Creating an Interactive Music Diffusion System

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Declaration

The thesis comprises only original work towards the Master of Music (Jazz & Improvisation).

Due acknowledgement has been made in the text to all other material used.

The thesis does not exceed the maximum word limit in length (exclusive of tables, maps, bibliographies and appendices).

James Wilkinson
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Abstract

In this study I take a phenomenological approach to music composition, improvisation and sound system design. I apply the writing of author Shoshana Zuboff’s The Age of Surveillance Capitalism to formulate an approach to composition and interactive design. I test whether it is possible to convert themes of Zuboff’s book into an interactive work of art which is relevant. I apply my research to the creation of an interactive sound installation based upon a Behavioural Value Reinvestment Cycle model. I explain my personal epoche, an interactive camera system, electro-acoustic music diffusion designs, audio software, and detail the development of the interactive music diffusion system design. I include descriptions of my compositions with accompanying sound recordings. A total of twelve compositions have been created for the purposes of this research. The music creation applies two approaches termed as either surveillance or conscious music. Surveillance music is composed by incorporating a camera for interactive outcomes. Conscious music compositions are works created in response to researching surveillance capitalism. To conclude I review and summarise my phenomenological experience and findings.
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1. **Introduction**

“When we look to the digital future there is one anxiety from which all others derive: What kind of home will it be? Will we be masters in a community of masters, or some-thing else - guests, fugitives, or perhaps unwitting slaves subdued by interests beyond our influence or understanding? If the digital future is to be our home, then it is we who must make it so”

- Zuboff

This study takes a phenomenological approach to researching, planning and producing ideas for an interactive sound installation. I employ software, composition, improvisation and audio system design, infusing them with ideas gleaned from Shoshanna Zuboff’s book The Age of Surveillance Capitalism, as a means to creating an interactive sound installation.

I reflect upon my life experience and research to establish a sound installation design for the performance of my compositions. The design details the components and environment this multi-speaker diffusion system is intended to be staged within. This study is the product of my research in music and audio production, it is intended to be a practical assessment of the elements which have combined to plan this work of art, and the foundation for staging it in future.

The music is created by two separate approaches, the first selects information gleaned from Zuboff’s writing, and applies it to music composition using a process I will call surveillance music, of which the music is composed using an interactive camera. The second approach is termed conscious music and is applied to music compositions which are written in

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2 Zuboff, *The Age of Surveillance Capitalism*.
3 The term conscious music refers to my own awareness to the choices made when composing music, and is specific to this research. The term is applied to limit observation to my processes. To broaden this term to include other theories of music creation is deemed beyond the scope of this thesis.
response to researching surveillance capitalism; it is essentially music from the heart. Both approaches use audio software to perform and diffuse the music through a multi-speaker sound system. Controlling the interactive performance is a camera which detects motion and triggers sound events via software. Any mention of a camera in this study refers to the interactive camera device. Central to the design of this interactive device is the exploration of behavioural modification through participants' interaction with the installation. Detailed explanations of the compositions, camera mechanism and sound system design are explained later in this study.

I am seeking to apply this research process to test whether it is possible to convert the themes of Zuboff’s book into a work of interactive art.

2. Methodology

2.1 Epoche

The research conducted for this study is phenomenological and draws upon Clark Moustakas’ Phenomenological Research Methods\textsuperscript{4} as the research model. Moustakas writes, “in accordance with phenomenological principals, scientific investigation is valid when the knowledge sought is arrived at through descriptions that make possible an understanding of the meanings and essences of experience.\textsuperscript{5} Moustakas’ approach refers to a state of personal transparency called the “Epoche”\textsuperscript{6}, he describes it as “a way of genuine looking that precedes reflectiveness, the making of judgements, or reaching conclusions. We suspend everything which

\textsuperscript{4} Moustakas, Phenomenological Research Methods.
\textsuperscript{5} Moustakas, 84.
\textsuperscript{6} The spelling of “epoche” (instead of “epoch”) is applied in order to acknowledge Moustakas’ own use of the word.
This neutral approach seeks to enter into a philosophical view which is personally authentic, to establish a relationship with experience which interrogates the “essential nature and meaning of things”. In applying this method I am seeking to bring clarity to the artform I engage with, namely music and audio production, and progress towards experiences and expressions which embody the results of this methodology. The thesis combines referenced published research and phenomenological experience to establish findings and accompanying music compositions.

2.2 Biographical Antecedent

In applying a phenomenological approach to this research I will now describe an event I consider an Epoche moment and describe how this experience changed how it changed my view of life and society.

At 5.54am on the 27th May 2006 I was lying awake in a second storey hotel room, located in the eastern quarter of Yogyakarta city, Indonesia. I lay with my hands on my stomach, clasped together, staring at the ceiling. Out of this calmness I vividly remember the moment when all my senses behaved in a sudden and unexpected way, it was genuinely a new experience. I would describe this moment as a slowing down of time, a slow motion unfolding of successive events that redefined my own perceived experience of time. It was, as it passed, the closest I have come to death and knowing my place in the universe.

As my hands started to vibrate on my stomach I wasn’t sure what was happening. Then, as the amplitude of the vibrations ramped up and the building shook in a deafening roar, I

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7 Moustakas, 86.
8 Moustakas, 87.
realized it was an earthquake. My first thought was hope, I hoped the earthquake wasn’t caused by Mount Merapi, a nearby volcano which is also Indonesia’s most active. A vision of the ground opening up and me falling into a pit of molten lava appeared vividly in my mind.

The hotel, a sturdy 3 storey building, shook violently as it was thrown upwards from the ground, only to quickly slam back downward again. As it bounced up and down it also shook violently from side to side. The building shook with such rage it felt like being transported on a truck, on a corrugated road with no suspension. The contents of the room had been thrown to the floor and bounced around in a sympathetic dance. My mind, working in slow motion, told me to get out of the building. I ran to the door and opened it to see a world filled with vibration, my eyes struggling to comprehend what was taking place before me. In this moment I witnessed several large hotel buildings crumble, razed to the ground in an instant. As this took place my mind took the time to observe that reassuringly the earth wasn’t opening up into a volcanic pit of molten lava and, considering everything else that was happening, that it was good news.

A hail of terracotta roof tiles rained down in front of me, while a large heavy marble pot stand danced back and forth on the landing. There was no escaping the room without injury so I leapt into the bathroom doorway and clung on for my life. Amongst this chaos I realized my work colleague, who was sharing the room with me, was sat frozen in his bed. He had awoken in shock to a world unravelling around him. I shouted through the din for him to join me.

We stood there clinging to the door frame as the building bucked, snapping back and forth, up and down; it seemed it would never stop. In this moment of danger I wanted more than anything to live, it was not something I reflected upon, it was imbued in my thoughts, my actions, and it was something I consciously recognised amidst it all. It was an Epoche moment,
my life in danger and the moment framed by a distinct personal transparency. In this moment I saw myself objectively, I truly wanted to stay alive and live beyond this experience. I saw in myself something new, something which I had assumed but not considered, it was a recognition I wanted to live, and how important that was to me. In facing death I did everything I could to save my life, and it was with great metacognition that this realisation was made apparent.

The personal transparency I came to reflect upon through experiencing this natural disaster is what I acknowledge as Moustakas’ Epoche state, where the intensity of my experience in surviving this earthquake was so new and overwhelming that it brought to bear an authentic metastate. I observed in my own will to live an authentic state of being, and in that moment a phenomena that “precedes reflectiveness, making of judgements, or reaching conclusions”\(^9\)

In recognising my earthquake induced Epoche state, I also acknowledge that this was a deeply traumatic experience. I do not suggest that people should experience such trauma as a way of approaching phenomenological research or want to experience the event ever again, but as an individual reflecting upon what took place, this phenomenological moment is personally significant to acknowledge the Epoche state, and what it brought to bear on my relationship with life itself.

The earthquake changed life for many in the community of Yogyakarta and surrounding villages. The United Nations World Health Organization stated at the time that “5,000 people died and several thousand were injured, including some 1,500 very seriously” and about “200,000 people are displaced from their homes”\(^10\) In the aftermath I saw the dead and injured rushed to hospitals overflowing with casualties, people trapped under buildings, mass panic and

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\(^9\) Moustakas, 86.

\(^10\) “UN Health Agency Rushes Aid to Quake-Struck Parts of Indonesia.”
heard stories of criminal gangs roaming the city looting as they went. In witnessing an earthquake I also witnessed its aftermath. The natural disaster tipped the society of Yogyakarta into dysfunction, chaos and disorder, and within it I witnessed the fragility of the human mind, as people became panicked, fearful and hysterical. I witnessed amidst the chaos of people’s actions the fragility of society and the collective consciousness which bonds it. In acknowledging this fragility I now find myself questioning the current digital milieu, and the impact of surveillance capitalism on our society. I am aware that, just as I experienced in the earthquake, there is little I can do but witness society change around me, but amongst it I am seeking to situate my experience within myself and to test Zuboff’s model of surveillance capitalism, in order to gain knowledge and conduct what I consider necessary and timely research.

3. Contextual Lens

3.1 Improvisation

When I reflect on my own relationship with improvisation, I find it difficult to align with any specific idiom of music. I am not a jazz musician, nor am I a free jazz musician, I have performed both but neither idiom is what I would identify with at this time in my life. Musician and author Derick Bailey describes his definition as such, “I have used the terms ‘idiomatic’ and ‘non-idiomatic’ to describe the main forms of improvisation. Idiomatic improvisation, much the most widely used, is mainly concerned with the expression of an idiom - such as jazz, flamenco or baroque - and takes its identity and motivation from that idiom”11. I therefore say my current

identity aligns with musique concrete and electronic music production, and improvising is an approach I use within those idioms, as my interest leads me.

For this research project I am committed to including improvisation as part of the performance criteria. The role of the audience is to interact and contribute to the musical materials. Improvisation is key to the design, music composition and operation of this sound installation are discussed in the following chapters.

