

PLAYING WITH FIRE AND OTHER ELEMENTAL HACKS

Autobiography and playfulness in digitally interactive sculpture

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ABSTRACT

This practice-based research explores the relationship that the solo artist has with available technology, and in particular how an imaginative low-cost 'hacking' approach can lead to the development of emotionally nuanced and expressive artwork, installational and interactive in form, autobiographical and playful by nature, offering an immersive experience for the viewer, while retaining the individual hand and touch of the artist.

This 'hacking' approach aims to find new and accessible ways of working with complex electronic devices and systems. The salient model for working with such systems assumes extensive collaboration with technical teams and institutional levels of resourcing, and acts as a barrier to the lone studio-based artist. The research instead explores a low-cost, DIY alternative, relying on playful imaginative wit in place of privileged access and institutional muscle.

I present a cultural context for my research that links a pre-digital technologically-engaged sculptural landscape of the past century, with more contemporary digitally-enabled practitioners, and recent developments in primarily digital forms of immersive and interactive installation. I note that there has been no authoritative synthesising account of these tendencies, with effective theorisation generally lagging behind artists' individual achievements.

My studio research has demonstrated a DIY way of mapping the human body as it moves in 3D space, and digitally recombining this data in a video feed that can be projected in real time, precisely mapped to any 2D or 3D surface. It then demonstrated a way in which a

virtual-reality headset can present to its wearer a live image of a chosen subject, moving not in the usual psychologically-unsatisfying digital fabrication of a landscape, but in a true representation of the physical space the user is actually in; this was in response to my conviction that much conventional VR mistakenly disengages from a reality that we can emotionally associate with.

A virtual work was developed, through which an audience sitting at home could share in a playful collective interaction, and which at the same time illustrated some of the significant principles of the research.

The research's trajectory was re-evaluated at mid-point, to avoid a distraction represented by off-the-peg programmable devices (e.g Arduino, Raspberry Pi); on reflection, these took the hacking out of your hands. I turned instead to ways of working installationally with the body and some of the physical extremes experienced in a previous working life; heat, cold and catastrophic changes of atmospheric pressure, and the autobiographical emotional associations these generated. Again, low-cost DIY solutions were explored and developed in their potential for psychological as much as physical engagement on the audience's part. Finally, coming full circle, and wanting to reconnect with the initial projection-mapping experiments, I explored another way of working with the elements – live projection onto water-vapour. This is among aspects of the research, abbreviated by recent circumstances, that I wish to return to another day.

Author's Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of the University of Gloucestershire and is original except where indicated by specific reference in the text. No part of the thesis has been submitted as part of any other academic award. The thesis has not been presented to any other education institution in the United Kingdom or overseas. Any views expressed in the thesis are those of the author and in no way represent those of the University.

Signed:

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INTRODUCTION AND OVERVIEW

How can contemporary notions of identity, body and site be explored through an immersive installational work of art, i.e., a 3-dimensional work of art the spatial field of which the viewer enters and actively engages with? And how can advanced electronic means be deployed by the solo artist to achieve such ends, while keeping resourcing low-cost and hands-on?

The stated aims of the research were:

- Show how a solo artist can produce nuanced emotionally-expressive immersive installational work, supported by advanced electronic means, without the extensive

resourcing (financial, material, human) behind most other exhibited work of the same kind.

- Evolve low-cost DIY/'hacker' ways of working with industrial/prosumer electronic devices and systems, in a multi-sensory installational/sculptural arena, where the audience engages interactively, i.e. modifies the state of the work (or their perception of it) through their presence or actions.
- Demonstrate how the individual hand and touch of the artist can be sustained alongside (as well as through) the use of advanced digital technology in an installational arena, and how a working process promoting both can provide insights into innovative approaches to using such technology.

Its objectives at the outset were:

- To develop a series of socially-engaged installational artworks, addressing notions of identity, body and site; to this end, evolving a 'hacker' approach to electronic hardware, software, and/or control systems, including virtual and augmented reality, motion-control devices, and projection mapping:
- To plan these artworks and related studio experiments as cumulative stages towards a final exhibition presentation in which personal experiences, including my time spent as a London fire fighter, and the social-political climate in which I operate as an artist, will be addressed:
- To set out in writing the contemporary and historically recent contexts for an art-practice successfully combining personal expression with advanced electronics, in an installational/immersive arena, and where the audience is an active participant. Demonstrate that there is a clearly definable modern canon of affective, content-full artwork operating in a sculptural arena and imaginatively drawing upon advanced electronic techniques, whether presented within a gallery setting or less conventional, site-specific environments:

- And through exhibitions of work, conference presentations and other networks, to further the low-cost, DIY, 'hacker' approach to electronic devices and systems, focusing particularly on my own examples.

Throughout this thesis, the terms 'installation' and 'installational' have been used as has been current in critical writing about art since the 1970's, to describe a form of sculptural practice in which the artwork, often multi-part, defines a spatial field into which the visitor (one might say 'participant') enters. The term 'immersive' and 'immersion' describe a particular quality of engagement where such an installation either fully surrounds the visitor, becoming their full physical or visual frame of reference, or through various means promotes the strong sensation that this is the case. The aim of physical immersion is always to promote in the visitor a psychologically-engaged quality of immersion.

'Interaction', 'interactive' and 'interactivity', as terms employed in this thesis, also need defining. An interactive work of art (usually sculptural or digital, and often though not necessarily installational in form) is one where the form or the behaviour of the work is modified by the behaviour of visitors. Visitor interaction may be active (deliberate) or passive (the work changes without the visitor necessarily seeing that they have been the agent). The change in the form or behaviour of the work may be mechanically or electronically pre-programmed, or may be open-ended and at the whim of the visitor. Interaction is often closely related with immersion, whether in the purely physical or the psychological sense, and with an intention on the part of the artist for visitor engagement to be maximised. Interactivity also reflects the way we engage with the world at large, if not always with art.

Over 15 years, my own practice has brought together technological elements in expressive union with more conventional sculptural/installational materials and components. In this research project, I was interested in bringing together digital display software/hardware, games devices and other audio-visual elements (360° cameras, lighting, sound) that could be harnessed as live, interactive tools in an installational context. My aim was to utilise

these together with more traditional forms of sculpture and installation, in order to develop a highly personalised and autobiographically-informed practice, but one that with imaginative adaptation could provide a useful approach for other artists working on their own. What is particular to this project is not only the development of a highly personal means of expressive engagement, but also the forging of an accessibly low-cost, DIY means of working with high-end and prosumer electronic equipment, thus dismantling a conventional barrier to the lone artist making such work.

Hacking and the term 'hacking culture', in an artistic context, can be interpreted as a hands-on, experimental approach to practical and expressive problem solving in the development of personal work, bypassing more conventional approaches. The role that playfulness and imaginative wit plays in this is fundamental; central to it is the enjoyment of testing one's own limits while engaging with different mediums, platforms and processes, and the ability to disregard conventional 'rules of the game'. What hacking means to the artist is to creatively exploit systems that may not be designed for the artist, to an innovative creative effect. Crucially, it means using the imagination to devise ways of doing things that avoid complicated solutions requiring access to institutional-level resourcing, smaller or larger teams of assistants, technical back-up, and plenty of money.

The process of artists using hacking in order to transform an object, device or process is not new. With the rise of tech systems coming in the 1960's when personal electronic devices started to make their way into the consumers' home, so too artists set upon subverting their uses to their own wishes.

There is a long history of artists who have exploited this methodological approach within their art, from the ready-made sculptures of Marcel Duchamp and the pioneering experimental approach of the Fluxus movement, through to present day artists and collectives utilising their own found objects and materials. The very nature of art and art-making is to look at the world differently, to be playful and resourceful. This research

explores the work of new media and immersion within artistic practice through an approach to making that embodies an experimental, hacking spirit.

Technical innovation often drives inspiration within art. New materials and techniques create new possibilities for our ideas and concepts. For example, the development of oil paints in tubes in 1841 allowed artists to develop the technique termed 'en plein air', painting an entire canvas in nature, outside with the newly portable paint tubes. This innovation led directly to the rise of Impressionism around 1860. The introduction of resin-based composite materials in the 1960's meant that sculptors could create new lighter, flexible, mouldable works. From the 1990's, the rapid spread of new digital tools has arguably had as great an influence on the shape of art as anything else in preceding centuries. However, it is not just the available materials and media that drive contemporary art. There has been a long history of cross-fertilisation between artists, scientists and political engagement. Art has been used to convey ideas, to react to world events, to highlight injustices, to convey the political, social and economic issues of the day. With the advent of new technologies and media in mainstream society, art has adapted to work symbiotically with our daily lives.

How does a work of art connect with its viewer when the viewer is bombarded with new media daily? We live in an age of distraction, we carry a smartphone around with us everywhere we go, we document our lives online, through images, messages and film daily. How can we re-sensitise our imagination when confronted with a work of art?

