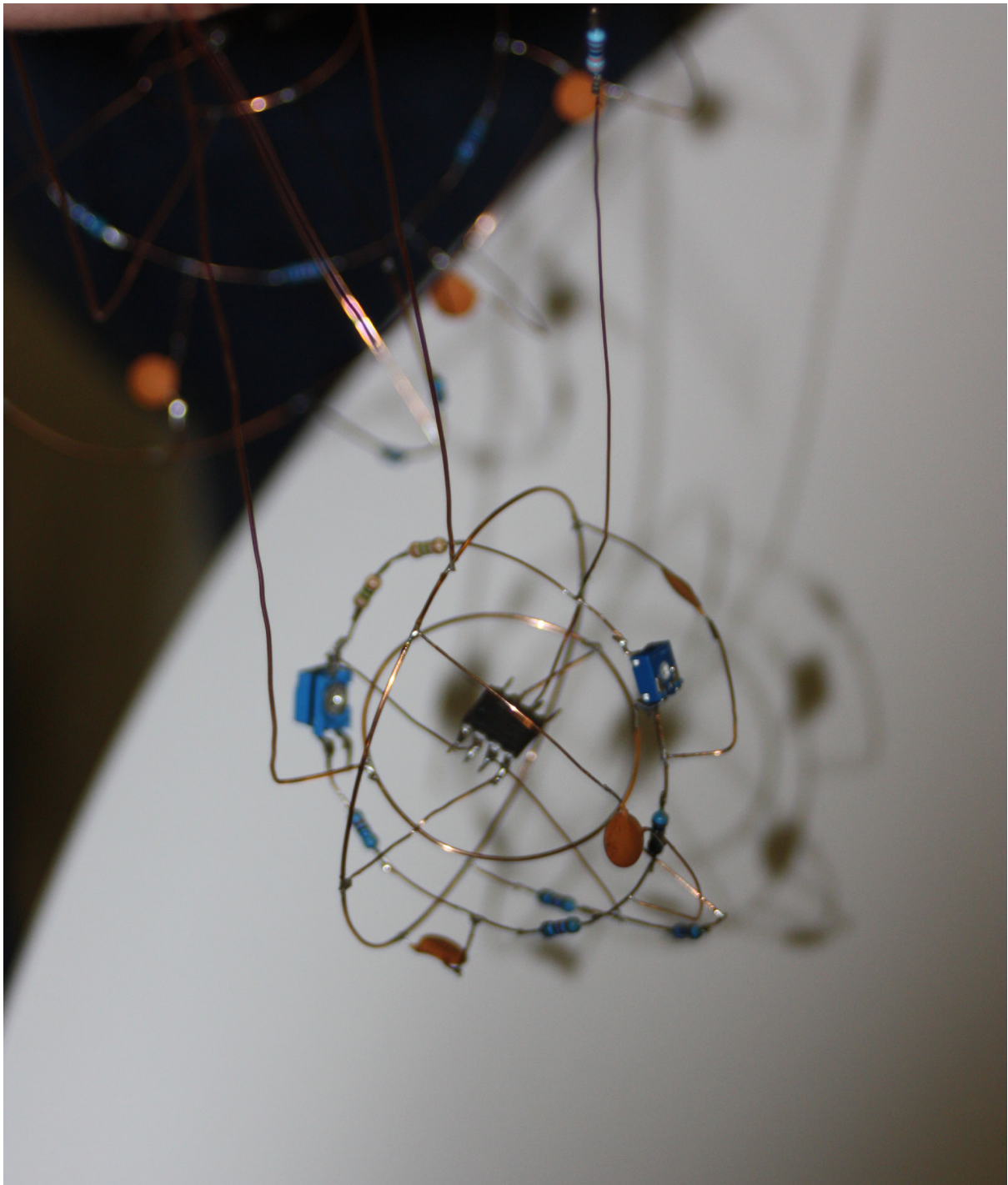
Figure 29. The unnecessary features were stripped leaving the circuit supporting itself, as a functional 3D electronic sculpture with no non-functional components.
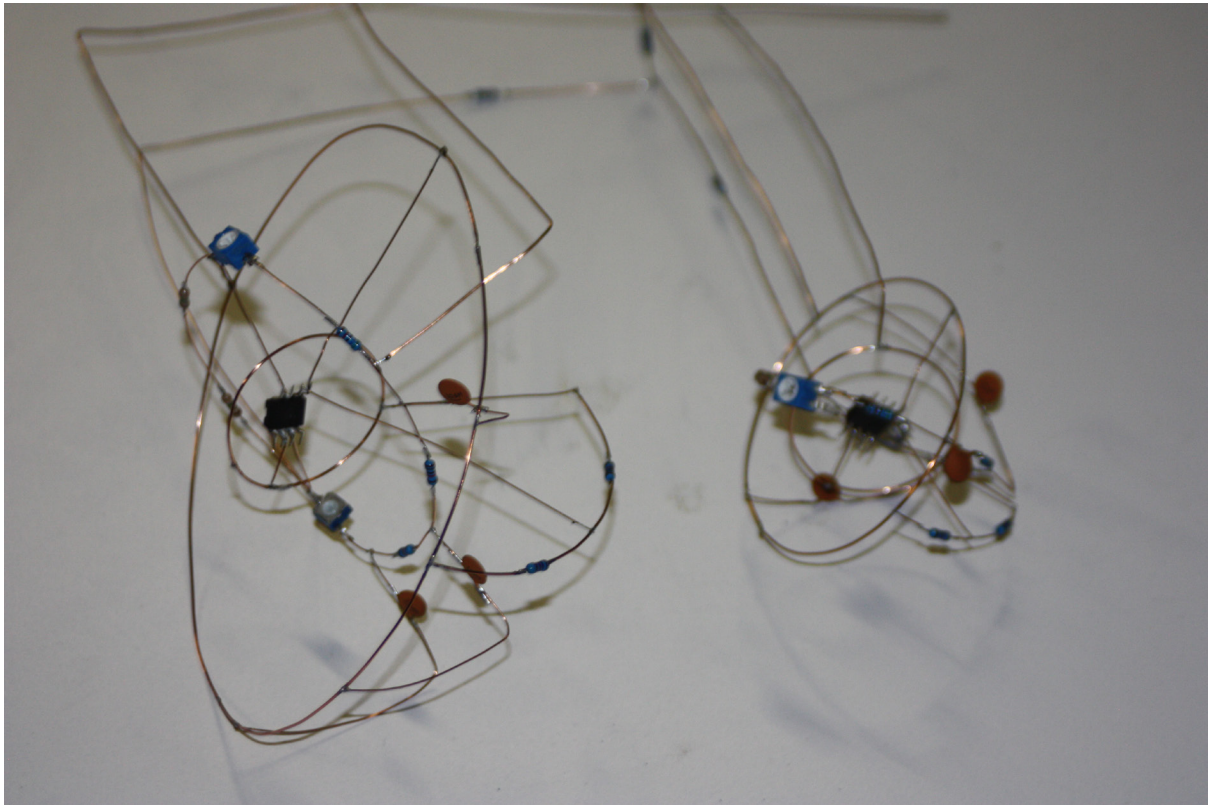
Figure 30. A second unit was added and they were combined to create a waveform comprised of