3.2 Surveillance Capitalism

This research paper is concerned with creating music studies using compositional processes derived from or inspired by surveillance capitalism. As a phenomenological research process, Zuboff’s *The Age of Surveillance Capitalism* is applied as a means to provoke new ideas and explore ways of music making which are new and significant for my personal development as an artist.

Zuboff is the Charles Edward Wilson Professor Emerita at Harvard Business School and author of The Age of Surveillance Capitalism. Surveillance capitalism is a term coined by Zuboff to describe the digital revolution logic, which she states “begins with unilaterally claiming private human experience as free raw material for production and sales. It wants your walk in the park, online browsing and communications, hunt for a parking space, voice at the breakfast table … These experiences are translated into behavioural data. Some of this data may be applied to product or service improvements, and the rest is valued for its predictive power. These flows of predictive data are fed into computational products that predict human
behaviour.” Zuboff’s work has become central to current discussions regarding the effect of this newer form of capitalism on global society. It has inspired me to incorporate ideas surrounding the collection and application of behavioural data, as the foundations for devising and creating an interactive sound installation. This design applies her critique of surveillance capitalism to create, control and perform music compositions.

This installation is benign, it is not intelligent, it does not learn, store or collect information, it has only a set of processes which respond to different stimuli. It is not as complex or intelligent as the systems which govern the global digital milieu, nor does it intend to be. Its purpose is to mimic a mass surveillance logic, and in doing so create music.

The foundation of this installation’s interactive design is based upon a process called the Behavioural Re-Investment Cycle. This cycle was devised by Google to improve their search engine results and targeted advertising. The process takes the behavioural data gleaned from an individual's interaction with the system, analyzes it and then renders it back to the user to improve the delivery of service. Google takes this process further by collecting data exhaust to further refine the data set. For the purposes of the interactive sound system design, I have devised my own adaptation to Google’s system, whereby the audience (the users) have their movement sensed by a camera (behavioural data), and the results of this interaction rendered into sound (service improvements). As the audience interacts with the system there is an audible response which they then respond to or not, and so the cycle goes (see figure one). More interaction is likely to initialize more sound events, less interaction is likely to result in less sound events. The audience may be encouraged through their experience to interact by being

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12 Zuboff, “It’s Not That We’ve Failed to Rein in Facebook and Google. We’ve Not Even Tried | Shoshana Zuboff.”
13 Zuboff, 70.
more active, or being still, they may decide to leave the installation, but however they interact the system will always respond. Sound may modulate, move around the space, change in loudness, tempo or style, there may be long periods of silence, all dependent on interaction. Entry into the performance space establishes a relationship with the audience and sound installation which is intended to modify behaviour.

![Musical Value Reinvestment Cycle](image)

Figure 1. Musical Value Reinvestment Cycle

Zuboff identifies surveillance capitalism as “a global system of behaviour modification” where global technology companies such as Google, Facebook, Apple and Amazon (who Zuboff refers to as the “Big Other”), engage in the mining of an individual's behavioural activity, by collecting interactions online. Key words, spelling, dwell times, location, health data, social

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14This illustration is a reinterpretation of the *Behavioural Value Re-Investment Cycle*. Zuboff, 70.
networks, online purchases and any other data points deemed applicable are applied by these companies to piece together an individual’s behavioural code.

I am seeking through the process of this research to understand the processes of surveillance capitalism’s behavioural modification systems. I am seeking means to inform an approach by which to create music and perform it using an interactive multi-speaker sound installation. I will create mechanisms inspired by surveillance capitalism logic, and apply them to design a sound system for performing interactive compositions. The work is to be impartial, it will not seek to pass judgement on the processes it identifies. This research seeks to understand and employ these processes to the art of making music. It does seek to find reason, it is conceived as a conduit to express ideas in music by way of logic born from Zuboff’s writing.

Zuboff identifies how the collection of personal data by surveillance capitalists is applied to predict or modify behaviour, to capture the user in the *Behavioural Re-Investment Cycle*. The design of this sound installation therefore seeks to reorientate our relationship to this technology, and by doing so acknowledges its’ ability to influence our behaviour. By entering the installation participants are asked to consider, by way of paraphrasing Zuboff, can we be the masters of information or will we be its slaves? Or in the case of this installation, will we be the masters of music or its slaves? (the word slaves is used here to describe peoples’ excessive dependence on technology, and as a provocation to those who enter).

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3.3 The Camera

Camera technology has been developed for the purposes of this research and any reference made to a camera is referring to this technology. Any use of the camera as research was undertaken alone and did not include any participants. Nobody was photographed, nor were any images used or stored. The camera used is the built-in camera of a Macbook Pro\textsuperscript{16}. The author is the sole participant in this research and the camera signal is used only to stimulate music software. There is no recording or saving of images at any time as part of this research, nor is there intended to be.

The metaphor of using a surveillance camera and researching surveillance capitalism is intentional, in the case of these musical works ever being used in a public performance or installation, the camera is central to providing a functional role and visual metaphor for surveillance capitalism. Shoshanna Zuboff writes “surveillance capitalism is not a technology, it is a logic that imbues technology and imubes it into action.\textsuperscript{17}” I will imbue the installation with a logic derived from the principals of surveillance capitalism with interactive capabilities made possible through the lens of these cameras.

The camera’s primary purpose is to aid audience interaction with the installation. I see the camera’s primary purpose as one which facilitates improvisation. Derick Bailey recognised that “Improvisation enjoys the curious distinction of being the most widely practiced of all music activities and the least acknowledged and understood…..Improvisation is always changing and adjusting, never fixed, too elusive for analysis and precise description; essentially non-academic”

\textsuperscript{16} A set-up using a Sony security camera interfaced via a Blackmagic Intensity to capture video was tested by Casey Rice for the development of the software, and is intended to be developed as part of ongoing research.

\textsuperscript{17} Zuboff, The Age of Surveillance Capitalism., 15
I am applying this logic to the installation and embracing a symbiotic relationship between the sound system and audience, facilitated by the camera.

The video camera is used to register movement and stimulate software. The software used with the camera is integrated to interface with other audio software. The camera aids in the generation of musical events. The camera feeds a signal of varying intensity to the software MAX, which interprets this visual input. MAX acts as an intermediary, interfacing to audio programs via MIDI.

Music has been created by interfacing with the camera. No public performance was made as part of the research process using the camera, the works were recorded and produced in isolation as a way of testing the methods of this research.

The research has only implemented one camera, it is intended with continued research the number of cameras and their ways of interacting with software are expanded to include more complex adaptations of the technology. The technology in this model is applied only to the creation of pitch and rhythmic related control, it is intended that the diversity of this control to include velocity, sustain, modulation and a multitude of other music related MIDI control, will be addressed with ongoing development.

The surveillance camera is used to collect and respond to different visual stimuli created by the audience. Participants' movement inside the installation will trigger compositional outcomes which they will then hear amplified through the sound system. A camera or suite of cameras will register the presence of people and interpret their movement for the production of music, termed the musical value reinvestment cycle.

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The role of an individual or group to stimulate the processes of music making may or may not be an explicit relationship, it will depend on the musical material. All Interaction may potentially be incorporated as a process, but how that will transpire are dependent on the compositional framework.

The camera and audience relationship is subject to a process whereby human movement is rendered into sound and reinvested as sound for the user to experience. The audience’s interaction is repurposed for the production of music, it is repurposed for the profit of the musical value system. The installation therefore relies on reinvestment to create more content, without it, it will fall silent.

3.4 Musical works

Compositions created from this research are born of two approaches, one is literal, seeking compositional ideas drawn from the processes of surveillance capitalism. The second is a response with intuition, to compose by reflecting upon phenomenological experience and in response to the themes of research.

The compositions are studies, they have been created for the purposes of this research paper. The compositions, whose detailed descriptions will follow later in this study, employ an approach which is either attributable to music concrete or diatonic music. All compositions employ some element of improvisation in their creation or performance. A composition which has the potential to evolve over a longer period of time (more than 10 minutes) is presented as a recorded extract, compositions with a shorter standard musical form are presented in full. The compositions are primarily proof of concept and provide the foundations to establish the
approach and content for this interactive sound installation. It is expected that a more comprehensive suite of compositions are to be created with future research.

As stated earlier, compositions created using the camera do so by responding to human movement. Movement in front of the camera was employed to elicit a response, it was not intentionally applied with a sense of musicianship. Any music with multiple camera sources was created by layering individual recorded events together in a multi track audio session, as there was only one camera in use at any time. The examples of this process are intended to show the musical potential of this interactive device and in doing so the potential for expanding its content and design through further development.

Central to the use of a camera to interact with the music software is integrating improvisation into the performance of the work. Movement within the camera frame influences the music pitch and rhythmic content and cues samples and aleatoric processes. By including the movement of individuals into the performance of the music, it is possible to vary a composition's form, pitch, tempo, modulation, rhythm, dynamics and other musical attributes.

This research topic has been chosen to explore ideas as they apply to music composition and performance. There is an informed creative response to Zuboff’s *The Age of Surveillance Capitalism* which is applied to provide a context for new work. I have purposefully narrowed the focus of this research to investigate Zuboff’s The Age of Surveillance Capitalism and to contain it within that reference.
4. Software

4.1 Max Patch

As part of this research, the development and implementation of a music interface system was undertaken. A video camera was chosen as an interface, it is used both as a metaphor for surveillance and as a practical interactive device. There are devices available for controlling software interactively using ultrasonics, infrared or PIR sensors, and build kits made by companies such as Arduino and Raspberry Pi. I chose not to follow further inquiry into these devices after consulting with Casey Rice, as his experience with Max/Jitter software convinced me this was a viable approach for developing an interactive software and camera system. The modular design of Max/Jitter software enables the building of a specific patch for use and integration with other software, and to be adapted as needed. The integration of a camera allows the use of any web cam or other camera device to be incorporated and negates the use of any proprietary hardware.