The desire to connect directly with the viewer through my own art has led me toward immersive practices. Through this research I hope to point to a redefinition of the nature and role of an audience as a participatory player in the work, and develop a fresh understanding of what we experience as real.

To achieve their ends, most artists working installationally or immersively with complex technology either collaborate extensively with artist-technologist-facilitator teams, form collectives with games designers, architects, scientists, etc., or pursue commercial work or high-end industrial residencies in order to have access to the kind of new technology required and the expertise to work with it – pieces such as Jean Tinguely’s *Homage to New York* (1960), Laurie Anderson’s *United States* (1983), and Hito Steyerl’s *Power Plants* (2019), could all be cited as examples of where the named artist has, despite their admirable individual ingenuity, benefited also from extensive support-networks.

Recent exhibitions of Olafur Eliasson (Tate Modern, 2019) and Bill Viola (Royal Academy, 2019) have shown how throughout their careers artists such as these have combined digital and related technology and traditional sculptural/visual elements within their practice. In recent decades there have also emerged primarily digital forms of installation art, frequently the work of collaborative groups such as Random International¹, Marshmallow Laser Feast², and Team Lab³. In Chris Milk’s work, *The Treachery of Sanctuary* (Tate Modern, 2012), the audience would raise their arms and their digitally-modified shadow would look as if they had wings. Beautifully executed, these exhibitors have deployed virtual reality or augmented reality in their work in order to provide an immersive experience. I argue that such work does not necessarily fulfil our sensory needs as human beings, in so far as what it presents is disengaged from a reality that we can associate with, not least on an emotional level. As part of this research, I have been experimenting with VR technology, and want to challenge ideas of immersion conventionally associated with it, and create new, more nuanced, forms of installation art that realign the digitally-inflected with the world of affective sensation and individual and social experience.

Theories of immersion in the world of audio-visual and other media, whether or not engaging with virtual or augmented reality, are best regarded as nascent, although the

¹ Random International, 2012, *Rain Room*, Barbican, London. Installation using live body tracking.

² Marshmallow Laser Feast, 2018, *We Live In An Ocean Of Air*, Saatchi Gallery, London. Entirely Virtual Reality installation.

³ Team Lab, 2019, *Borderless Shanghai*, Shanghai, China. Multi-channel digital installation.

broad concept, driven largely by developments in digital technology, has been around for decades. As a recent literature review ⁴ makes clear, assumptions made through the oversimplifying of sensory input and psychological responses are common, with consequent misunderstandings of 'reality' and of the way the imagination works. The range of ambient provision (the physical or digital 'container') and of proposed perceptual experiences is wide and varied; at the same time, the terms 'immersive' and 'immersion' have no widely accepted definition, let alone authoritative theorisation. The definition of immersion offered earlier in this Introduction, narrower than many adopted by others, should be taken as specific to this thesis and to my particular body of research.

I argue that some current ideas about immersion promote a mis-apprehension of 'reality' and of what is valuable in our relationship with our environment and with events involving us. I am not interested in the purely digital, constructed work of alternative reality. Instead, my focus is deeply rooted in our understanding of our primitive reality. That is, a reality without the distraction of other realities – what it feels like to be human, how we interact with each other and our environment, and how we can access the part of our subconscious that allows us to feel a depth of emotion that has perhaps become lost in the superficiality of our daily lives. I recognise that the dichotomy in utilising technology in order to forget that the technology exists is a complex one. But it is an idea I feel can help us to reimagine and re-position ourselves within the notion of the 'real' in order that we may be able to look again at the art object afresh.

The reason for this research therefore is to examine what low-tech methods of creating an immersive experience are available to the solo artist of today, and how these can help us connect with 'real' experience. My background as a firefighter in London forms much of the social and emotional context of my work. A background spent working in an environment of extremes, highs and lows created a desire for me to re-examine my practice

⁴Agrawal, S, et al. 'Defining Immersion: Literature Review and Implications for Research on Immersive Audiovisual Experiences', *Audio Engineering Society*, Oct 2019, New York

to explore immersion as a tool to gain greater understanding. I would experience extreme joy and extreme sadness often in the same day or night. I pushed myself to the limit of what is possible physically and mentally, and this left its legacy on me today. So when I make my work, I cannot help but make reference to these experiences, whether relating to an intense micro-event or a larger social or institutional moment.

Despite the underlying seriousness of its subject-matter, there has always been a playfulness in my work as an artist; this may emerge in the materials I have chosen, in the processes involved in the work's development, in the very ideas that sparked the work's genesis, or in the form of audience engagement that I hope will mark its public reception. Very often, these characteristics overlap one another, with more than one of them in the mix. This playfulness does not inhibit the deliberate adoption of what are sometimes deeply personal psychological triggers and the exploration through the work of personal memories, some of them traumatic. Rather, I have attuned myself to ways in which the playfulness can intensify these aspects, bringing a deliberate psychological 'edge' to the work – sometimes the playfulness may open a way into something darker, at other times the two may act in dynamic counterbalance. An aside on 'play' and 'playfulness' as topics in discourses of art, psychology and education may be in order here. The role of play as addressed in psychoanalytic and psychotherapeutic literature (particularly in the work of Melanie Klein and D. W. Winnicott) tends to emphasise play as a portal to an imaginary world, or as a strategy to address traumatic or repressed memories. Here play has a clear psychoanalytic or psychotherapeutic role. But in respect of my research, I suggest a distinction needs drawing between 'play', in this particular sense, and 'playfulness'.

It is not irrelevant that both play (as an activity) and playfulness (as an attitude or attribute) have been highlighted in their theories of progressive childhood education by the likes of Rudolf Steiner and Maria Montessori. What such theories support is very close to the way that adult artists characteristically embrace play and playfulness as part of their process of studio development.

For the individual artist or other creative practitioner, who has retained and refined play in its pre-verbal free-associational sense of a mode of unbounded learning for learning's sake, and refined it in adulthood as a direct tool for open-ended experiment and serendipity, the critical distinction is that made by Mihaly Csikszentmihalyi, in his work on creativity, between *play* (which may still be a circumscribed activity) and *playfulness* (an inherent form of behaviour.) It is the latter characteristic that has so often been remarked upon in artists like Picasso, Klee, Calder, Tinguely and de Saint Phalle⁵. Csikszentmihalyi's well-known articulation of the concept of 'flow' has a lot to do with the state of creative playfulness so important in creative disciplines, and it is *playfulness* as he addresses it that is relevant to my research.

The relationships of playfulness, imaginative 'hacking' wit, and a deeper (perhaps hidden) meaningfulness in the work, are qualities that may also be found in many of the artists whose work informs the 'Research Contexts' chapter to follow.

In the case of such artists, just as in most of my research, it is important to note that while the quality of playfulness resides in the artist and in their working processes, interaction is something that takes place on the part of audience members. That is, the artist may have set up the conditions in which interaction takes place (this is often integral to installational or immersive works in particular), but for the interaction to be meaningful, it must be initiated by the visitor, not imposed on them by the artist.⁶

My research aims to explore notions of immersion through the manipulation of sensory triggers, whether this be through the use of light, sound, smell, texture, heat or cold. It

⁵ Playfulness's role in the process of creativity is helpfully described by the contemporary artist William Kentridge: "...in the act of playing with an idea, you can recognise those things that you didn't know in advance, but knew were somewhere inside you"

⁶ The only exception to this in my research is the online game presented at a virtual symposium, noted towards the end of the chapter 'Practical Experiments and Outcomes'. Here it could be argued that a playful interaction was shared by the artist directly and collectively with other participants.

aims to bring a hacking approach to everyday technology in order to produce outcomes that were probably not anticipated during that technology's emergence, forcing the viewer to re-examine the world around them in a different way, to find elements of danger or beauty in an otherwise overlooked system. The role of play and the qualities of playfulness run through the conception and execution of this practice-led, autobiographically-informed research. I enjoy being playful and imaginative with objects and other devices, I have always taken them apart in order to find out if I could re-purpose them. This coupled with a greater understanding for the preciousness and fragility of life has led me into this research.

RESEARCH CONTEXTS

I am interested in and inspired by the largely unwritten history of what can be described as a hacking approach to creating art. There are plentiful examples of artists, especially sculptors, adopting this approach since the early 20th century; several are looked at below, and one could equally have mentioned among others the likes of Roman Signer, Rebecca Horn, the early Alexander Calder, Paul de Marinis, and Perry Hoberman. The approach has identifiable theoretical underpinnings in, for example, Lévi-Strauss's ideas about bricolage as a cultural tool, the surrealist's co-option of collage and montage as strategies for constructive disruption, the Situationists' ideas of the *détournement*, and the light-hearted DIY ethos of the Fluxus group. But this history still surprisingly lacks an authoritative art-historical account. Despite this, it provides a vital context for my practice in general, and this research in particular.

As far back as 1919 the sculptor Naum Gabo created arguably the first kinetic sculpture when he produced 'Standing Wave', a vibrating metal rod that through its rapid movement produced an apparent spatial volume. This is particularly significant to the context of this research because he hacked the technology employed in its creation, an electrical doorbell mechanism concealed below the rod itself. Although a trained engineer, he said it was all he could find to work with in the Moscow of the time.