two tones instead of one. The form is now more natural, and the artifact now places more visual emphasis on the human craft within the circuits. The removal of the sand aspect now makes the human labour the primary visual element, whilst the audio generated by the sculpture now sings alongside this as the generative output.
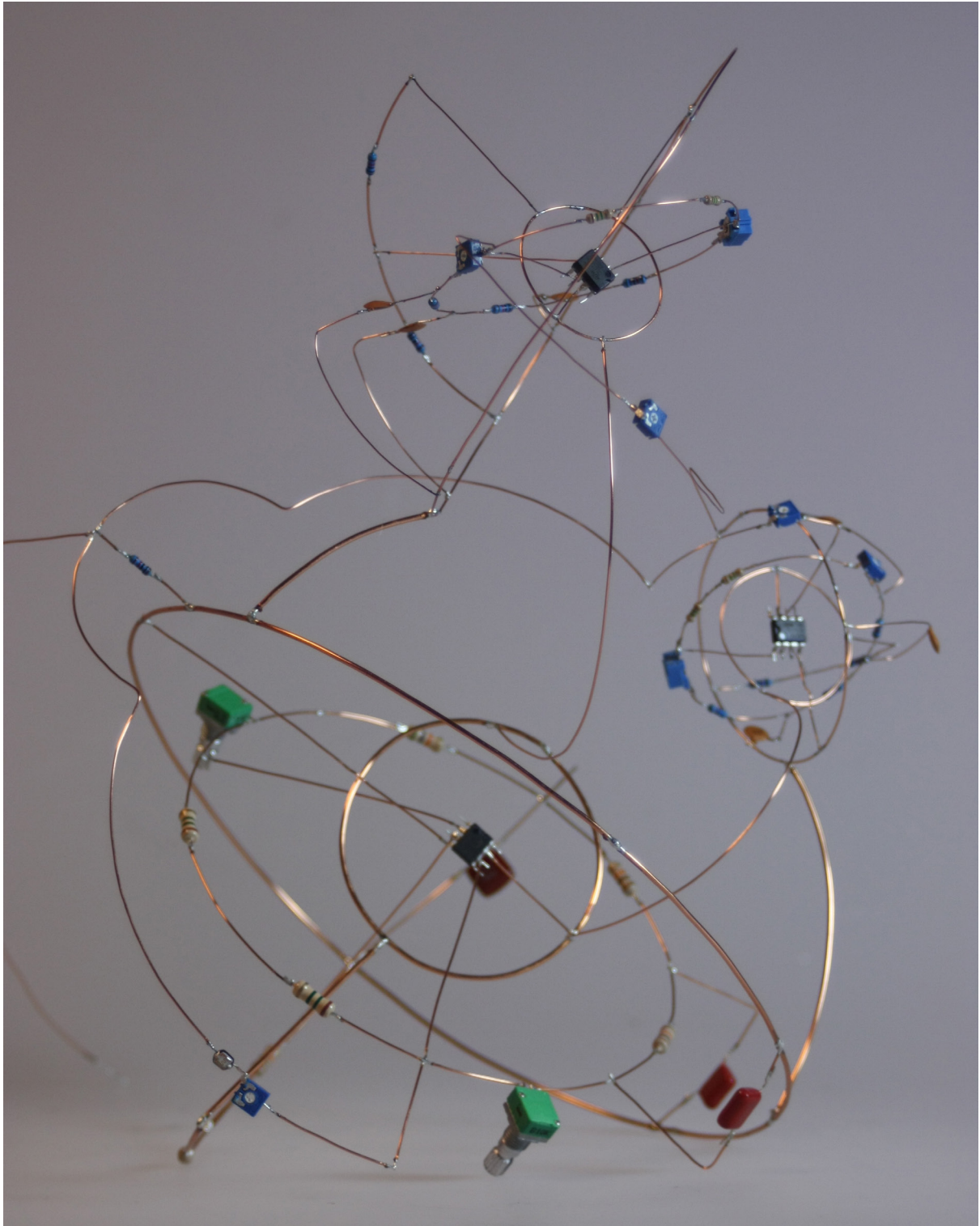
Figure 31. A third oscillator was added and they were combined into a tunable harmonic generator. Their connections reference constellations either at a planetary or molecular scale.
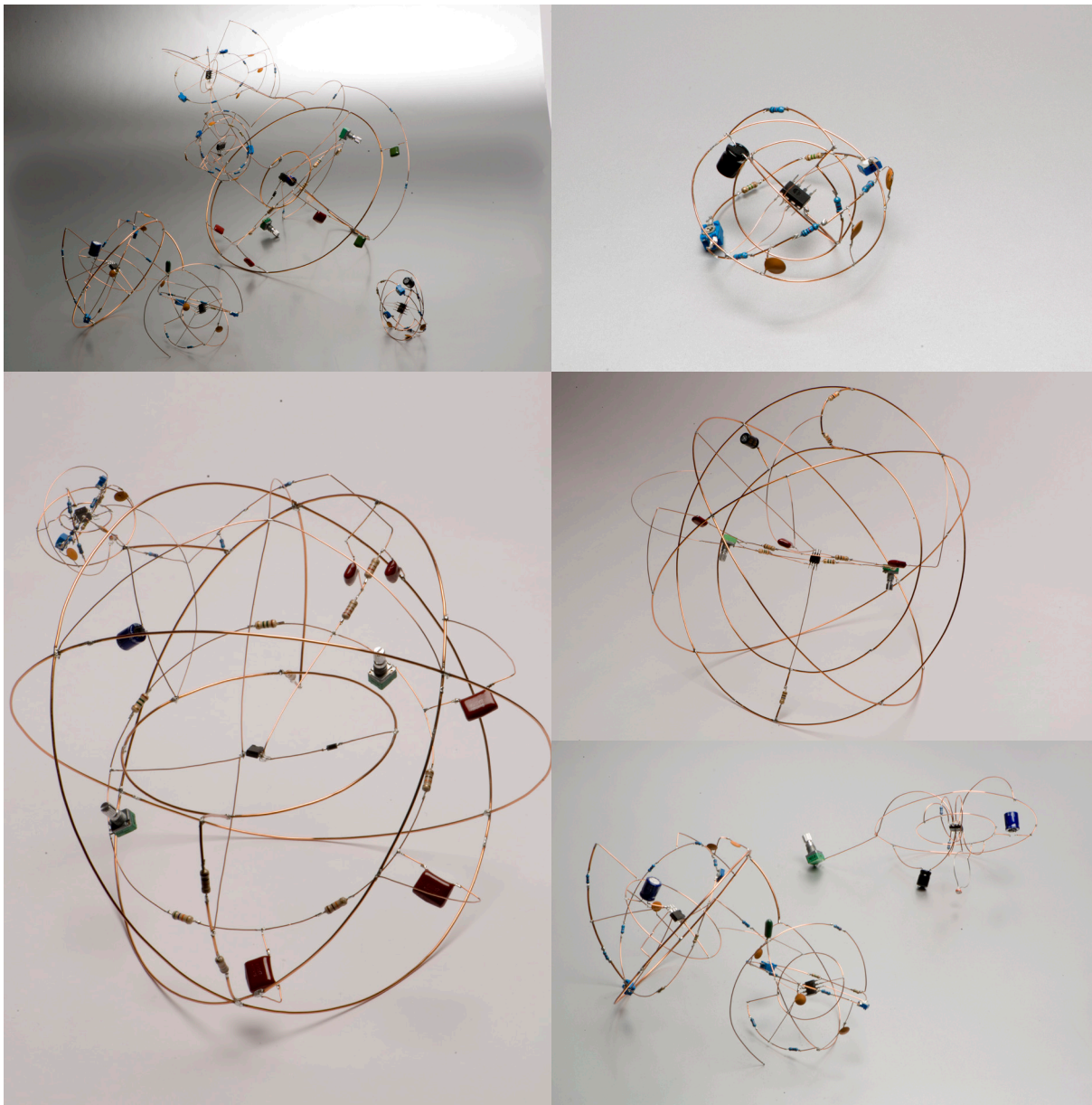
Figure 32. A total of twelve harmonic generators are created from 28 oscillators.