A simple description of the camera and Max software interface is as a movement sensor. If movement is detected the camera software triggers sounds which are then heard in the performance space. Sounds are initiated through the use of a video camera, and the playback or manipulation of audio is achieved using auxiliary software (Live or Qlab). Max/Jitter interpolates visual data into Musical Instrument Digital Instrument (MIDI) coordinates, it does so by referencing the mass of image pixels and any variation from frame to frame. The Max patch (see figure two) was created by Casey Rice, it tracks changes in pixel intensity. When pixel intensity rises above or falls below the “video trigger threshold”, a MIDI note is triggered. Sensitivity is set by the user to define the point at which the program will respond, and can be
adjusted as needed. The triggered notes are confined to 88 semitonal intervals and are selectable to allow different scalic combinations. The selection of intervals from one note to the next is random, effectively letting the software improvise its own progression through an established scale. A total of 8 presets are used to save settings and these can be recalled as needed. The MIDI values generated can be assigned to any desired end point such as a synthesizer, sampler or any device with MIDI input capabilities. For this research the camera interacts with MAX and through MIDI to Ableton Live.

Figure 2. The camera Max patch

To aid in more complex possibilities for input stimuli, the main camera image is divided by MAX into a matrix of sixteen windows (see figure three). Each one of these windows is a unique segment and can be assigned its own unique parameters. There is the facility for sixteen separate camera feeds from individual sources. For the purposes of this research, only one
camera module was used for the creation of music. It is intended that looking beyond this research process multiple cameras are applied to expand upon the ideas and outcomes explored in this study.

![Matrix of windows showing movement registering as intensity](image)

**Figure 3.** Matrix of windows showing movement registering as intensity

The MAX patch allows pitch, velocity and sustain to be varied, their application affects the software’s sensitivity to stimulus from the camera. The settings in MAX are changed when there is a need to adapt to variations in the amount of light, movement, contrast and other variables. Compositions utilize a different setting to aid the musical outcomes of each work, and an exploratory approach is taken by the composer when setting these parameters (see figure four). The intention with each composition is to establish software settings that respond in a way which is deemed an appropriate musical response. I have used my own sense of musical judgement in this case. Trial and error is used to determine how the camera responds in each situation, this a subjective process in which I have engaged to produce settings that bring about a desired outcome.
The application of this software in conjunction with the camera has been applied to compositions as part of this research paper, they are identified as surveillance music in their descriptions. This software facilitates the application of an interactive device (the camera) to compose music by way of randomized selection of prescribed intervals. It is intended that this software is applied to improvise music by interacting with the audience, and by doing so creates a unique performance each time.

This proposed model for the creation of a large scale installation would potentially see the incorporation of twelve or more cameras. These additional cameras would require further development of the software to facilitate their interaction, and this research could include more than the simple triggering of audio related MIDI events. The software also has the potential to be applied to lighting, video and other MIDI assignable devices, which would increase the interactive capabilities of the installation. To summarise, the development of this software is progressing and continues to be developed.
4.2 Ableton Live

Ableton Live software integrates synthesis, sampling and other music production features. It is used in this research as a means of music generation, using sound samples or softsynths, triggered in response to MIDI cues sent from MAX. Live has many features which aid in the manipulation and generation of sound. MIDI can be applied to control a multitude of parameters within the application (of which I am still engaged in finding new ways of applying to music making).

For this project Live is primarily used in two ways. Firstly Live is set to respond to MIDI input from the video camera, via the Max patch, to trigger components such as sound samples or the notes of a synthesizer, and these interactions are amplified as an interactive performance. The second approach is to create a list of “clips” which consist of either sampled audio or MIDI notes, set to interact with each other randomly. This approach is aleatoric, the clip cycles through its content and then randomly moves to another clip within the stack. Recordings of these processes too can allow the ability to review, edit, manipulate and add additional ideas to create a more elaborate composition built upon the original performance.

The plug-in called Sampler was used to control playback of sounds, and applied to manipulate pitch, time, amplitude and other parameters. Synthesized sounds were primarily created using soft-synths produced by Arturia, emulations of analogue synthesizers made by companies such as Yamaha, Korg, Oberheim and Moog. More detailed explanations of their application are described further when reviewing each composition.
4.3 Qlab

Qlab is a software program designed to playback cues. Qlab can be applied to cue audio, video and lighting. Cues for this installation are intended to be triggered using this software as a type of central command, and also to matrix audio within it. Cues are triggered manually, in interaction with other cues, via MIDI or set to a specific time. These cueing options allow for the building of a music music matrix which can influence in predictable and unpredictable ways. It is possible to build cues with Qlab which follow an aleatoric process. A Qlab session can be designed to cue and respond to cues with random or interactive variability. The implementation of this software is intended to allow the application of variable content from performance to performance, to be able to reorder musical elements by aleatoric process. This program affords another software application with the potential for improvised outcomes. Qlab will add aleatoric complexity to cueing audio files, midi and other sources. Qlab controls the global content of the installation, routing of sound and interaction with other software.

4.4 ProTools

ProTools is audio production software designed for music creation and sound production. It has been applied to this project to compose more conventional forms of music, which I have termed *conscious music*. These musical pieces, inspired by ideas formed from researching surveillance capitalism, suit the more traditional approach of music composition this software promotes.

Compositions made in this software were recorded and added to as multi-track sessions, in the same way most conventional music production is conceived currently. Performances were
edited and revised to create layered performances, which when combined together give the effect of a singular performance. These pieces were made with a focus on the timbre and overall sonic quality of the music, I find this is well supported when making music in ProTools due to the sonic quality of the software. This music software affords an environment to hone a particular sound quality and is suited to recording, editing and mixing of music performances.

This software was not used to interact with the camera. All the ProTools audio mixes accompanying this study were exported as stereo files. It is intended that the diffusion of works made with ProTools would take place in the installation, by separating elements out into individual tracks or stems (mixes of groups of instruments) and playing them as files in Ableton Live or Qlab.

5. Music Diffusion

The staging of this work is to take place in public as an installation using a multi-speaker array to spatialize sound within an acoustic space. The design of this system draws upon established designs and art practice in order to devise a large scale work. This chapter will assess established designs, and reflect on my own work to propose a design inspired by these examples.

Commonly the composer of the electroacoustic work occupies a central position within the audience and orchestrates the spatialization of the composition as part of the live performance. The execution of these spatialization events predominantly takes place by way of stereo playback, fed into an audio mixer which matrixes audio to the various loudspeakers. The mixer is used performatively to vary intensity to each loudspeaker or can also use a codec to diffuse the source material within a digitally rendered sonic 3-D environment. Diffusion of
electroacoustic music adds to the process of amplification by engaging the listener in a reactant multi-dimensional sound world. At the centre of this sound world is the composer, at the helm, conducting the orchestra of speakers. The role of the composer in this central position as artist and condutor, when witnessed, is a compelling creative process for the audience to experience first hand.

As part of this research I am seeking to design systems which suit the practical and creative purposes of the work. The tradition of having a composer sit central limits the options for design, as it removes central seating for the audience, typically the best listening position in the house. I am seeking to dethrone the composer and remove them from this central position of focus, and establish a performance where there is no stage, no beginning, end or interval, and it is unclear as to who is the author or how the installation is produced. I am investigating a way of producing an installation which functions as a machine of processes designed to respond to behaviour. Movement within the space will playback sound and also determine how some sounds are specialized. The interaction of the participants will create a symbiotic relationship whereby the installation will respond to interaction and the audience respond in turn to what they experience.

I am focused on the playback being amplified by multiple transducers and their arrangement in the environment provoking an immersive experience. I am choosing not to use modern technical developments which could be employed to spatialize sound using ambisonic software or the use of mobile phones.

Historically spatialization has been used in acoustic music to localize sound beyond the constraints of the ensemble, venue or acoustic. Composers apply spatialization in performance to
localize sound in different ways such as the distribution of instruments on stage, a procession or venturing beyond the confines of the venue. Spatialization can also be used for effect or elicit a metaphorical relationship too, for example, the programmatic tone poem of Richard Strauss’s An Alpine Symphony (1915), in which brass instruments are heard offstage to evoke a distant party of hunters processing by.\(^{19}\) Electroacoustic music uses spatialization through the application of multi-speaker arrays to allow the composer to interpret the performance and diffuse it as the audience bears witness. Several loudspeaker pairs make up a polyvalent generator of space, time and timbre. The loudspeakers are no longer loudspeakers, columns, boundary markers, or objects of reproduction. They have become instruments, interactive elements in the diffusion-interpretation electroacoustic instrument\(^ {20}\).

5.1 Acousmonium

A significant influence upon my art practice is the work of Pierre Schaeffer who, with Pierre Henry and other composers, established the genre of musique concrète in 1948. The composer Francis Dhomont in his 1995 article Acousmatic Update, describes musique concrète as “an art practice whereby sonic materials are worked on directly by the composer. This original compositional method begins with the concrete (pure sound matter) and proceeds towards the abstract (musical structures) –hence the name musique concrète – in reverse of what takes place in instrumental writing, where one starts with concepts (abstract) and ends with a performance (concrete)\(^ {21}\). Central to this ideology is the act of acousmatics as without a spatialized

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\(^{20}\) Clozier, "Composition, Diffusion/Interpretation in Electroacoustic," 17.

\(^{21}\) Dhomont, Francis, "Acousmatic Update," 1.
performance a musique concrète composition remains essentially unrealized. A composer’s application of a multi-speaker or acousmatic system to diffuse sound in performance allows the audience to bear witness to them working with “pure sound matter”, as they sculpt and evolve it into living “musical structures” This notion of the work unfolding, being fully realized in performance is of particular interest to me, as is the design and application of the sound system as the musical apparatus.

Francis Bayle created in 1974 an “orchestra of loudspeakers” on which to perform two channel (stereo) compositions using various types of loudspeakers which he called the Acousmonium, an orchestra of loudspeakers arranged in front of, around and within the concert audience.\(^2^2\) In total it consists of eighty loudspeakers of various sizes placed across a stage at different heights and distances from the proscenium\(^2^3\).The composer is positioned centrally and performs using a mixing console, spatializing sounds to one or more speakers (usually grouped in pairs). Key to this design is incorporating a diversity of loudspeaker designs which have varying attributes relating to their frequency response, dispersion and loudness. The choice of speaker type and position allows a variety of timbral and localization possibilities to the composer. A diversity of loudspeaker designs are used to diversify timbral variation available in performance. Position too is important to harness spatial and perspective variation. Although loudspeakers are positioned in front of and around the audience, this design retains a frontal emphasis.