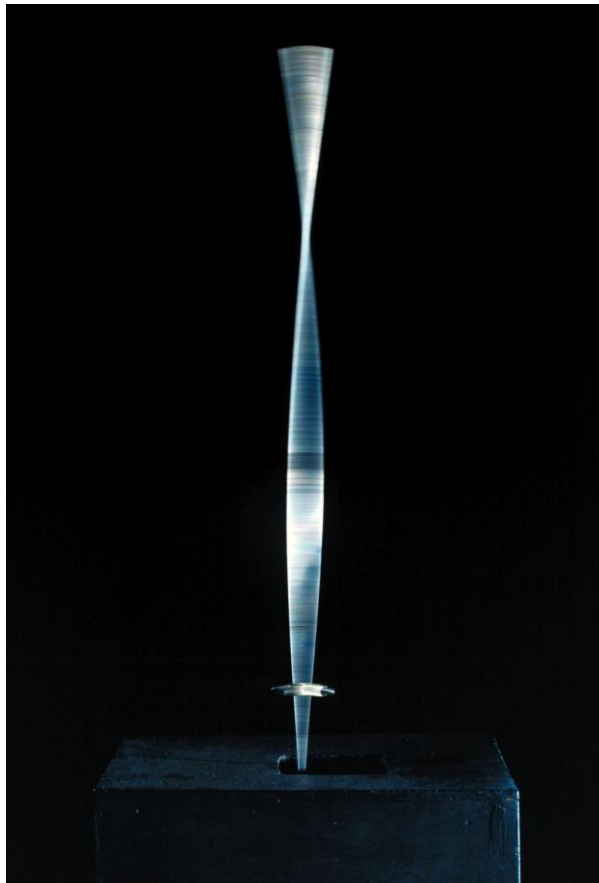


Fig 1. Naum Gabo, *Standing Wave*, 1919-1920
(Tate.org 2022)

This experimental spirit was espoused by kinetic artists to come, notably in the work of Jean Tinguely, its origins in his childhood habit of constructing small wheels, spun by mountain streams, which in turn set wooden hammers tapping through the forest. A good example of his mature work is his 'Homage to New York', 1960, an intentionally self-destructing mechanical performance utilising scrap car parts, bicycle wheels, motors and other mechanisms of industrial modernism.

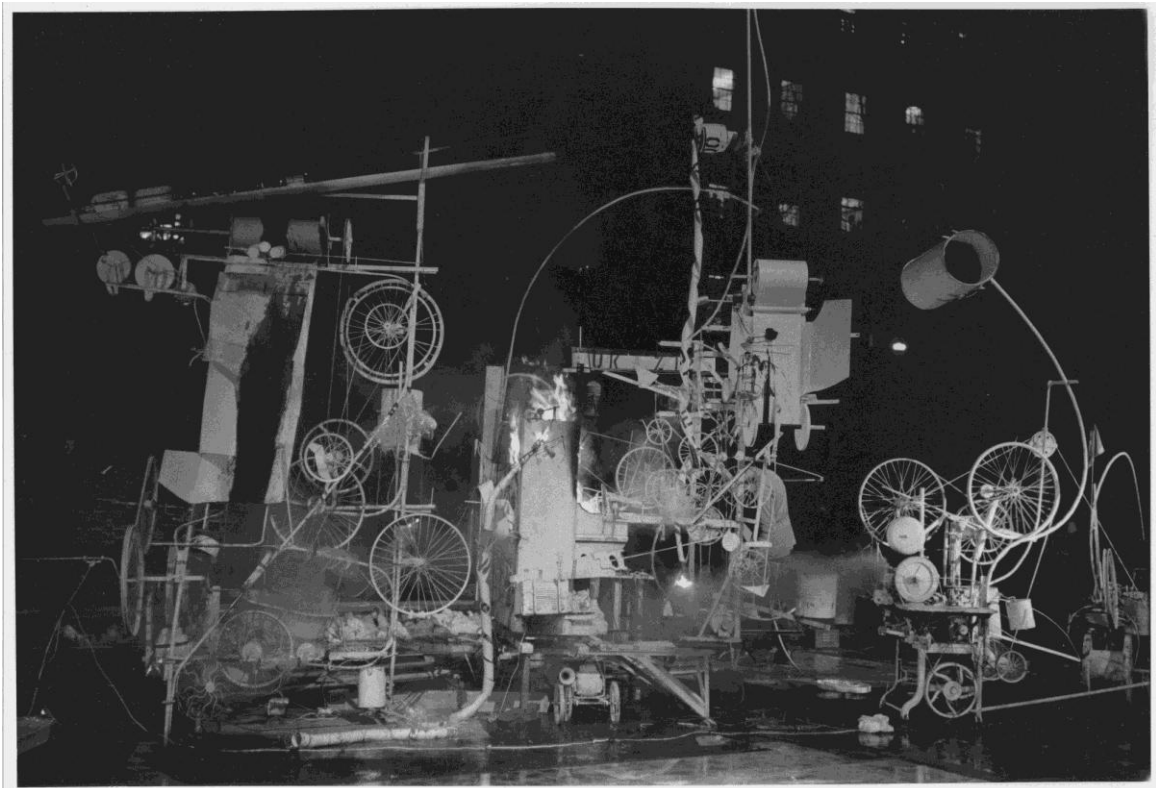


Fig 2. Jean Tinguely, *Homage to New York*, 1960
(MoMA.org)

The more sombre and autobiographical side of Tinguely's practice is well illustrated by his 'Mengele Totentanz' ('Mengele – Dance of Death') of 1986:



Fig 3. Jean Tinguely, *Mengele Totentanz*, 1986
(Tinguely.ch)



Fig 4. Jean Tinguely, *Mengele Totentanz*, detail.
(Tinguely.ch)

To address the hacking spirit of the research is to draw upon a rich background within the artworld of the artist creator and visionary. A textbook pioneer of such an approach is the artist Nam June Paik. Paik is perhaps an obvious choice in order to describe hacking through his art. His work used programming, technology, cables, television, computers and other associated apparatus of traditional hackable technologies. He playfully manipulated existing systems in order to create new forms of art. He also embraced new technology with a playful and inquisitive energy. Some of his most simple techniques exposed the beauty to be seen in everyday electronic devices. A prime example of this is the TV piece, '*Nixon*' 1965/2002. Two television screens playing some of President Richard Nixon's best-known televised speeches, including the Watergate scandal and his resignation. Paik took the technology that shapes the changing image on a cathode-ray screen, an arrangement of two electro-magnetic copper coils on the back of the tube, and added his own third coil at the front to change the image in further, originally-unintended ways. The distortion caused by this creates a perfect subversion of original speeches by the man widely known for his cover-ups and manipulative ways as 'Tricky Dicky'.



Fig 5.



Fig 6. Nam June Paik: '*Nixon*', 1965/2002
(Tate.org, 2020)



Fig 7. Nam June Paik: '*Nixon*', 1965/2002
(Koreaherald.com)

A beautifully simple hack with a different purpose is evidenced in Laurie Anderson's *Tape Bow Violin* (1977), where the playback head from a tape-recorder has been fixed to a stringless violin. A length of tape pre-recorded with short spoken phrases was then fixed to the violin bow in place of the usual horse-hair, so these spoken phrases could be played in part or in whole, forwards or backwards, as part of a performance. It seems very likely that this was in part inspired by a hack implemented by Paik in his 1963 audio-tape installation *Random Access*.