these vary in size from roughly 4cm - 60cm in diameter. They are combined, with

other units, into a single circuit that functions as a soundscape generator.
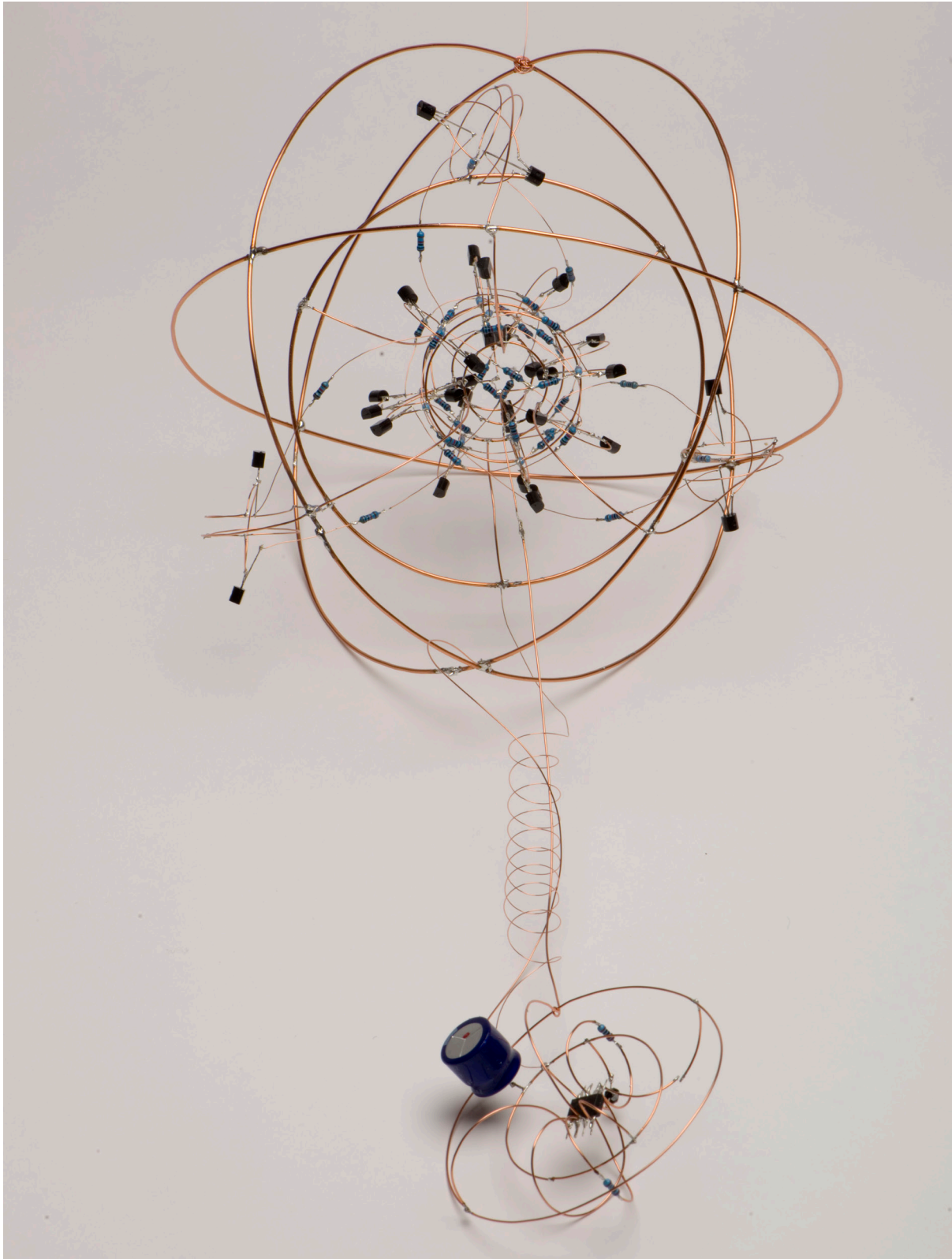
Figure 33. Several control circuits are needed to