In designing an acousmatic system for diffusing music the choice of loudspeaker is of great importance. In the same way a symphony orchestra is composed of different instruments of

\(^2^3\) Chadabe, Electric Sound: The Past and Promise of Electronic Music, 68.
varying shapes, sizes and materials, we see similar roles too for loudspeakers in multiple speaker systems. Music ensembles make use of a diversity of instruments designed to perform well within a particular pitch range and timbre, and by doing so provides the potential for a composer to choose from a greater palette of sounds within the ensemble. A similar approach can be taken when choosing loudspeakers, and this is evident in the design of the Acousmonium. The loudspeaker orchestra comprises different parts or sections, the differences promote timbral attributes to add to the rendering of a composition in performance. Acknowledging that this is the case, I am taking a different approach to the application of varying loudspeaker designs, and instead will use loudspeakers of similar design, the reasons and details of which are discussed later in this study.

5.2 BEAST

Influential to my own research and practice is the University of Birmingham’s BEAST (Birmingham ElectroAcoustic Sound Theatre), founded by Jonty Harrison in 1982, a design of which they are capable of mounting systems of sizes in excess of 100 loudspeakers (circa 80 is typical), each addressable as a discrete channel.\(^\text{24}\) The tenet of their design is a group of loudspeakers consisting of the “main eight” Loudspeakers are grouped into 4 pairs, described as the Main, Wide, Distant and Rear.\(^\text{25}\) BEAST designs have a practical emphasis on coverage to ensure that “holes” are removed by speaker combinations with consideration to the acoustic space. Larger or smaller venues are adapted to with more or less numbers of speakers as needed, which allows for the design to adapt to the venue. Harrison states “Of course, not all of these

\(^{24}\) Wilson and Harrison, “Rethinking the BEAST: Recent Developments in Multichannel Composition at Birmingham ElectroAcoustic Sound Theatre,” 2.

speaker locations are likely to be necessary, not are they the only ones possible - it depends entirely on the nature, character and sound of the performance space - but it would be wrong to assume that small halls necessarily require fewer speakers (in a 100-seater hall in Birmingham we use 28 channels)”. Their design is adaptable and offers variations in response to the venue.

Beyond the main eight, are solutions to aid in dispersion within a space, by employing combinations of speakers such front, rear and side fills and arrays suspended above the audience as a canopy facing downward. This approach of using an identified main group with individual speakers in support is appealing, it adds diversity of options and seeks to support unity between transitioning between different speaker sets. The overhead canopy and the use of main pairs is designed so that “dramatic effect can be perceived by everyone”

5.3 Discreet Eight

The University of Illinois at Urbana-Champaign, under the direction of Scott Wyatt have researched utilizing multi-channel sound systems for performance and developed resources examining various systems. Their Discrete Eight System was applied to researching three designs using eight loudspeakers. Three designs were investigated, the first favours “mono sources to be panned from one loudspeaker to the next”, the second is “one designed to more effectively present stereo images to an audience” and the third “allows for maintaining and moving stereo images from front to back, while also allowing for panning of mono signals in a circular fashion”.

I have had similar results through my own research and experimentation, some of which are

28 Harrison, 5.
27 Harrison, 5.
28 Harrison, 4.
detailed later in this study. I consider the third of these designs to be the most appropriate for the sound system I am designing, and will explain this in detail later in this study.

5.4 Foundation

I am drawing upon the established elements and approaches of the Acousmonium, BEAST and Discreet Eight as foundations for my own design. While not ignoring other practitioners or technical designs, I am choosing to narrow the focus of this study to include examples which are representative of my own interest and reflective of my own arts practice.

This installation design is intended to remove the composer from the performance of the work, and to also free up the central listening position for the audience. It will playback automatically, pre-programmed using computer software and interact with people moving within the performance space. There is no seating, simply an open space for people to congregate. The duration is intended to be flexible and evolving, derived in part by a predetermined structuring of sound events combined with movement triggered events and aleatoric processes.

As we see from the examples of the Acousmonium, BEAST and Discreet Eight, traditionally a spacialization performance includes witnessing the composer engaged in a manual extension of the composition process. We witness the final creative act of a composer realizing their composition in the performance space. This approach places the composer centrally and with seating emphasizes a forward facing perspective of front, sides and back. The design for this installation does not seek the same outcomes, it is instead conceived to hide the process of composition and remove the composer from the frame of performance. The work is to be spatialized in isolation, completed by choices made before the time of performance. The
audience will witness a performance which is automated, with the ability to respond to audience interaction. The design provides a non-dominant perspective to the audience, one which is less formalised as to where to stand or sit, or what plane is of primary focus. Through self-discovery and listening it is intended that each listener will find an appropriate place and way of hearing and interacting within the space. Their interaction will make them a composer of the music, to influence the content with their movement, and the spatialization by their location within the installation.

I provide the following examples of my work, all of which were designed for different applications. They have been selected to show a range of different design ideas and rationale. I will explain their development, application and then reflect on how they may be revised and adapted for the purposes of this research paper.

I am drawing upon my own experience designing, installing and producing multi-speaker sound systems for the purposes of this project. I will give examples of my previous work to investigate what elements are relevant to the staging of this new work, and refer to other established sound system designs. Common to my work is the use of multiple loudspeakers to amplify and diffuse sound in different environments for artistic and commercial projects. These designs are created without the intent of applying psychoacoustic software and is not a focus of this study. Psychoacoustics is an element which has not been chosen as something to investigate or employ in this current process. The reason for this choice is because my interest is in using loudspeakers in combination with one another and experimenting with their relationship to the listener and the acoustic space. As this proposed model employs diffusing audio through loudspeakers and not the use of software to create psycho-acoustic effects, the selection and
positioning of loudspeakers are included to justify this line of enquiry. This application of a multi-channel sound system is not necessarily the most contemporary use of technology, there are many commercial systems available, for example the Dolby Digital 5.1 system. I am instead making a choice to follow a line of investigation without the use of proprietary software or hardware. In describing my work, some of the key points will explain the design concerns, which are the localization of sound image, the audience’s distance to the work, the physical and perceived acoustic space, and the type and number of loudspeakers. This sound diffusion system is devised for the performance of my own compositions, it is therefore not intended to be on for which other composers prepare for and perform their work with, unlike for example the Acousmonium.

Perception of space is achieved by loudspeaker placement to allow sounds to be amplified at varying distances from the audience. Recordings will exhibit a sense of space if they are recorded in an environment and this will vary between recordings. Synthesized sounds may have no ambient character and require the adding of artificial ambience to contrive a sense of environmental space. All sounds amplified will have the opportunity to be modified in their perceived ambience or spatial distance, with the use of reverberation or other time based effects to emulate acoustic settings, alter the localization of sounds and for creative effect. Sounds may have ambience added to infer a sense of space beyond the perceived source by placing reverberation in loudspeakers which are for example, behind the listeners forward orientation. There is currently no confirmed venue for this design, any acoustic space in which it is installed will have a unique reverberative quality which will affect perception of the sound system.
The sound system is designed to transduce frequency between 20Hz and 20kHz, the full range of human hearing. The specifics of the system are described in more detail later, but a series of loudspeakers from the manufacturer d&b is specified which will adequately reproduce any variation in pitch as is inherent in the content.

The sound system will have the ability to vary intensity from the threshold of hearing (0dB) to the threshold of pain (120dB) and reproduce musical dynamics with accuracy. The experience within the installation is expected to be dynamic, at times active, loud and overwhelming and at other times silent, still and subdued. The design is intended to reproduce the dynamic qualities of the recorded music and variation in intensity without adding a perceivable amount of system noise. Loudspeaker and amplifier choice affects dynamic reproduction and the choice of loudspeaker system is in part to ensure the accurate reproduction of dynamic events.

Timbral qualities of a sound system are inherent in the technical components and their interaction with each other and the acoustic space they inhabit. A d&b system has been chosen as their loudspeakers and amplifiers are high fidelity and produce a timbre which is complementary to the intended application of this installation. By combining the same manufacturer’s loudspeakers it is the intent that timbre unity is sustained across all loudspeakers, allowing for an evenness of reproduction regardless of listening position. To be considered also is the application of multiple loudspeakers and how they interact with one another in the acoustic space. Loudspeakers interact when combining two or more, by way of their transduction of high and low air pressure. The effects of the interactions of sound pressure can create issues, such as standing waves, destructive interference, comb filtering and others which directly affect timbral
qualities. Consideration has been made to seek an evenness in perception of timbre for all listening positions by ensuring all loudspeakers are combining positively, and this is explained in more detail in a later chapter. Any variation in timbre is achieved in performance with the use of equalization (EQ) to filter specific to a frequency or band of frequencies. This approach to timbre differs from the Acousmonium’s application of an orchestra of multiple loudspeaker variants, which are employed as a significant contributing source to timbral variation. By standardising the selection of loudspeakers I am instead working to achieve an evenness of timbral quality through the components and then apply any changes to timbre by filtering frequency.

6. Case Studies

6.1 Curtis Roads

In October 2012 I worked with Curtis Roads from University of California Santa Barbara designing and installing a acousmatic sound system for his performance at LASALLE College of the Arts Singapore. At the concert he performed his own compositions with visuals by Brian O’Reilly. A nineteen speaker system was used to diffuse his stereo (two channel) recordings, played back from a computer. Roads performed the diffusion of the pieces live and did so using a mixing console. The placement of loudspeakers was done in collaboration with Roads, the type and number of loudspeakers was governed by what was available in LASALLES’ equipment store. The speakers were a collection of L-Acoustics 108p, 112p and d&b Max12 and Q-subwoofers (see figure 3). All the speakers used, excluding the subwoofers, were a coaxial design, which places two drivers together on the same axis, so that sound originates from the
same source point and this in theory maintains better phase coherence than other designs.\textsuperscript{30} Coaxial loudspeaker designs are usually associated with a more neutral tone colour, good clarity and an even frequency response across their axis. As long as they are not driven too loud they work very well for this type of application. This speaker design suited this performance as the combination of multiple speakers and their interaction is paramount to effectively diffusing the music within the space. The loudspeakers had good clarity, wide dispersion and varied in tone colour, all of which aided transitions between speaker arrays, and in doing so added timbral contrast which allowed Roads a greater range of tonal palettes to choose from.