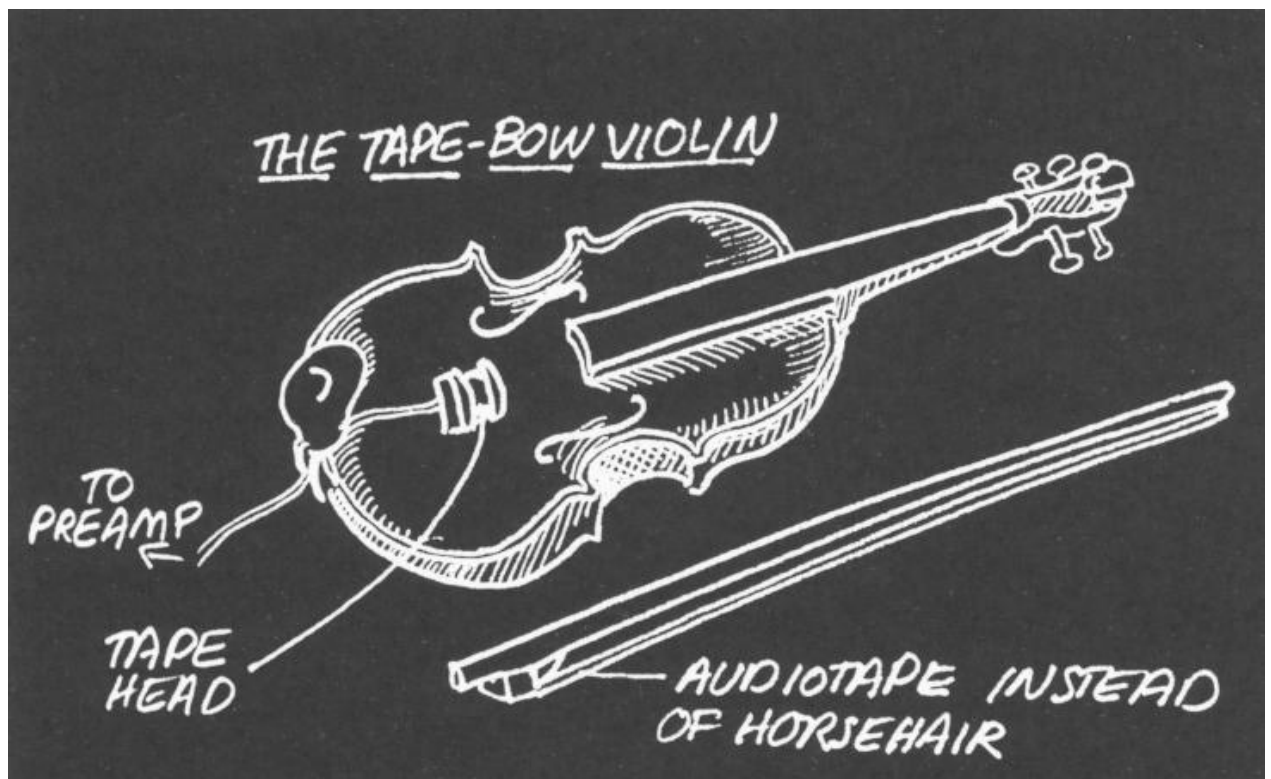


Fig 8.



Fig 9. Laurie Anderson, *Tape Bow Violin*, 1977

to be supported by ideas from the mid-to-late 19th century (e.g. Wagner's Gesamtkunstwerk or Scriabin's colour-organ), the extensive development of installation art from its early beginnings in the knowingly playful practices of Duchamp and Schwitters, and Roland Barthes' assertion that "the birth of the reader must be at the cost of the death of the author"⁷, with its articulation of an audience as a key participant in the completion of a work (or Bourriaud's reformulation of this as "An artwork... [as] an ensemble of units to be

⁷ (Barthes, 1977)

re-activated by the beholder-manipulator”⁸). It can easily be argued that more recent developments in electronic systems have helped fuel further developments in this direction: Random International’s *Rain Room* is a clear demonstration of these tendencies, by which the viewer is equally a key performer in the work’s configuration and behaviour. This is in essence artificial rain, falling from an extensive constructed ceiling. When a viewer walks into the space, the rain stops precisely and only at the point they are standing, that magically-dry area moving equally precisely wherever their body moves, so they do not get wet but experience the immersive quality of being in a rainstorm.



Fig 10. Random International: *Rain Room*, 2012
(random-international.com, 2022)

Olafur Eliasson’s major retrospective at Tate Modern in July 2019 included a host of immersive works. Most interesting of which for my own research was the enclosed tunnel of coloured fog with a door at each end entitled *Your Blind Passenger*, 2010. Totally disorientating due not only to the extremely dense fog and almost blinding light, but also because as it was a narrow corridor the sound was not immediately clear as to what direction it was coming from when other visitors entered the space. I found myself

⁸ (Bourriaud, 2002)

revisiting this piece twice, on the second occasion I was able to experience it alone which brought a total and absolute stillness to the immersivity. This was a great example of a simple installation with minimal interference to the fundamental act of being immersed in the space.

During the period of research, I attended a conference held at the University of Westminster by disLAB called 'Blurring the line between the virtual and real: art in the age of distraction'. The keynote speaker for this was Robin McNicolas, one of the founding members of Marshmallow Laser Feast, another artist, designer, programmer collective who have produced some of the most immersive work I have seen inside an art gallery setting to date. In 2019, they produced *We Live in an Ocean of Air* for the Saatchi Gallery. This work utilised VR headsets, heart and breath monitors to feed into the immersive experience, linking the viewer into the work.

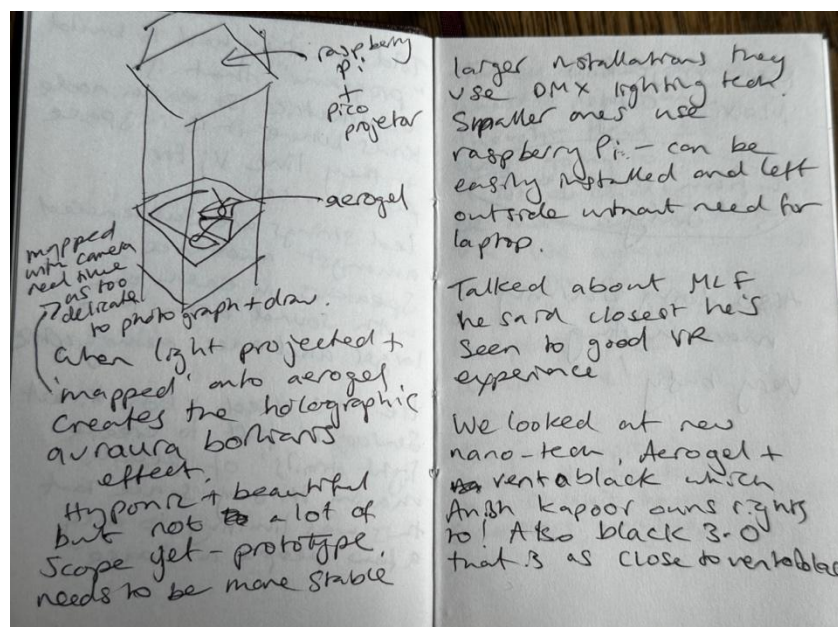


Fig 11. Sketchbook work showing development of ideas following personal engagement with collective groups Squidsoup and Marshmallow Laser Feast

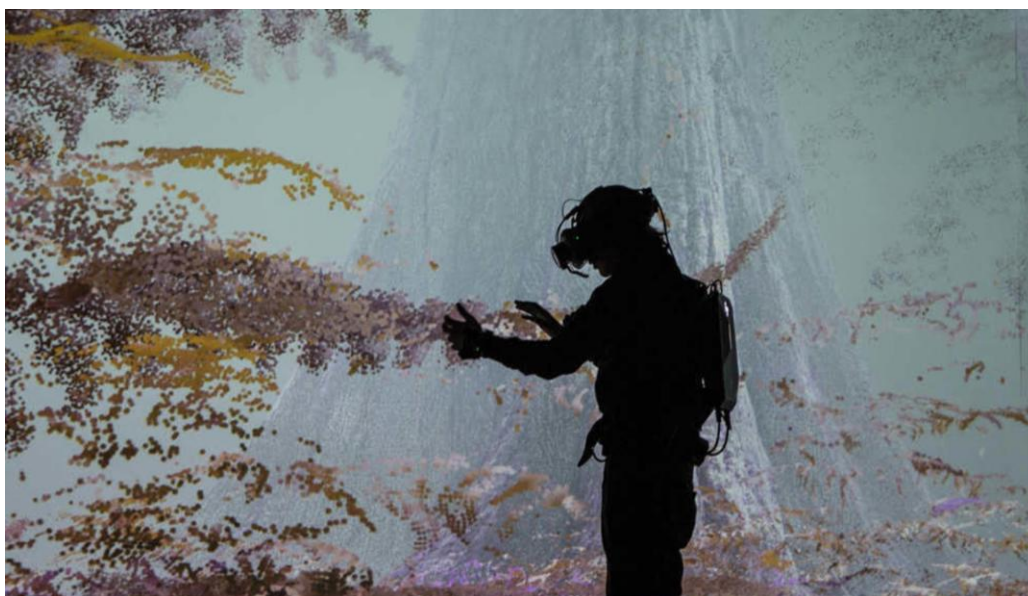


Fig 12. Marshmallow Laser Feast: *We live in an ocean of air*, 2019
(marshmallowlaserfeast.com. 2022)

At the time, I had not experienced a more advanced use of VR in the gallery setting, their use of technology was as complex as could be possible, utilising Lidar (3D laser) scanners, Point Clouds (a set of data points in space), heart, breath monitors and the largest VR headset/backpack I had ever witnessed. As you exhaled, your breath manifested itself as a series of dots that appeared to exhale from your mouth. Similarly the pulse through your veins was visible as channels of blood cells in your arms and hands. The external visuals were that of a journey inside a giant sequoia tree from the ground to the canopy and out into the sky. As you moved around the space, other participants were only discernible by the blood flow and breath that you could see. If you reached the limit of this digital environment, you saw a strong white cube, a boundary limit that told you to turn around and head back into the work. It was clear that this was a very slick, highly designed and presumably expensive production that offered infinite possibilities to these collectives that included high-tech practitioners in programming, coding and designing computer-based installations. But also far beyond what I was capable of producing. Importantly to me was the rising acceptance that this type of art installation was gathering in the gallery world.