activate and deactivate different oscillators. This is a decade counter connected to a square wave generator.
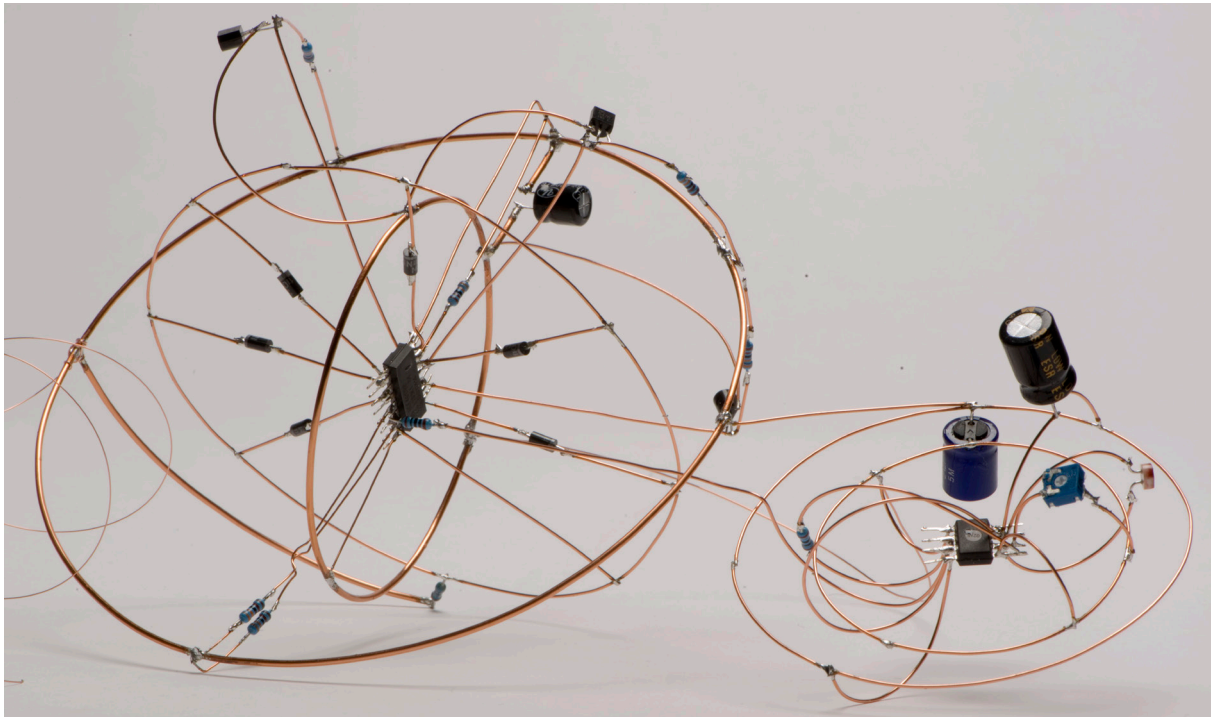
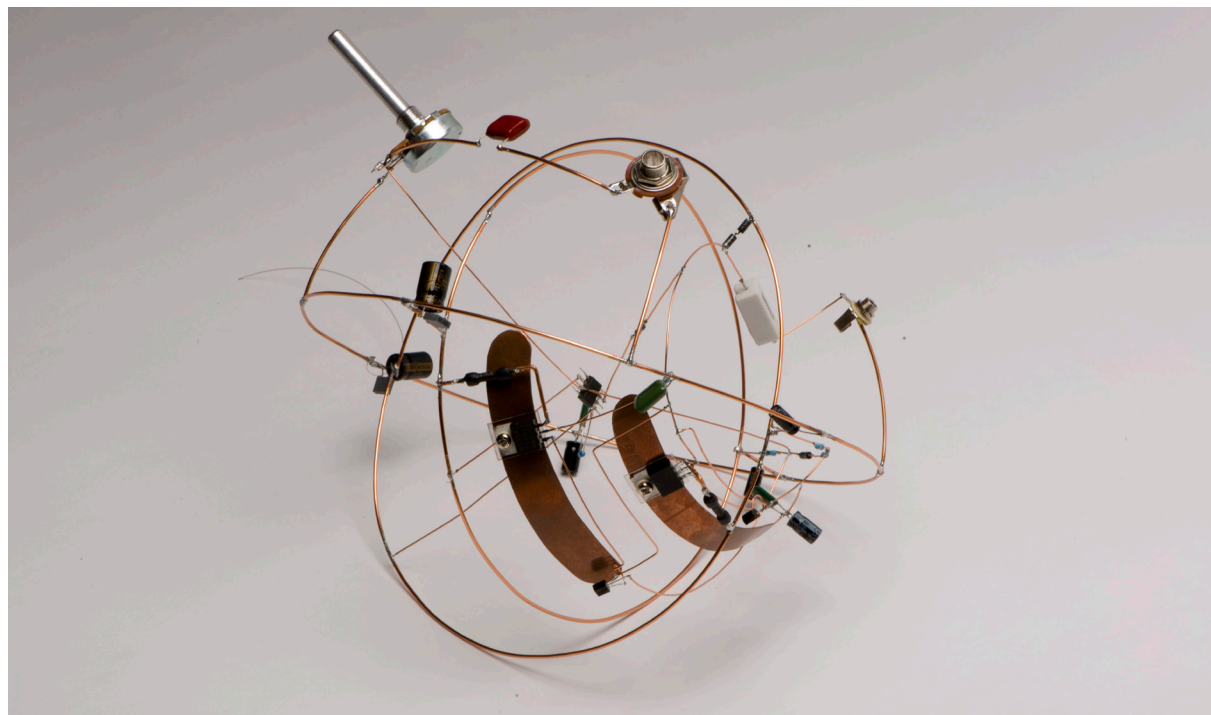Figure 34. A second decade counter made with an integrated chip.