The loudspeaker positions were made with reference to established BEAST designs\textsuperscript{31}, and positioned on stands according to the design and then moved around to finetune the placement once set up. All speaker positions were measured in reference to the mixing console’s central position and to each other, in order to establish phase coherence. The configuration was seventeen loudspeakers for mid and high frequency, two low frequency subwoofers (17.2) divided into groups of eight pairs for control, with a separate mono send for the subwoofers (see figure five). The console was utilized to send sound to individual speakers, grouped together to allow Roads to diffuse his composition in the space. This speaker design borrowed ideas from BEAST systems which helped provide a sense of perspective, and to allow control of sound to move, for example, from foreground to background, or pan from left to right. The audience sat in the middle of the loudspeaker array as Roads responded in situ from a central position. This design worked successfully for Roads and he was very happy with the results, but my concerns

\textsuperscript{30} Borwick, 474.
\textsuperscript{31} Harrison, “Diffusion: Theories and Practices, with Particular Reference to the BEAST System.”
for the limitations of this system were that the central position is the best for experiencing the full effect of specialization, and any position which moves from the center eschews the experience.

Figure 5. Placement of loudspeakers for Curtis Roads concert

6.2 Sally Smart

In July 2018 I collaborated with David Franzke to design and install a sound system for the artist Sally Smart, whose work “The Emerald Lady” was permanently installed in the atrium at Melbourne Central shopping centre. A four speaker array was designed and hung to provide music and ambient effects for the sculpture and accompanying light show. Shoppers who pass by on the separate levels of the surrounding walkways are able to view the sculpture, from many angles. Loudspeakers were placed to direct sound towards listening positions located on the adjacent levels (see figure six). Playback of music and sound effects is with QLab software,
which plays back audio files and lighting cues in repeating sequence. A timer stops and starts the sculpture daily.

Four K-Array Anaconda loudspeakers were hung either side of the sculpture which hangs in an atrium (see figure four), extending downwards over several levels. Music and sound effects were created for the installation. Every half an hour the sculpture exhibits a sound and light show which builds from an ambient interlude into a crescendo of lights and sound. The crescendo section performs the same musical piece each time, while the ambient interlude randomly selects a collection of sound effects to promote variation throughout the day.

Design concerns were primarily that sound would permeate through the mall into shops, and disturb customers and staff. Directional loudspeakers and low volume were applied to negate issues around sound dispersing into the atrium. The listening environment is challenging depending on how much human traffic is progressing through the area, given that the surrounds are all hard reflective surfaces (steel, glass and stone).

I took from this project that gaining attention and focus of people within a chaotic and reflective environment is difficult. For this thesis it is therefore planned that the proposed installation is installed in a separated space and not intended to be housed within a mixed use venue.
Figure 6. Sound system design for Sally Smart’s Emerald Lady

6.3 Yarra Bend

From October 2017 until February 2019 I worked in collaboration with David Franzke for developers Glenvill, creating a display suite sound installation for the Yarra Bend housing development in Melbourne. The brief was to provide a sound system for the courtyard to play back sounds of nature amongst the confines of a garden courtyard. The developer was looking to mask the construction directly behind the hoardings, as well as add ambience to the garden as potential buyers walked through. The installation was designed in 3 sectors, the garden, water feature and walls (see figure seven). The garden bed and water course housed transducers sunken in the ground, and the boundary hoarding used outer mounted transducers to amplify the
The sixteen speakers used were Dayton Audio HDN-8 weatherproof transducers, fed audio from a computer and multi-channel amplifiers housed in the building. These transducers differ from conventional designs as they couple to a solid surface, in this case wood. The base has a screw installed and you simply drill a pilot hole and secure. Once attached each panel vibrates in sympathy with the transducer, effectively turning the surface area of the panel into a loudspeaker and rendering the speakers invisible.

Hidden from view these sixteen transducers allow sound to permeate the space from the walls and underbrush. 70 local bird species and other environmental sounds were collected by us and then diffused in the environment. QLab software was employed to cue the audio files randomly and also control a sounds’ position within the installation. Stereo and mono files were used, with the separate 16 channels allowing these sounds to be sent to one or more transducers. It is possible to create a general atmosphere to be used across all loudspeakers simultaneously, panning sounds to create the illusion of movement, or simply localise the sound to a singular speaker. Birds appear to fly past, a brook babbles, frogs croak, blackbirds fossicking in the brush - the effect in situ is very convincing.

As this is a semi-permanent installation for up to five years, open to the public for nine hours a day, seven days a week, it was essential to include random variation in the soundtrack. Hearing a kookaburra call at twelve noon every day was not desirable, we needed to devise a process to ensure a more natural sounding performance, one that is randomised to avoid unnatural regularly repeating patterns. We worked to concoct a cueing system which allowed sounds to playback in random sequence. Eleven groups were created in Qlab, using a total of hundred and seventeen audio files. Qlab randomly selects within these groups a file, plays it and
then follows on to the next group, continuing the process. Multiple groups are active at any given
time, creating a bed layer of atmosphere recordings which are overlaid with bird calls, insects
and other animal sounds. The process is fully automated and starts and stops itself each day.

This project proved successful for a number of reasons. Standing in the courtyard the
sounds have a realism which is quite believable. The Dayton Audio transducers are limited in
their ability to produce extended high frequency (above 5kHz) and low frequency (below
200Hz), which is problematic if your content is music and wanting to hear frequencies which add
clarity (high frequency) and impact (low frequency). As the content here is of birds singing,
water bubbling, crickets chirping and other natural sounds, the limitations of the speakers' high
fidelity adds a character which is beneficial. High frequency attenuation is audible when sound
travels over distances greater than 15m, due to air absorption. The reduced high frequency has
the effect here of setting the nature sounds into the background, the sounds are not muffled but
they are less directional. Sounds coming from the walls are particularly convincing and appear to
emanate from beyond the confines of the surrounding structure. As the transducer is coupled
with the wall sound radiates in a broader pattern across a large surface area than conventional
horn and driver designs. As a acousmatic element, the transducers have a quality which is
timbrally dull and directionally diffuse, and provides a good option for inclusion in an array
when looking for a transducer which is able to push the perceived sense of environment beyond
the limitations of a physical space.

32 Spiousas et al., “Sound Spectrum Influences Auditory Distance Perception of Sound Sources Located
in a Room Environment,” 1.
This project employed Qlab’s randomising cueing features, field recordings and diffusion within the environment, and inspired the integration of similar design elements into the design of this study’s installation design.

![Sound system design for Glenvill’s Yarra Bend courtyard](image)

Figure 7. Sound system design for Glenvill’s Yarra Bend courtyard

### 6.4 Time:Space

Advances in audio technology have produced a proliferation of computer-based networking, automation and processing, and when combined with loudspeaker design and amplification they offer new possibilities to advance the experience of a live diffusion system. The components contribute greatly to the sonic nature of the system by influencing the effect of diffusion in the environment. There is a range of psychoacoustic software products available
which can be used to create realistic forms of localization within the soundstage, developers include IRCAM, GRM and a range of open source variants. This software is highly effective in producing a sense of ambience beyond the confines of a traditional loudspeaker system, it can offer multi-speaker localization and a range of room acoustics from 2 or more speakers. I have some experience with psychoacoustic software having worked with Dirk Stromberg at LASALLE College of the Arts, Singapore, to create a 24.1 channel diffusion system in October 2014.

This sound system was designed with three arrays of loudspeakers, which the audience were situated around and within. Performers stood central, within the array and the audience was free to move through the space throughout the performance. The outer circle of loudspeakers (L-Acoustic 108p) faced inwards, while the central cluster (L-Acoustic 112P) was directed outwards. The central array (d&b E8) faced downwards, suspended above the audience (see figure eight). Dirk Stromberg wrote software for the synthesis and psychoacoustic effects.

The outcomes of this design were witnessing the potential of a diffusion system which surrounds the audience, and one which they may move freely within.
6.5 The Design

“Surveillance capitalists work hard to camouflage their purpose as they master the uses of intrumentarian power to shape our behavior while evading our awareness.”\(^{33}\) - Zuboff

I have designed a large installation based around a dodecagon. The installation shape is a twelve-sided polygon with two rings of twelve loudspeakers facing inwards. Central to this array are four downward facing loudspeakers called Clouds, which are suspended around two centrally located subwoofers. The design comprises 28.2 loudspeakers (twenty eight loudspeakers and two subwoofers) which are all independant and can be used separately or in varying combinations with one another.

The arrays circling the audience are hidden behind fabric, there is no technology visible except for cameras mounted above the audience looking downwards. The fabric is a scrim which will appear opaque. The scrim is thin as to not inhibit the transfer of sound through and allows the possibility of having lights or projected images set upon it. There is a sign as you enter which reads “will we be the masters of music or its slaves?”

Lighting effects and visual media are not my expertise and are to be decided as part of consultation with experts in the field, they are therefore not investigated in this proposed model. It is of interest that a visual component be included but for the purposes of this research the installation is assumed to be a well lit, vacant space of twelve meters in diameter within which the audience can move freely.

The dodecagon design evokes Jeremy Bentham's panopticon. Bentham’s “all seeing” prison design places a hidden guard centrally, with the cells of prisoners surrounding, facing inward. The guard, facing outward, can observe the inmate in their cell at any time. This relationship, with a guard who may or may not be watching, is supposed to impose a process of behaviour modification. Prisoners, knowing they can be observed at any time, are supposed to manage their own behaviour, by way of fearing punishment from an all seeing guard. Michel Foucault writes of the application of Closed Circuit Television (CCTV) and speed cameras in modern society as similar mechanisms of control.34 Zuboff furthers these observations as to how the current digital milieu is designed to create a closed loop, whereby nobody is out of sight, and nobody can exit the imposed conditions.35 In entering the installation this audience will never be

34 Foucault, Discipline and Punish : The Birth of the Prison.
35 Zuboff, The Age of Surveillance Capitalism, 471.
out of sight of the cameras, and their presence will stimulate the device to engage in further
behaviour modification through sound in a reinvestment cycle.