Until this work came to the Saatchi Gallery, it had been unusual to find digital installations taking centre stage in this kind of mainstream institution.

Unusual, perhaps, in that she is known both as artist and theorist, Hito Steyerl can be seen as a 'hacker' of contemporary digital systems and culture, she is also much more than this. A socially connected and outspoken critic of political systems, her writing and teachings are numerous, from the publication; '*Too Much World*' (2015), in which there are a collection of essays relating to her film work, in which she tries to make sense of the constant stream of information and digital culture we are exposed to. To the almost apocalyptic vision of the future art world in, '*Duty Free Art, Art in the Age of Planetary Civil War*' (2017). She uses both her theories and practice to expose advanced technology that is embedded within the systems of our everyday, in order to subvert the use and context of that technology. Reflecting our addiction to it and our complete, almost blind trust in the future as seen through the digital lens.

Digital technologies provide additional possibilities for the creative wrecking and degradation of almost anything. They multiply options for destruction, corruption and debasement. They are great new tools for producing, cloning and copying historical debris. Amplified by political and social violence, digital technologies have become not only midwives of history but also its (plastic) surgeons.

(Steyerl, 2011, p110)

To examine what makes Steyerl interesting to the notion of hacking, it is pertinent to look at both her artwork and her writings. In her 2013 work; '*How Not To Be Seen: A Fucking Didactic Educational .MOV File*', Steyerl examines the role of surveillance in our everyday lives. To be used as a tutorial to avoid detection through a satirical monologue of commands. The lessons include; 'how to hide in plain sight', 'how to disguise yourself as a picture' etc. The latter being an example of how Steyerl uses the flaws in the technology to expose new ways of creating. As she wipes her face in what we can assume is a chroma-

colour, green or blue for example, so the camera cannot 'see' her. She becomes invisible to the camera's gaze and thus to the recorded image. Of course she is still physically there, but through the lens of technology, she is not. Steyerl is 'hacking' the qualities of the digital image and manipulating its flaw for her own gain.



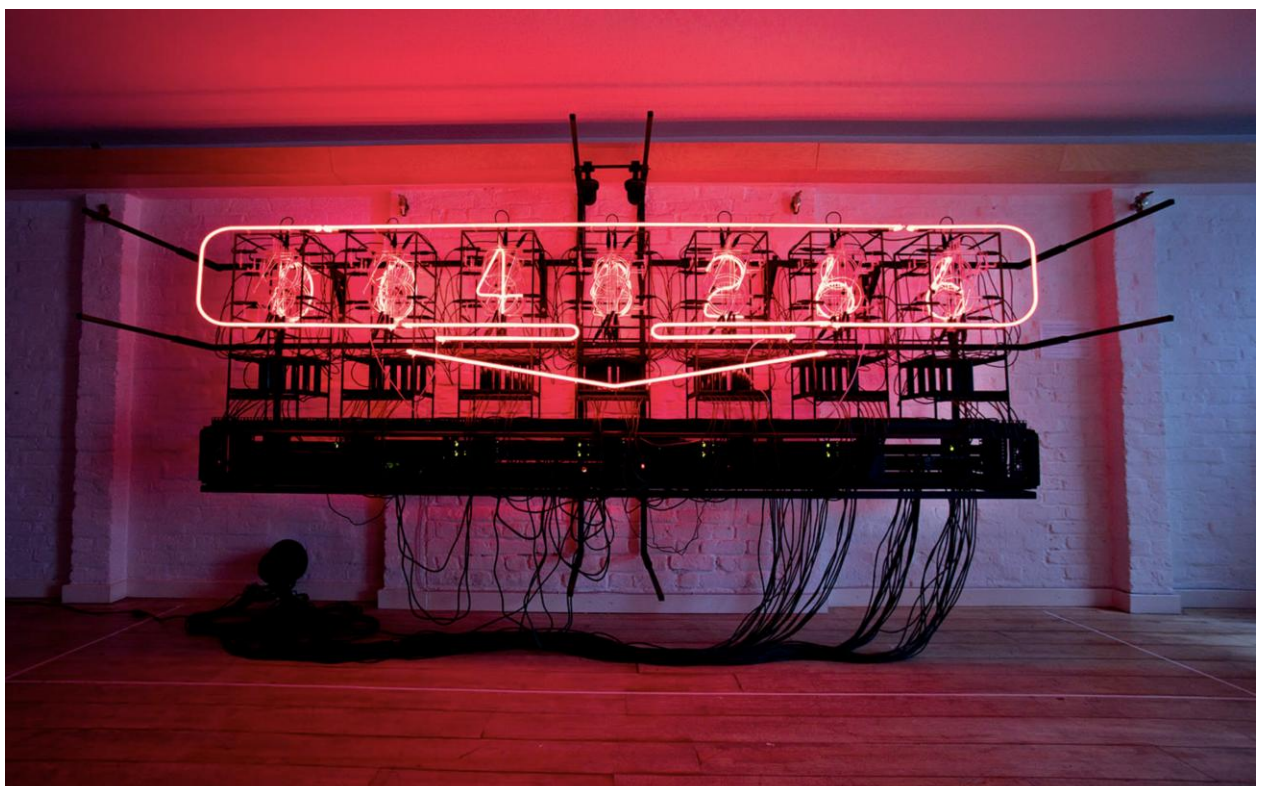
Fig 13. 'How Not To Be Seen: A Fucking Didactic Educational .MOV File' film still
(Berlinartlink.com, 2013)

One of the interesting things about Steyerl is that she is a theorist as well as an artist, she not only dissects and dissolves the digital image through her films but through her writing and teachings. She questions and interrogates the world of technology and media until it ceases to exist in the way we know. I think of Steyerl's work like this: take a word, say it over and over and over again, split it up, jumble it around, question it, keep questioning and asking its meaning. The word ceases to make sense anymore. This is what Steyerl makes us do to the world of digital media, data and imagery.



Fig 14. 'How Not To Be Seen: A Fucking Didactic Educational .MOV File' film stills
(MOMA, 2020) (artnet.com, 2020)

An artist whose work I found more directly relevant to my research through her hands-on approach is Rachel Ara, encountered at the EVA (Electronic Visualisation in the Arts) conference in London in 2019. Through her background as a computer programmer, she has been able to break down existing tech to create new installational sculpture. Her tools were outdated Windows PC's, repurposed for example in *This Much I Am Worth* (2017). Here Ara used computer parts and a neon display to create a sculpture that shows its own perceived monetised value, by scanning the internet for mentions, tweets, social media posts, etc. The more interest the work generates in this way, the higher the value indicated by the flickering neon numbers. As Ara explained, this is a commentary on the disparity in income from their work between female and male artists.



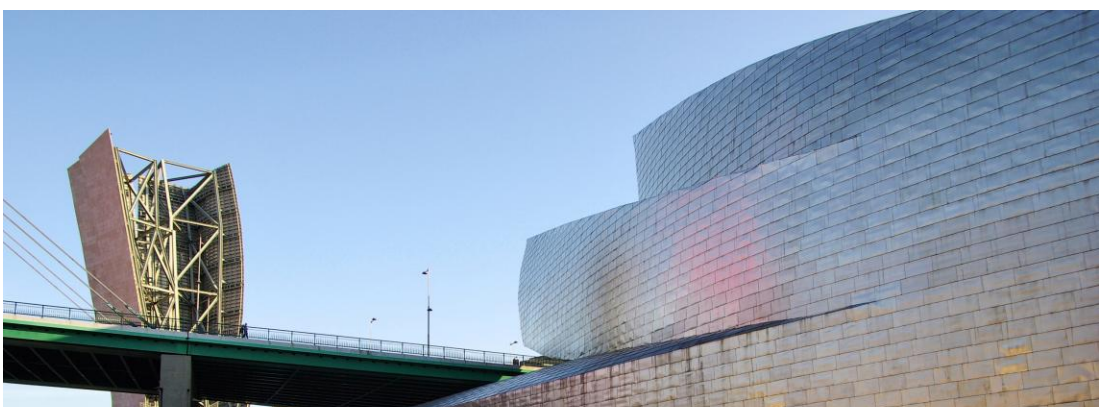
While Ara's witty re-purposing of consumer technology is exactly in line with the spirit of my research, it is important to note that the concern in her work for the gender politics of the artworld, while something I am naturally sympathetic to, lies outside the remit of my own research.

As my research progressed (as will be seen in a later section), an interest in working with the natural elements – fire, water-vapour, etc. – came more to the forefront than I had initially anticipated. In this connection, another artist's work that helped provide a context for my own research was Rose Finn-Kelcey's steam installation, shown at the Chisenhale Gallery in 1992. This utilised heating elements to create a fluid cube of steam which condensed once drawn up into the extraction hood above.