Figure 35. This is an 18 Watt amplifier. The oscillators need to be amplified in order

to to be audible. The output of the entire soundscape is fed to this amplifier which

then feeds into a speaker.

Figure 36. All of these units are then wired together and hung in a room creating an interactive generative soundscape. The final piece visually presents human craft and effort, whilst simultaneously celebrating the system of a generative work through the all encompassing soundscape. The separation of the audio and visual aspects of the work helps to differentiate these two aspects (the human behind the machine, and the generative process itself) and have them work simultaneously together.

The signal mandala is a universe of space and sound, human effort and automated system.

Figure 38. The Signal Mandala, close up of an harmonic oscillator.
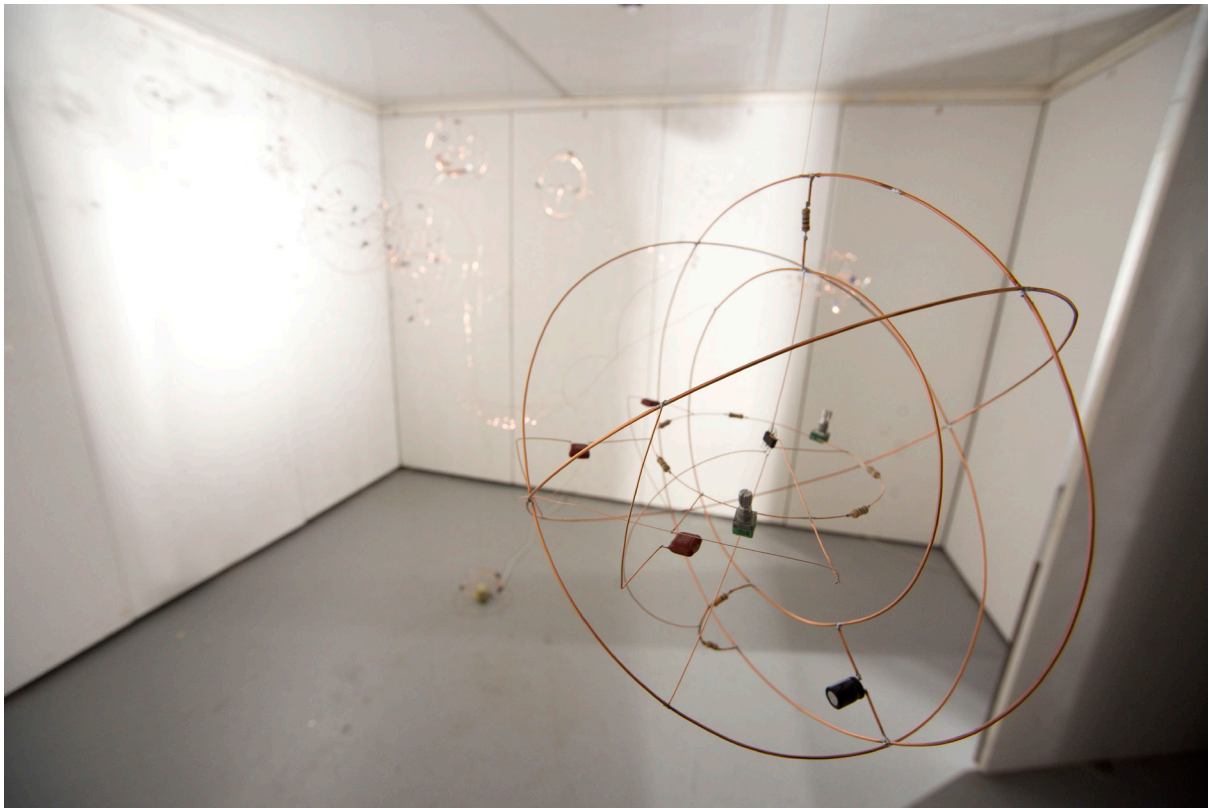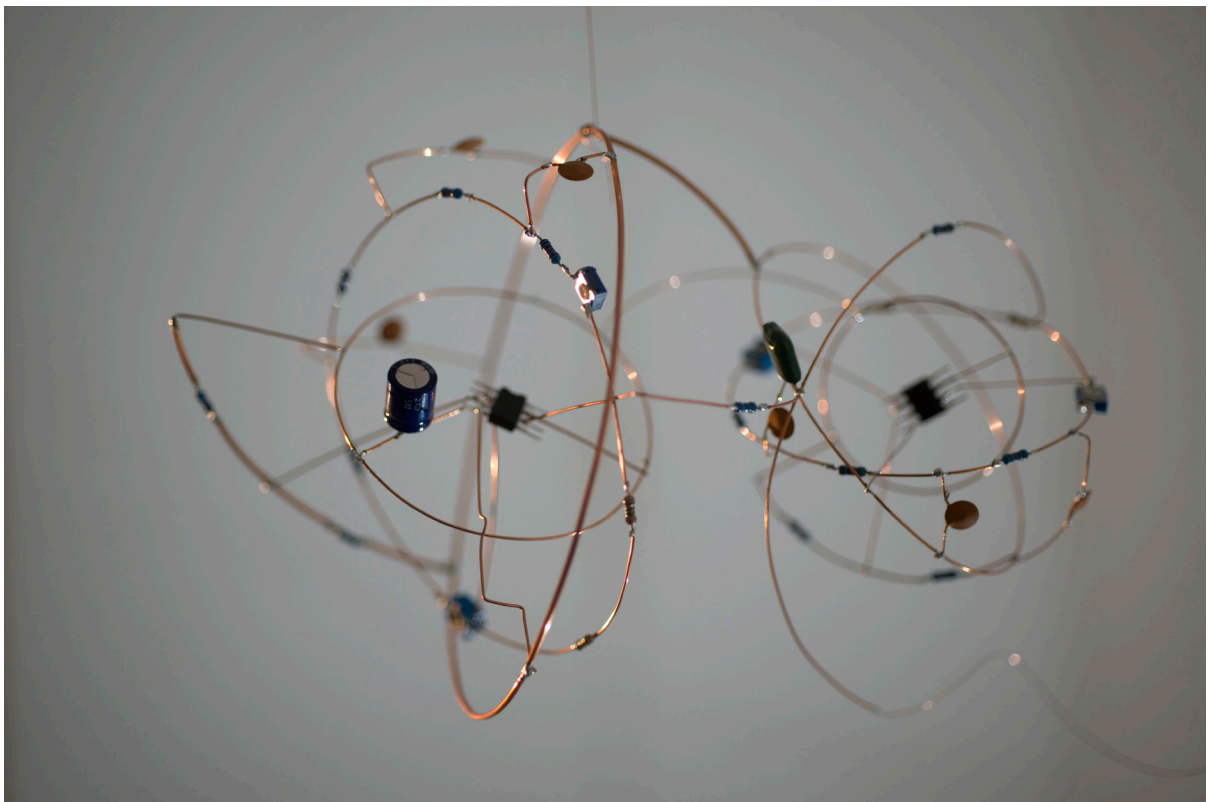
Figure 39. The Signal Mandala.