If we are to confront the social issues of surveillance capitalism, we first have to identify
them, to see and confront them. We have to be able to identify the parts of the system so we may
see the whole picture. This installation seeks to bring awareness to some of these parts so that the
audience may reflect how their life, their social media, work, travel, money, nature and anything
else they engage with are part of the digital milieu.

This installation provokes by asking the audience to question “will we be the masters of
music or its slaves?” I ask this question because I see the installation they are entering into as a
panopticon inverted. As the collective guard gathers in the central position, they have somewhat
unwittingly become the watched, the prisoners, observed and subject to behavioural modification
by the mechanisms of surveillance capitalism. Zuboff describes this as a bloodless coup from
above, one which threatens society to modify the behaviour of the population for commercial
interests. I saw in Indonesia an earthquake that shook the society of Yogyakarta apart in only
sixty seconds, I recognise currently society is being shaken in slow motion by a new
technological paradigm. I recognise surveillance capitalism is shaking the foundations of society,
and we are in the phenomenological process of witnessing a social earthquake. I ask the
participants by entering this installation to stand in the centre of the panopticon, the behavioural
value reinvestment cycle, the sound installation. By entering into this installation I challenge
them to be active, engaged and to make decisions in response to what they are witnessing unfold
around them.
The designs of multi-speaker installations primarily position the composer at central, surrounded by loudspeakers. In this design, the removal of the composer from the central position is made possible by the enabling of technology. We can now remove the composer from the performance space, the panopticon’s musical guard who watches over the music performance, the authority who governs people’s behaviour with their presence, and conduct similar outcomes by technological means. The cameras, used to sense the movement of people within the space, respond to their behaviour by way of physical interaction. For participants there is no composer to acknowledge, the space is empty, there is nowhere to sit, no stage, no social indicators as to how to relate to the music performance. It is not stated as to how or if they are influencing what they are exposed to. This process of interaction is intended to imply the same opaque processes applied with surveillance capitalism in the collecting of data for behavioral modification. If participants are passive and do not move within the installation then the process of feedback ends and eventually the installation will stop producing sound. People who stand, sit or lay down to experience the installation and do so without movement will need to contribute to the mechanisms. They must sustain the process by modifying their behaviour to enact movement within the space. They will physically have to feed back to the system, to engage, otherwise it will simply stop working. I am evoking the same relationship we see in people’s interaction with surveillance capitalist systems, where there is always a need to engage and shape our ways. The audience in the installation are distracted by the music while the mechanisms of the behavioural reinvestment cycle are applied.

All compositions are intended to be spatialized within the installation. Recorded works are presented as part of this study as stereo files, they are spatialized in the installation as mono,
stereo or multi-track sources. Sound sources will have discrete sends to each of the 30
loudspeakers. It is intended that elements of each composition are given the opportunity to be
spatialized, this would be done in the installation, and apply as a process of mixing the work in
situ and then using an automated process to present the work. Elements relating to the camera
have the potential to be localized to the point of detection, this could be applied for example, so
that a sound may appear to follow an individual around the installation.

The loudspeakers are chosen from the d&b xS-series point source design. The outer ring
of speakers 1a to 12a are model 24S loudspeakers set at a height of two meters, they have a
dispersion of 75 by 45 degrees. The inner ring of loudspeakers 1b to 12b are model 8S
loudspeakers set at a height of three meters, they have a dispersion of 100 degrees conical and
are angled downward by six degrees. The Cloud speakers 1c to 4 c are model 5S loudspeakers,
they are set to a height of six meters facing downward and have a dispersion of 100 degrees. The
two subwoofers are 18S-SUB subwoofers suspended central to the installation at a height of six
meters. All loudspeakers are powered by eight d&b D80 high power, four channel amplifiers,
producing 4000 Watts per channel into 4 Ohms. All loudspeakers have been time aligned to
maintain phase coherence.

The design is intended to utilize individual loudspeakers separately or in combination
with two or more. The rings of loudspeakers can be paired with every second loudspeaker, for
example 11a and 1a (see figure nine), and this will allow the pair to be used as a stereo set. The
angle of each pair pointed inward is thirty degrees, standing central to the design will create an
equal distance between the listener and the stereo pair. Standing central to this pair will provide
good stereo imaging.
A design similar to Dolby 5.1 loudspeaker positioning can be achieved by, for example using a left (11a), centre (12a), right (1a), left surround (7a) and right surround (5a) configuration (see figure ten). The flown Cloud loudspeakers above the audience will facilitate locating sound above the audience's head. More overhead speakers were considered but a decision was made to limit the number of loudspeakers due output channels. The number of overhead loudspeakers in this configuration is minimal, as previous experience has found the contributing effect of these transducers is less effective than those placed on the horizontal plane. Side fills and spot mono sources are employed for effect as needed.

Figure 9. Speakers assigned as stereo pairs, in this case 11a and 1a.

Figure 10. Speakers in a configuration similar to Dolby 5.1
All bussing of audio as individual sends are possible from Live and matrixed through Qlab, which is to be used as the central control matrix for all audio (see figure eleven). Qlab is utilized to start and end the performance, either manually or by a timer. Cues are created to progress the show through the musical pieces, these include an element of aleatoric process whereby the next cue may be selected at random by Qlab to reformulate the sequence of pieces. Qlab is employed to fade music, send MIDI cues, pause or control sources as needed. The inclusion of any lighting or visual content would be cued by Qlab.

![Figure 11. Signal flow of installation software components](image)

Plans of the installation have been created for camera and speaker placement (see figures twelve and thirteen). The size and configuration could be adapted to accommodate different venues, although the design proposed is considered the ideal at this point of research.
Calculations of speaker placement and sound pressure interactions have been undertaken using d&b software Array Calc (see figure fourteen). The software was applied to decide the speaker model, heights, angles and spacing. Loudspeaker positions were set based on the results of this software research.

Figure 12. Installation camera positions
Figure 13. Installation sound system design showing speaker positions

Figure 14. ArrayCalc plot showing dispersion of pink noise sound pressure level.
7. Compositions

The compositions described in this chapter have been created for the purposes of this research. The recordings which accompany this study provide an understanding of the intended content for the installation. There have been many compositions made in the research of this study, the ones presented are chosen to provide successful representations of that process, they provide evidence of using surveillance capitalism as inspiration for composing music. The compositions test the ideas applied and exist as a means to gauge the results. As studies they may be subject to change or act as a stepping point for developing further compositions.

The compositions are provided as stereo files for presentation, but may or may not be performed in this format. Compositions use mono, stereo or multitrack files and are spatialized within the installation.

7.1 I Agree EULA

“Surveillance capitalism derives from the dispossession of human experience, operationalized in its unilateral and pervasive programs of rendition: our lives are scraped and sold to fund their freedom and our subjugation, their knowledge and our ignorance about what they know.”36 - Zuboff

This composition is created around recordings made by having a computer read a terms of service agreement, it is accompanied by a musical underscore. As the majority of consumers don’t read the privacy policies relating to their use of software37, this composition seeks to provoke by providing a spoken reading from the Google Chrome Terms of Service. These

36 Zuboff, 498.
37 Berreby, “Click to Agree with What?”
contracts are commonly known as an End User License Agreement (EULA), a document which is a legal contract between the software producer and the user.

The agreement used in this work was read by two Apple computer generated voices named Alex and Samantha who read the entire document. They were recorded directly to ProTools and edited into individual sections which align to the individual contract terms and subsections within the document (to maintain coherency of information). However, some sections are not governed by conditions of grammar, as in some cases edits occur within a sentence.

The edits yielded about three hundred and fifty separate files of the two voice readings. Each file was imported into a sampler designated Alex or Samantha in Live, which allowed each sample to be triggered randomly by the camera. This set-up allows the playback of random parts of the EULA, triggered by the participants movement before the camera, helping to create an improvised performance of the EULA. Each new trigger of the sampler yields the playback of an individual sample, if there is a lot of camera stimulus then the dialogue becomes chaotic and multi-layered, if there is none it falls silent. Meanwhile the underscore will continue to repeat unaffected by the camera. The underscore is designed to promote contemplation, it is calming, and allows reflective engagement with the spoken word. The music starts in harmony and becomes more dissonant as it progresses through the cycle.

It is the intention of this composition to engage participants who may or may not be aware of their contractual arrangements with Google or other EULAs they may have entered into so they may gain a new perspective as to what governs their use of the Chrome application and in doing so, their access to the internet through it. It is intended this music is used in the
performance space as people are entering. Spatially the voices will surround participants, emanating from individual loudspeakers, panning or moving in perspective, appearing to move closer or further away.

I am seeking in this composition to add gravity to the legal contract between an individual and a company when using a web browser. As of February 2019 Chrome is the world's most popular web browser. Simply clicking “I agree” when installing the software sets in motion a range of conditions to which the user consents. By agreeing we are submitting to the conditions set out by Google as to our use of their software. We are aware of our own personal use of Chrome as it is implicit, but are we knowledgeable as to what uses Google makes of our interaction when we do not read the contract? Zuboff points to a logic which is at the heart of surveillance capitalism, a “logic of accumulation, in which information and connection are ransomed for the lucrative behavioural data that fund its immense growth and profits.”

Therefore, I question in writing this composition, if we understood this logic would we still consent to it? And if we do consent then is it simply a function of installing the software, or indeed an informed choice? Not reading the conditions of this contract links to one of the tenets of Zuboff’s argument, that there is a power imbalance. Central to these EULAs she argues is the company's informed knowledge and the users' ignorance.