The significance of this obvious need for extraction and recirculation in an enclosed galley setting was not lost on my own, deliberately lower-tech experiments with heating water to create a body of vapour. It appeared to me that all the paraphernalia associated with this work of Finn-Kelcey's could be interpreted as a bit of a distraction from the essential element itself.

And last but not least, Fujiko Nakaya is an artist who developed technically complex, yet visually simple and less intrusive large scale fog installations. The fog creates a different atmosphere in order for the viewer to experience their surroundings in a new immersive way. Rather than creating a space for the fog, Nakaya brought her fog to the space. The water vapour is incredibly fine, born out of the technology that her father who was an innovative scientist⁹, created for artificial snow machines. I find them an extremely beautiful piece of ephemeral art and a wonderfully simple manifestation of the immersive. The technology and systems that go into creating them, however, are anything but.



This brings me back to my initial enquiries into the relationship between hacking and immersion. Both can be as simple or as complex as the solo artist can attain given their level of skills within the field. The more complex either become, so the potential reliance on collaboration with other skilled individuals is increased. I think in essence what my research is asking is how far can I as a solo artist push these two methods in order to effectively convey my artistic ideology to my audience?

STUDIO METHODOLOGY

The methodologies used in this practice-led research are based on standard 'studio' or creative approaches. They are characterised by critical reflection and by Brian Massumi's take on process philosophy, the idea that thinking evolves through change, and embrace autobiographical, empirical and heuristic principles.

Practice-based research such as this takes my existing artistic processes, modified and channelled to focus on the particular aims and objectives of my research, providing me with the core methods through which I have conducted my studies.

The studio has been the site for experimental development, via a staged series of tests, each dealing with an identified aspect of the research (e.g. how to adapt video-games motion sensors so that a viewer's spatial coordinates could be fed to projection-mapping software; how to correlate 3D video-camera footage with VR headsets; how best to use ideas of live-feeds, sound responsiveness and mechanical components within performative sculpture).

Studio experiments formed the basis for staged cumulative development, so that increasingly ambitious installational ideas could be tested and realised, in part or in whole. These were, before the pandemic, augmented by three public exhibitions of aspects of work in progress, in order not only to gather further critical feedback, but also to test specific aspects of audience response and to refine technical aspects of audience interaction.

These staged developments (of expressive as well as technical aspects of the research) were always intended to culminate in a final synthesis in the form of an exhibition, bringing together my research in the form of an exhibition summarising my investigations and more importantly conveying my ideas in the most effective utilisation of the technology, i.e that which was most in tune with my subject matter.

Studio developments were accompanied at all times by explorative sketchbook work, and by visual documentation of all stages of the work.

This studio-research process (supported by theoretical and contextual research, and also informed by autoethnographic and empirical methods from other disciplines) can be represented as encompassing four related working methods. The methodological basis for these may be more clearly understood by addressing the core methods, which are:

- Generative thought and self-critique, through exploration in sketchbook work and the subsequent analytical and critical ‘discussion’ – a term I have used to describe the constructive discussion with oneself as an artist: internalised thought is externalised through my drawings, diagrams, notes, which allow me to subject my work to self-critique and feed back into further evaluation in an evolving and cumulative process. These private discussions also usefully feed into the supervisory discussions (see below).
- 3D (or 4D, when involving a temporal dimension) studio experimentation: ideas that at first seem to hold promise on paper are then tested in reality in the studio, the evaluation of this process informing further critique and practical development. Some ideas are inevitably found unworkable at this stage, but as failure is the mother of invention for me, these can provide new avenues for development.
- Gallery/exhibition testing: work in progress, as well as potentially resolved work, can be seen as not fully realised until it is engaged and tested by a real audience, this being particularly pertinent for a research practice that is engaged with the immersive and/or is participatory. Some of the most enlightening perceptions about the work in development came from the unpredictability of these encounters, and the further critical and analytical evaluation that they directly generate. An example of this was while showing a virtual reality headset piece in a local exhibition, one of the most engaged audience members was in their 90’s; I hadn’t anticipated his reaction, but it demonstrated to me that no matter who is viewing the work, the receptivity of the person can be unexpected (in this instance, the feedback confirmed and reinforced my own critical evaluation of this work in progress). Other examples of this came from an interactive talk I gave at a

postgraduate research symposium¹⁰ – I devised a live-feed interactive game for the audience, something they could interact with playfully, as a way of illustrating my immersive installational work. This provided unexpectedly stimulating feedback, some aspects of which I am still exploring.

- Lastly the regular studio critique that informed supervision sessions, my supervisors bringing a special depth of knowledge and insight to their encounters with my work. These well-informed discussions both critical and exploratory, regularly led to new insights and informed future related lines of thought.

Theoretical research paralleled and further informed the practical research. Ongoing reading (with some writing) established critical and historical contexts for immersive, interactive, installational, and ‘hacking’ practices. Equally it helped me to establish a critical stance in response to current thought, including around the ‘virtual’ and its relation to the real, much of which I feel is based on false assumptions. It has been instructive to find in researching the cultural and historical contexts for the territories I am working in, that the literature is in general very fragmented; authoritative comprehensive accounts are notable for their absence, so part of my task has been to synthesise a coherent viewpoint.

To return to the practical research, although the working approaches as outlined above are systematic of artistic practice in general, they are built upon the relationship between the following methodological principles:

1. Autobiography: all my work has been derived from my personal lived experiences, and examined through self-critique, this in turn seeks to express (generate to its audience) related emotional and sensory experiences. An autoethnographic influence may be discerned within this broader autobiographical approach.
2. Generative exploration and testing: the development of my ideas in the studio – and in sketchbooks, and through gallery exposure to an audience – is focussed yet open-

¹⁰ Post graduate symposium held by the school of art and design at the university on 13th November 2020

ended, adopting a process of guided trial and error. Finding out through testing what will work as I had anticipated and what fails (but as mentioned above, this failure can be refined or allude to alternative approaches), and what may need to be shelved for another day.

3. Empirical evaluation: work that is being developed must continue to be analysed and evaluated, which is done in general on an empirical basis. In a reflective creative practice, there is no independent universal yardstick. Working as a solo artist means being able to trust your judgement, which is sharpened over time. An important element of this development (particularly so with this research) comes from discussion and critique originating in peer evaluation.

To return to the autobiographical aspect of practice as an artist, one of the things that has most strongly informed my practice both in ideas and execution has been the ten years I spent in the London Fire Brigade. This provided the expressive impulse behind much of the work I have developed during the course of this research, for example from the exposure to what it is like living on the margins of a society that disregards those who find themselves in need either physically or emotionally. But equally it also gave me a vast amount of knowledge about the physics of a space, atmospheric conditions and how to think on my feet when adapting equipment to fit the situation in hand. It also left me with memories I would prefer to forget, examining these through an exploration of immersive practice.

Reflection on (sometimes traumatic) scenes I have witnessed can act as a psychological trigger in revisiting such experiences and my emotional responses to them. This often sparks an exploration through studio and sketchbook play into possible ways of conveying the subject to an audience. A synaptic triggering between play, memory and ideas about audience engagement may characterise a looping sparking of ideas that is then refined and condensed into the work that is eventually tested on an audience. If successful, the 'trigger' may spark off new thoughts in individual audience members. As part of the live testing,

discussing their responses with individual audience members, it is interesting how frequently it emerges that something was triggered in their own memories, and a commonality discovered with their own lives.

Returning to the generative exploration and testing aspect of my methodology: while different aspects of this guided trial-and-error process have formed the basis of many individual artistic practices across centuries, it has a specific affinity with the ‘hacking’ aspect of my research. Hacking can be defined as a low-cost, individual and imaginative solution to a problem that would characteristically attract a high-tech, high-cost, institutionally-resourced solution. ‘Hacking’ in the sense that I use it requires a less worn path of ingenuity, a different and more imaginative way of thinking. There is likely to be more than one solution to the problem that will require exploring, before a promising avenue or two require further testing in the studio. Through the processes of reflective thought and physical evaluation, refining and adapting, the solution materialises, and the work comes into being (often sparking ideas for other pieces en route). This is imaginative and open-ended (but also guided) trial and error at work.

One final methodological point: with creative research projects like my own, it is customary to ‘feel one’s way’ in pursuing aims and realising the objectives of the research. The gathering of data (the adapting of instruments, materials and techniques, the critical reflection on the structural and expressive success of the work) never really ends. What I have learnt from creating one piece of work informs and inspires the next. This is akin to the ideas of Brian Massumi’s approach to process philosophy, the idea that thinking evolves through change, and this change becomes the new reality. The roadmap for this kind of research therefore needs to be able to adapt responsively as it progresses. How this progression took place is explained within the next chapter.