Figure 40. The Signal Mandala.

Figure 41. Finished statue of Avalokiteshvara, the Buddha of compassion, in place

on a temple shrine.

7. Conclusion

Concluding thoughts and trajectory

This Chapter presents my concluding thoughts and trajectory, along with some explanation and images of my current work in a Buddhist art studio.

7.1 Current work in a Buddhist art studio

The Signal Mandala and a subsequent trip to a Buddhist center and temple in the UK has lead to an opportunity to work in a Buddhist art studio that produces Buddhist statues and images for use in temples and centres around the world. This studio uses various digital techniques (digital modelling and 3D printing) combined with physical techniques such as mould making, casting, painting and so forth. Currently I work both digitally and physically, learning the techniques and practises involved in making Buddhist imagery. This is furthering my understanding of both the philosophy and production of Buddhist art.

With the following work (and images) I am only a small part of a much bigger team and can not claim the work as my own. I have a hand in most aspects of production from digital sculpting through to mould making and finishing. The purpose of presenting this work is to propose a trajectory that will lead to further more qualified Buddhist artwork (both generative and non-generative, digital and physical work). A series of images and brief explanation of some of the processes involved follow.

Figure 42. This is a render of Je Tsongkhapa. The smaller (3 foot) statues produced

In the Kadampa art studio are digitally sculpted and then 3D printed in many parts.

The printed parts are then glued together, reinforced, painted with car body paint,

and extensively sanded to a very fine finish. After this a mould is made from the

3D printed original. This is then used to produce casts that are made of a modified

gypsum plaster and fiberglass laminate. These are given a fine finish before they are

painted with car body paint, gold mica paint for the skin, and finally hand painted with

acrylic paints.

This process, although using digital techniques and 3D printing is still ex-

treemely labour intensive, with each statue taking several weeks of finishing before

being hand painted. The hand painting also takes several weeks as it is done with

many very thin layers of acrylic paint to achieve a smooth finish. The combination of

digital techniques (albeit software art, not generative art) and manual labour creates

very refined artifacts that are simultaniously digitally perfect in form, but very human

in finish.

Figure 44. 3D print of a Buddha statue ready for a mould to be made. This was print-

ed in many pieces which were fastened together, painted, and extensively sanded.

Figure 45. Plaster laminate casts ready for weeks worth of sanding and hole filling.

Figure 46. Finished statue of Buddha Shakyamuni.

Figure 46. Finished statue of Green Tara. The digital aspects lend toward extreemely refined details, whilst the hand finishing makes the result more human.

7.2 Concluding thoughts

The projects presented here are the starting point of my continuing exploration of a generative practice based on the non-materialist philosophy of Tibetan Buddhism. This philosophical view, combined with the desire to overcome some of the specific difficulties of generative art has led to a focus on human experiences as the subject for generative exploration.

The projects presented, "Mantra" and "the signal mandala", attempt to explore human experience in different ways, the former through visually codifying direct meditative experience, and the latter by integrating human craft seamlessly into a generative system. The result of basing these works on Tibetan Buddhist philosophy and symbolism is that, not only do they more honestly present the artist behind the machine, they are also less arbitrary in their creation process and decision making than previous projects undertaken.

This work as well as my current continuing work producing Buddhist statues sets a trajectory for more computational generative projects. Future explorations will seek to delve further into the highly symbolic aspects of Tibetan Buddhist practise. This I hope will lead to artifacts that harness the highly flexible nature of computing to convey some personal experiential meaning. From a non-materialist position, this seems like a logical method to avoid letting loose arbitrary digital spectacles upon the world.

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