By playing this music as people enter the installation it addresses the notion of consent as the terms of entry. Calming music plays, we hear the computer generated voice of Alex reading the terms of the contract as people pass by. It is proposed the audience will, by entering the

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38 “Most Popular Internet Browser Versions 2019 | Statista.”
39 Zuboff, *The Age of Surveillance Capitalism*., 54
installation, consent to the terms of the agreement. In making this agreement I seek to question consent and how it is given when consent is not asked for.

7.2 Behavioural Data

"Information and connection are ransomed for the lucrative behavioural data that fund its immense growth and profits" - Zuboff

This piece is conceived from the viewpoint of a computer analysing behavioural data. Granular synthesis is applied to represent behavioural data analysis. Synthesis takes a rapid succession of very short sound bursts called grains (e.g. 35 milliseconds long) that together form larger sound events. These grains in this composition are taken from sound recordings and applied to build a new interpretation of the data collected.

Field recordings were made in the city of Melbourne and its natural environment. All recordings relate to movement, including transport, people and nature. The sound recordings are used as samples, moments in time within which the computer extracts its data. Each sound file is processed using Max for Live’s granular synthesizer plugin. The abstracted sounds heard in the recording were made for the purposes of this compositional research.

Three sound sources were used in the study, all were triggered by the camera to promote activity. The sound sources are a street busy with traffic, a flowing river and a train station announcement melody. Notes were randomly selected by Max, cued by movement in front of the camera. The MIDI notes supplied by the camera triggered the granular synthesizer to select varying parts of each sample for processing. Settings of the synthesis were adapted to suit my

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40 Zuboff, *The Age of Surveillance Capitalism*. The Age of Surveillance Capitalism, 54
own sense of musical effectiveness. Other samples and layers of sound were tried, but this example provides a good balance of activity and silence. The composition tests whether the audio synthesis process is viable and how many cameras are necessary to supplement the music process. More samples and camera recordings yielded music which was too dense and chaotic for the intended purposes.

The piece opens with traffic rendered into a long, drawn out abstract texture. It is joined by the train station melody re-pitched and stretched as if frozen in time. In stereo we hear the water enter as a murky low pitched texture, which can be heard to change timbre and pitch through the recording. In creating the elements there was a process of trial and error to determine what I liked, then once this was completed I triggered the camera by moving in front of it. The piece itself is random in its possible outcomes as the synthesis is varied with each re-triggering, rendering a mix of the piece I had not experienced before.

In the installation there is potential for the music to be mixed with unprocessed field recordings and for sounds to be localised to individual speakers, but this is to be considered and revised in situ. The composition is significant to me as it is the first time I have applied granular synthesis.
7.3 Self determination

A polychord is the superimposition of two or more chords upon each other, it can be related to as a way of implying a scalic idea upon a chord or as two separate chords combined to create a polytonality. In this composition I am applying the polytonality of polychords as a metaphor for what I observe to be the complementary and opposing interests, present within the current digital milieu.

This composition is built around aleatoric process, once started it has a progressive life of its own, it is significant to my compositional progress to have written this. The evolution of music is random sequences and yet it has a certain interest to its progression which I find satisfying. It is pleasurable to experience the setting up of materials and having them evolve and respond to stimulus to create new relationships in their progression onward.

This composition uses the camera and Live to trigger random sequential events which evolve over time to create variations in harmonic and melodic events. Once the sequence starts it continues to create new relationships of the materials to one another, by way of indeterminate choices. There are low melodic parts which are aleatoric, they adhere to a set triadic scale and are triggered by participants’ interaction with the camera, allowing their rhythmic placement to vary but still comply within the harmonic boundaries of the composition.

As a study, this composition is representative of what I would like to achieve in the approach of creating musical works for this installation. It is significant because it creates musical sequences which are formulated to develop within certain set structures and also incorporates interaction which changes the timing of events. Form, harmony and rhythm are reorientated in response to human interaction with the camera. The development of the
composition is always in a state of flux, dependent on how participants respond to it in the performance space.

7.4 Interaction

This composition applies white and pink noise to create an evolving response to participants. It is surveillance music as it employs the camera to produce sounds in response to participant interaction.

There are four Arturia Mini softsynths which are paired together and one which is not. The paired synthesizers are triggered by one camera per pair, while the solo instrument has one camera dedicated to it. The settings of each pair of synthesizers are identical, we can observe them fading in and out as they are triggered independently. The solo instrument uses a phaser and Low Frequency Oscillator (LFO) to impose a modulation of frequency over time as it passes through a band pass filter. This effect divides different bands of frequency to the left, center or right of the stereo image, so that we may hear it panning as it moves through the individual spectrums. This was composed as a way of determining the potential of this idea in its application, which if installed on a larger scale would include multiple cameras controlling the localization of sound.

7.5 The right to possess (phase)

This is a surveillance music composition, it uses the camera to control the musical outcomes. We hear the computer responding to the camera against a backdrop of the natural world. The music was composed as a response to Rosalind Picard, whose academic work with
MIT Media Lab sought to establish a computer system to automate the measurement of human behaviour. This research led to Picard establishing studies in “affective computing”, a new sphere of computer science which “she reasoned, would be able to render your emotions as behavioural information”\(^{42}\). Zuboff makes the point that Picard’s original model was for therapeutic and educational purposes, “intended for you, not merely about you”\(^{43}\), but that over time this research, although benign in its conception has been repurposed for targeted marketing and advertising. Reading this summation of Picard’s work made me want to create a musical piece which seeks to find a balance between the natural world and computer science. The composition uses the sounds of nature overlayed with a synthesizer which, when triggered by the camera, produces a random selection of monophonic notes from a Arturia SEM synthesizer and polyphonic notes from an Arturia CS-80.

7.6 New Digital Age

This “conscious music” composition moves from the present, to the future, and then considers what it is like when we inhabit the imagined digital milieu beyond our current knowledge. The opening melody is a morse code turntable scratch which, although not a true binary system, is intended to signify and mock the binary centric world we inhabit. The introduction is followed by two sections which repeat three times, each initial improvised melodic passage is countered with a dissonant clustered chordal section, they are opposing in nature and represent market forces battling to become the dominant force in a world progressing rapidly toward a new digital age. When the new digital age arrives we can observe a less chaotic,


\(^{43}\) Zuboff, 286.
more harmonically certain progression which builds slowly, eventually resolving into a fragmented ending.

The music was made using ProTools software, it was conceived as a study in trying to meld incongruous ideas together, this was mainly achieved by keeping the tempo unchanged and allowing continuity in the percussive parts to bridge alternate sections. The parts are predominantly sequenced Arturia synthesizer sounds or samples. There was some recording of percussion and synthesizer parts with sound designer David Franzke. The drums beats are created using Addictive Drums software.

This composition asks what happens after we arrive at the imagined digital future, what then? When engaging with this question, and reflecting on my own experience and existence I fail to recognize how a technologically advanced endpoint will change life in a fundamentally positive way. The current cycle I identify with is one of dispossession, it is a process which is planned and acted upon materially, it has an end goal and I question whether it is for the betterment of society.

7.7 The right to be forgotten

This conscious music composition represents my feelings in response to reading the 2012 draft European Data Protection Regulation Article 17\textsuperscript{44} commonly known as “the right to be forgotten” act. The law can obligate search engines to remove information from results to an individual's personal data. Opponents to the law argue access to this information is in the public's interest. I am conflicted on this issue, I value my privacy and that of others, but I also value

freedom of information. This composition laments this personal conflict and irrationally seeks emotional refuge in the past, where I illogically harbour sentimentality for a simpler time.

A mixture of sources were applied in the creation of this composition using ProTools software, some content was created with the input of David Franzke. A vinyl record was used to sample its associated surface noise, beats were played on an AKAI MPC and using the AIR BOOM plugin. Melodic voices comprise of analogue synthesizers, namely the Oberheim Matrix 1000, Realistic MG-1, Korg Juno, used in combination with soft synths, such as Arturia’s Farfisa V and AIR Vacuum. Filtering was used to cut high frequency and add a dull timbre to the drum sounds, analogue spring reverb was applied to add analogue ambience and a sense of sonic legacy to the recording. The recording is infused with sounds from the analogue past, some of them real others an emulation.

The opening chords evoke memories of my past self, sensing the future. The analogue synthesizer sounds, pops and clicks of the dusty record and muted ambience imbue a sense of nostalgia to the music. When we experience the analogue medium here it represents a technology which is redundant, a memory, lost to the new digital milieu. Analogue mediums such as tape or vinyl degrade over time, they change over their lifetime, they embody in their medium an evolving memory of the past which changes with each recollection. In my sentimentality, when I recall memories of the past they include only what I remember. The memories I do not remember are forgotten, lost. I ask, is forgetting a natural state? Is the “right to be forgotten” act simply acknowledging a process which is common to the natural world and our observation or recollection of it, or one which has been improved by digital technologies ability to retain those events for an eternity.
7.8 Behaviour modification

This “conscious music” composition builds slowly, introducing each musical element by fading it in. Fading is a technique that refers to the manual process by which loudness is controlled, usually via a mixing console fader. It is a process which is central to the aesthetics of the Acousmonium and other diffusion systems whose ethos is founded in manually diffusing sound in this way. Using this approach allows variation in loudness to balance the instruments, but also creates shifts in texture too. In a diffusion setting the sounds are to be separated and located as individual parts within the system. They are able to move and appear as unique sounds within the spatial arena.