As mentioned, contextual and theoretical research has been conducted in parallel with the studio research. It is therefore constructive to say that there is a conscious blurring of

boundaries here – with creative research, exposure to ideas through an exhibition of another artist’s work, or through a film or novel, can through subsequent analysis be understood as important a source of theoretical knowledge (not to mention also a primary stimulus) as any theoretical essay. For example dystopian films such as ‘Blade Runner’¹¹ and ‘Metropolis’¹², films that foretold a view of the future whereby technology has all but obliterated the human race and the only people who survive are those who have learnt to adapt or overcome this through hacking the systems of its control. Similarly there were exhibitions that inspired initial and ongoing studio practice, such as *Rain Room*, Random International¹³, and *We Live in an Ocean of Air*, Marshmallow Laser Feast¹⁴. Major retrospectives of Olafur Eliasson (Tate Modern, 2019) and Bill Viola (Royal Academy, 2019), both of which included a large proportion of work that was either or both interactive and immersive – ‘immersive’ in the full sense that you are not looking *at* the work, but are inside it, physically contained or framed by it, and become an engaged component within it. This helped me focus critically on aspects of immersion, audience engagement, and subjective personal content.

¹¹ (Blade Runner, 1982)

¹² (Metropolis, 1927)

¹³Random International, 2012, *Rain Room*, Barbican, London. Installation using live body tracking.

¹⁴Marshmallow Laser Feast, 2018, *We Live In An Ocean Of Air*, Saatchi Gallery, London. Entirely Virtual Reality installation.

PRACTICAL EXPERIMENTS AND OUTCOMES

I began my research by exploring the interactive qualities of a software package called Isadora that I had been using for projection mapping¹⁵. This software is capable of interpreting various inputs to allow creative control of this data, configured to various visual and audible outputs. The first work that sparked this idea was my sculpture based on the Grenfell Tower tragedy of July 2017, a piece of work made just prior to formally starting the research, but very much part of the same process:



Fig 18. Cladding (2018)

This sculpture was created from timber and MDF, with an interactive projection that mapped the structure. From this I decided I wanted to learn more about the potential for immersive sculpture and projection mapping.

¹⁵ Projection mapping, similar to video mapping and spatial augmented reality, is a projection technique used to turn objects, often irregularly shaped, into display surfaces for video projection. (Donato, 2014)

I researched the various inputs that are compatible with the software I was starting with. One interesting component stuck out for me; the Xbox 360 Kinect Infra-Red sensor, developed for the computer-games market. This piece of kit is capable of tracking in real-time various points on the human body and therefore offered obvious potential for immersing the body into my work.

Through an open-source third party software called Delicoder, I was able to pair the Kinect with Isadora, and start to get real data inputted into the mapping software. In order to get to this point I had to trawl through obscure tutorials and YouTube videos for tips. The Kinect sensor needed to be first generation in order to be successfully hacked into; later versions were 'protected' against this kind of user tinkering. This I was able to source from eBay, the free version of the mapping software was also compliant enough for me to be able to use without much hindrance (the only difference from the paid for version being the ability to save your work). The inability to save my progress forced me to take screenshots and notes of my progress. This meant that I had to re-program the work each time, which helped me to remember the sequence that led to the desired output.

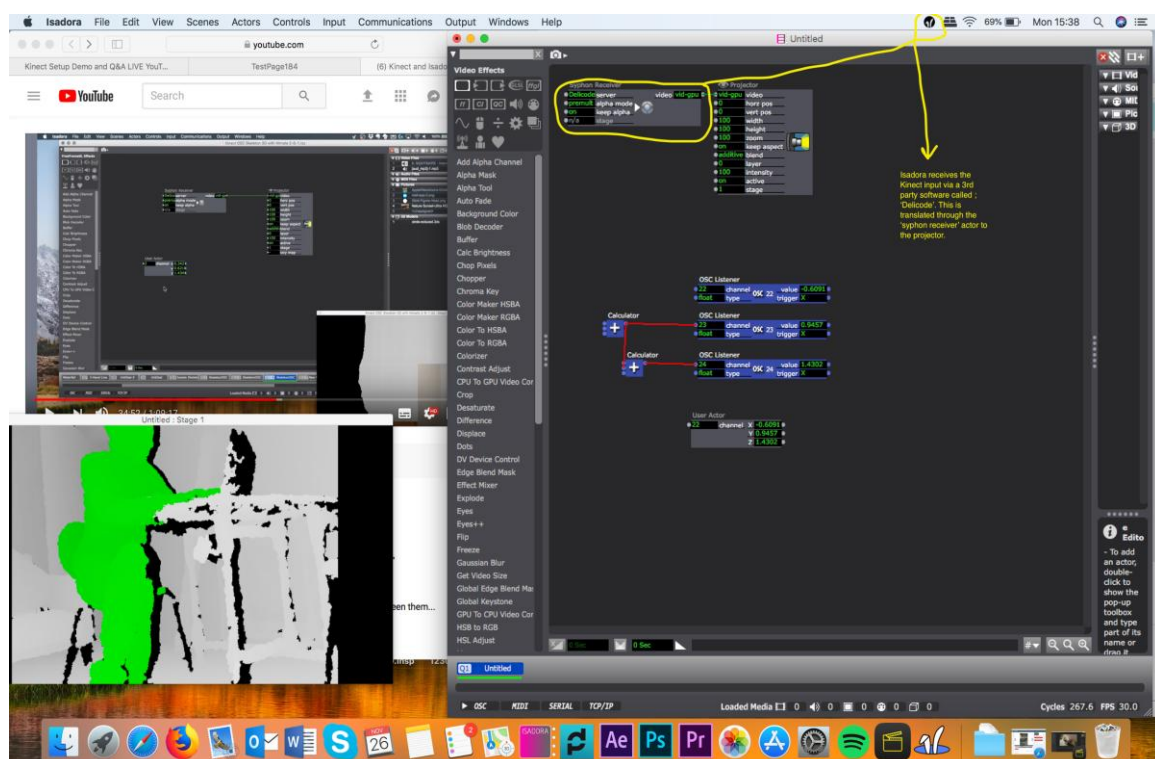


Fig 19. Kinect and Isadora screenshot, Kinect is picking up my body (green) and transferring the data points into Isadora.

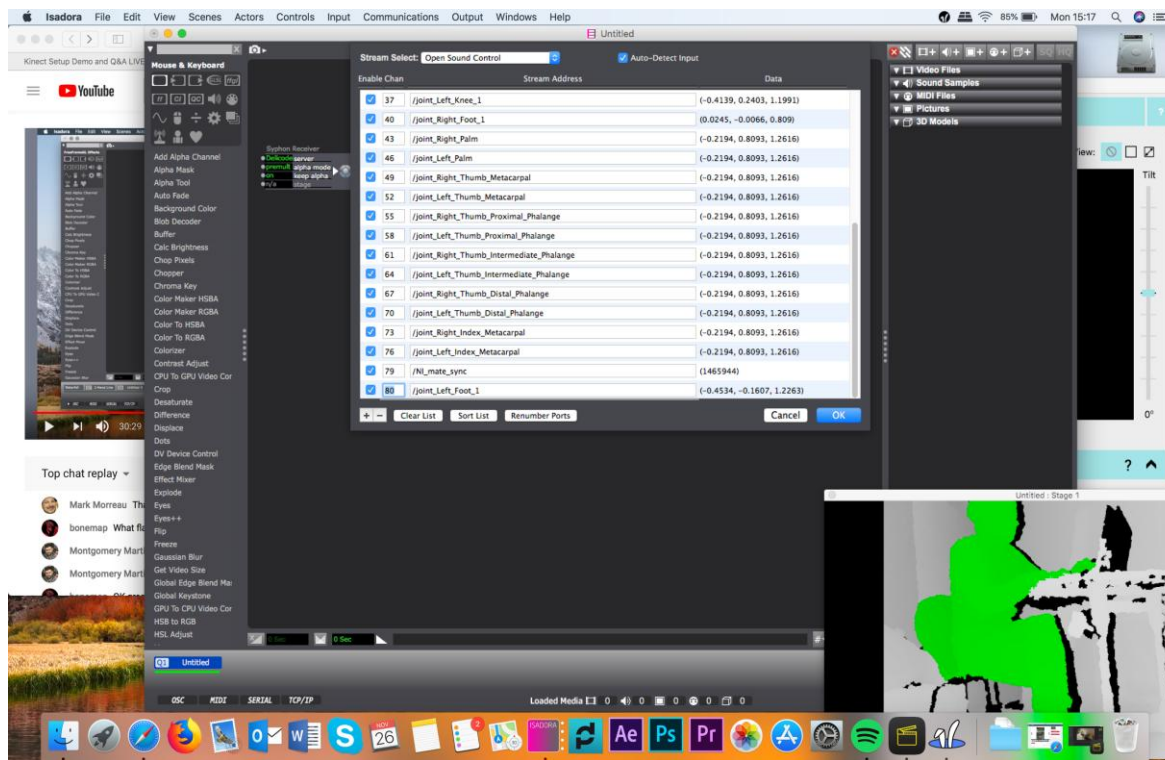
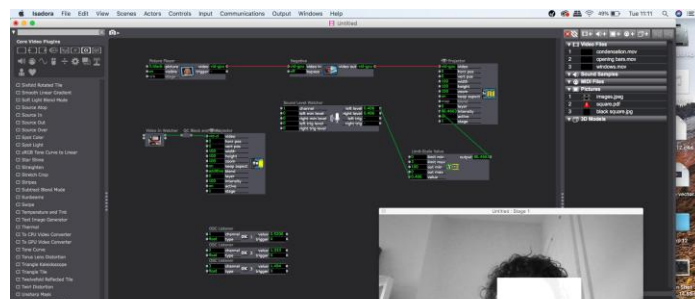


Fig 20. Data points relating to parts of body being picked up by Kinect sensor

The outcomes of this line of enquiry were manifested in a digital mirror piece that used the tracking from the Kinect sensor together with a live video feed to track a white square onto the head of the viewer. This square was programmed to track the data-input co-ordinates of the viewer's head, so the viewer's head would always be obscured with this square no matter where they looked.