Created in ProTools this recording employs analogue and digital instruments, there is a Hammond Sounder keyboard used for the drums and some keyboard sounds. A Roland Juno and Korg Monologue keyboards were used for melodic parts, as were Arturia CS-80, Solina and Mini softsynths. The main themes and chords are played using softsynths for their sound and ease of set-up, recall and implementation of MIDI features. For this composition I preferred to use an analog synthesizer for feature melodies as their sonic character is perceivably more complex than a software equivalent. Analogue low frequency appears more extended in their recordings and the timbral quality of the instrument allows it to be placed in a mix easily as a feature instrument. Whereas for the most part, softsynth variants were more suited to accompaniment or blending with the analogue source.
7.9 Li Like

“A single click on the Like button will 'like' pieces of content on the web and share them on Facebook. You can also display a Share button next to the Like button to let people add a personal message and customize who they share with.”⁴⁵ - Facebook

The “Like” button was first introduced by Facebook in 2009⁴⁶, it allows users to support or approve content by selecting the icon within the Facebook application or a website housing their plugin. Zuboff explains how the Like button’s implementation was intended to surveil web users whether they click on the button or not. She describes how the installation of tracking cookies was shown to allow Facebook to track users beyond not only those who use their service, to include potentially all users of the internet⁴⁷, and how after many years of arguing to the contrary Facebook changed its terms of service to include the new tracking policy.⁴⁸

This conscious music employs homophonic paronomasia and personal responses to the logic of behavioural modification and behavioural surplus in its composition. A driving beat, catchy melodic phrases and the climactic building of the main theme are all intended to be familiar in form and content, and encourage people to dance. This music uses dance music to impose a form of behaviour modification upon the audience, namely dancing. The lyrics are intended to provide humour and pass comment on the Like button. I use a form of homophonic paronomasia to extract lie from like, and apply this pun to draw attention to the deceptive practice Facebook engages in to collect personal information. It is also a reflection of my own annoyance at the pervasiveness of this tool and how, not even being a member of Facebook

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⁴⁵ “Like Button - Social Plugins - Documentation.”
⁴⁶ “Facebook Activates ‘Like’ Button; FriendFeed Tires Of Sincere Flattery.”
⁴⁷ Roosendaal, “Facebook Tracks and Traces Everyone.”
social network, I am still captured in their *extraction imperative* by visiting websites that embed their application, in order to extract behavioural surplus at an ever-expanding scale.\textsuperscript{49}

This composition uses Live to create the composition, it was applied in this case instead of ProTools due to the applications ability to sample and manipulate audio with ease. I recorded myself saying *lie, like and button* in differing ways and then used the Sampler plugin to edit and pitch shift the samples.

The approach to this work uses physical interaction to lead the sonic material from an abstract state towards a pattern of increasingly cohesive moments. What starts as an unrecognisable abstraction becomes whole over time as more fragments are drawn together as the movements of the participant are linked together to form a comprehensive sample. The camera is triggered by the participant’s interaction and through this process a seemingly abstract collection of sounds become identifiable as a recognisable, familiar and relatable sample of audio. It is conceivable that this approach could expand to a larger work which uses a larger sample of material and more sophisticated forms of tracking movement to increase the diversity and possibilities of interaction.

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\textsuperscript{49} Zuboff, 87.
7.10 Creative Destruction

“Capitalism creates and destroys” Creative response shapes the whole course of subsequent events and their ‘long run’ economic outcome….Creative response changes social and economic situations for good …. This is why creative response is an essential element in the historical process.” - Zuboff

Creative Destruction is a composition inspired by Austrian economist Joseph Schumpeter whose economic theory includes the argument of the need for industry to mutate and destroy the old, while giving rise to the new. Zuboff writes, Shumpeter understood creative destruction as one unfortunate by-product of a long and complex process of creative sustainable change.51

This composition was created from recordings made with David Franzke by way of microphones strapped to his fingers as he worked in the kitchen. The sounds collected were individually processed using a GRM plug-in to abstract or rather destroy the original recording into a new form. The abstracted sonic material bears no resemblance to the source due to the synthesis applied. This process was undertaken to represent Shumpeter’s theory that creativity is an essential part of the process of rebirth which comes with sustainable change.

Recordings were edited and then processed to abstract them, producing two sets of files, the original and the processed. Both sets were then imported into Live and set-up as batches of sound files to be triggered by the camera. In addition to these sounds was the inclusion of a synthesizer to add pitch variations. Notes were chosen by the triggering of the camera and the corresponding MIDI pitch value.

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7.11 Twelve Cameras

Twelve cameras were applied in this composition of *surveillance music* to test whether their implementation was feasible. The twelve synthesizers were all the same softsynth, a Max for Live August Synthesizer was used, triggered in Live by the camera via MIDI.

The process of building the twelve parts was done individually by recording movement in front of one camera and layering the separate performances. Twelve separate renditions were created and mixed together. Movement in front of the camera was achieved by walking back and forth. The MIDI scale used is random, a new note is triggered each time the camera intensity crosses the trigger threshold.

Each synthesizer has been panned within the stereo image to individual points. It is intended that, in the installation, each synthesizer is to appear discreetly from a loudspeaker. The sound of the synthesizer will correspond to the position of the camera it is triggered by, allowing probable acknowledgement by an audience member to recognise the relationship of movement to a corresponding camera. It is intended that this relationship will spur further interaction of the participants with the camera to produce more musical events. This research is significant as it provides evidence that the camera system works and can be applied directly to the creation of music from human interaction.

7.12 Beating Pulse

This *surveillance music* composition employs three Arturia Mini V synthesizers to provide a monophonic LFO (low frequency oscillator) triggered rhythmic accompaniment while two Arturia Mini V are controlled melodically by input from the camera. The composition
evolves as a process, the pitch content is established and then adapted by interaction with the
camera, the rhythmic tempo is unaffected by this interaction, although polyrhythmic interactions
are.

This composition tests setting up an evolving rhythmic pattern and the results of
interactive influence on melodic content. Changes heard to the arpeggiated melodic content are
from movement in front of the camera, which was done by moving my arms to promote changes.
As the notes are chosen randomly by MAX there is no intent to the melodic progression
harmonically except that it will change.

As a metaphoric composition, this notion of a pulse or beat which is continuous
represents surveillance capitalisms presence to capture our engagement with it. That interaction
has some influence on the content, but the overall impetus of the mechanism is fixed in a
trajectory which we cannot control.

8. Conclusion

This proposed model for an installation is my Epoche, it has allowed me to stand and
view the processes of surveillance capitalism and respond with creative invention born from
research and the phenomenological process. The process has led to a number of outcomes which
support my research. Firstly, the ideas contained within Shoshana Zuboff’s Surveillance
Capitalism have provided a foundation for the formulation and composition of musical works.
This research has led to the discovery and implementation of compositional ideas which differ
from my usual approach to creating music. Their use has prompted enquiry and analysis to
incorporate new technologies into my personal process of music creation, these have included a
camera to interact with human motion, a multi channel audio design and the application of aleatoric software processes. Secondly, there has been a body of work created with the application of camera technology, a process which involved a period of research, development and implementation. The creation of the camera software enabled a process of exploration into the potential of the interface for composition and further enquiry to determine how best to employ it as a creative device. Thirdly, the body of music created through this process of using the camera to create surveillance music studies has shown that indeed it is possible to respond to, and create music from Zuboff’s critique of surveillance capitalism.

The description of my experience surviving the Yogyakarta earthquake is included in this study to bring focus to a perspective which represents the synthesis of the Epoche. From this experience I bring a clarity of focus to the essence of what I have phenomenologically observed. Through this experience I bring a lens to bear on Zuboff’s analysis of surveillance capitalism and expand upon her research to produce original music. The application of the Epoche has helped focus the phenomenological lens, to give context within which I have observed my research.

Improvisatory experience and expression is woven into various elements of this design, namely the camera’s interactivity with the audience and the more playful ingredients of compositions. Furthermore, the underlying principle of the sound system interacting with the participants is at its heart an improvisatory pact, to create and then respond to new, original events as they transpire in performance.

The music diffusion system is a twelve sided polygon, its design allows speakers to surround the audience and remove the composer from the central position by employing automation and interactive cameras. The two circles of loudspeakers, suspended Cloud
loudspeakers and subwoofer are positioned to allow a variety of spatial variation. The design has been modelled using ArrayCalc software to test loudspeaker interactivity and respond to the results to refine loudspeaker type, position, heights and angles.

The sound system with which these works are diffused itself represents metaphorically a surveillance mechanism, its design mimics the panopticon, cameras surrounding the audience and all interaction potentially captured for use. The design also employs the Musical Value Re-Investment Cycle, adapted from Google’s Behavioural Value Re-Investment Cycle, to provide a design which enables applying surveillance capitalism logic to the processes of music creation. The camera and sound system are employed to interact with the audience and in doing so explore methods of behavioural modification.

The camera system has been tested and proven to be capable of stimulating music creation and interacting with human movement. Its application for this research is limited in variation, but shows the potential to expand the application of MIDI values to include the triggering and control of many other music creation parameters.

A number of audio software products were applied in the creation of this interactive work. These programs were selected for performing a distinct role within the chain of music creation components. ProTools was used to create music works which did not include interactive elements. Max was applied to interpret visual information from the camera. MIDI is applied to control or cue features between Max, Qlab and Ableton Live. Ableton Live is used primarily for the creation of music by use of its ability to cue sampled audio by either MIDI or aleatoric process. Further research would improve the potential complexity of the relationships between software programs to develop more sophisticated ways of interaction.
Case studies have been provided to add context to ongoing practice devising and producing installation audio systems. The design examples were created for a specific location and included music, field recordings and sound effects, which are all important precursors to the interactive design detailed in this study. The examples of Curtis Roads, Sally Smart, Yarra Bend and Time:Space show evidence of historical processes and design approach, by doing so they portray a research link between these works and how they have informed this current research project.

Researching the work of the Acousmonium, BEAST and Discreet Eight was beneficial as it provided greater clarity into the fundamentals of these diffusion systems, and how the design affects the creation and performance of music. These three examples were chosen as they are influential to my research.

The compositions created as a result of this research process we achieved by imposing approaches and ideas to the act of composition which I have not attempted before. The music creation process was liberating as it gave context, a theoretical approach and time impetus to the act of engaging in composition. The interactive camera and aleatoric processes were especially satisfying as they objectified my qualitative judgements to assess the music on the resultant processes outcomes, rather than a personal reflection of my own emotions.

In looking to the future for further research, there is potentially more to be investigated within the main chapters of this study. Diffusion systems require design but also testing in situ, and this part of the process awaits implementation. The camera and software design has been tested and works, although it deserves integration within the context of a performance to observe how the music, sound system and the audience will respond in combination. Finally, the research
of Zuboff has much more to offer than included in this study and is a resource worthy of more in-depth review.
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