Isadora is a projection mapping software package designed for mapping and video DJing. It is capable of producing multiple outputs and control for large scale light, sound and interactive productions. In order to understand this software I had been on a course prior to commencing this research, provided by the London Guildhall School of Music and Drama, which taught me how to effectively use this package and the fundamental programming required to operate a projection mapping display.



Fig 22. Gallery installation view of equipment and projection set up, **Kinect sensor** is positioned above projection screen, looking towards viewer. Laptop is running the software package converting the input to tracking data, before outputting to the projector behind.

At this point in my research and spurred on by the Marshmallow Laser Feast exhibition, *We Live in an Ocean of Air* (2018) at the Saatchi Gallery, London, I had begun to experiment with creating my own virtual reality content. I found this process straightforward; using a 360-degree camera I created video footage that could be viewed in VR. Platforms such as YouTube now have the option to be able to upload 360-degree content. This is then recognised by their software and converted into a VR video. Obviously, the device that you use to view this needs to be capable of showing the video; thankfully most smartphones have this capability. You can even download a flat pattern that allows you to create your own cardboard version of a VR headset, housing a smartphone to provide the display.

For my exhibition with Nau Arts (2019) at the Gardens Gallery, Cheltenham, I loaned a headset and an Apple iPhone from the university so I could show my uploaded content of a person walking around the town with a white square tracked exactly to their head. The viewer could see this person but not their face as it was obscured by the square. The idea being to give the viewer a sense that they were being followed closely by an anonymous figure. The device I used was a dedicated VR headset capable of playing sound (my footsteps and voice) through headphones, allowing for a more immersive experience. This exhibition brought together several different initial experiments in immersion and transferred them onto a public platform in order to test their effectiveness. I viewed this exhibition as a way of testing my ideas and for the most part they stood up to public viewing, having had people of all different ages and backgrounds attend and become interestedly immersed in the work for up to several minutes at a time.

Something that became apparent was the amount of intrusive cabling required, and connectivity issues that meant I would need to be physically in the space each day to ensure

the work was functioning as intended¹⁶. It was then after speaking with the collective Squidsoup¹⁷, that I explored the idea of using either a Raspberry Pi or Arduino¹⁸ device in order to allow for autonomous installation. I started experimenting in the studio with the Raspberry Pi as this system is widely used by schools to teach computer programming content. Therefore, there are a lot of tutorials available online for what is effectively a small programmable computer easily connected to input and output devices. Unfortunately, apart from making a small LED light up, I found the Pi too complex a system to understand and configure to what I wished it to do. I discussed this with my supervisors and agreed that getting competently up to speed with a programming language was itself a project of several months, and too much of a distraction for this particular research project. A decision that was further justified through re-reading my aims and objectives, and realising that systems like Arduino (especially) and Raspberry Pi were specifically designed to do the hacking for you, so in a very real way could be seen as undercutting one of the main premises for this research, and its artist-hacker spirit.

Following this exhibition, I continued my work with VR and started to experiment with the disconnect between the senses of sight, sound and touch when they are experienced through a system designed to transport the user to another place. Looking back at my reasoning for this line of research, the desire to recreate the dangerous situations that I was faced with in the Fire Brigade had been at the forefront, but in a safe environment, allowing others to experience real danger, but in a responsible way. So I did what anyone might do in this situation and set myself alight! Obviously, I ensured this was safe by wearing the appropriate firefighter protective equipment, I filmed myself with the 360-degree camera, with flames coming from my boots and gloves.

¹⁶ A familiar hazard for artists working with electric, electronic, and other such non-traditional media

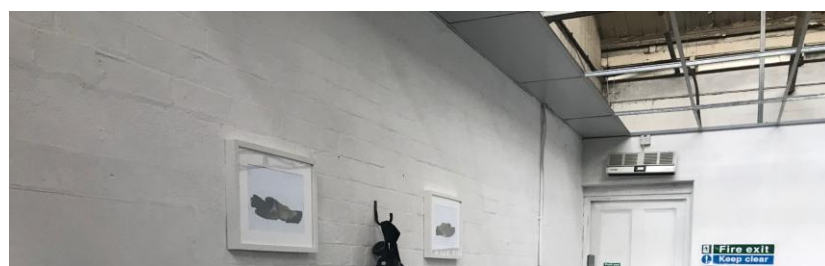
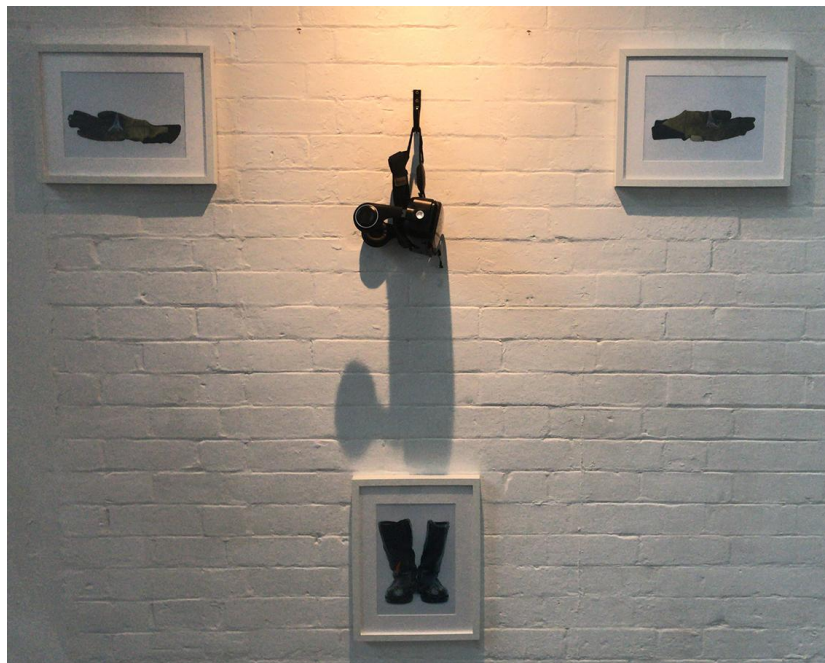
¹⁷ Squidsoup is a UK-based international group of artists, researchers, technologists and designers working with digital and interactive media experiences. (Squidsoup, 2021)

¹⁸ Both relatively low-cost commercially available micro-computer systems designed to aid like-minded people build interfaces between different input and output devices.



Fig 23. Film stills from 360 degree film₃ footage of burning hands and feet, 2019.

I made the decision to shoot the film in the same space it was to be exhibited in; this was an important decision in ensuring that the body and site elements of my proposal were integrated into the work, so that a viewer donning the headset would turn to see me 'live', flames licking, directly in their line of vision. A soundtrack of burning and crackling was later added to this footage, to enhance the viewer's sense of proximity and danger. My research has always been concerned with what is real, as opposed to the constructed digital fictions of a lot of VR content. The work was then shown in the space as part of an exhibition that included a mixture of VR, projection, sculpture and photography.



This work led me directly onto my next experiments with heat, water and ice. I decided to draw upon my knowledge of the science behind fire behaviour. I started to experiment with producing a low cost version of technology capable of producing heat and cold. I began to work with ice and cold initially, as information about creating DIY refrigeration technology is widely available. Extreme heat and extreme cold will produce involuntary reactions in human bodies. This along with familiarity with how the coupling of a compressed-air cylinder will ice up during use,¹⁹ made me chose this initial line of enquiry.

¹⁹ A standard breathing apparatus set will last for around 30 minutes depending on rate of exertion. A very small opening from the cylinder allows the 9 litre compressed air to enter the set via high pressure hosing, this area will ice up as the liquid turns to a gas during use.

So without being able to use emergency service breathing apparatus cylinders that require refilling, what could a solo artist use that is low-cost and hands on? I began to research cooling systems that are used in fridge and freezer manufacture. Commercial production uses encapsulated refrigerant gas. My hacking approach, however, was to explore the potential of repurposing a device known as a Peltier plate, used in combination with a fan to cool computer systems. A Peltier plate is a thermoelectric device that through the transfer of electrons produces a hot side and a cold side of a metallic block. The cooler you can make the hot side, the colder the cold side will become.

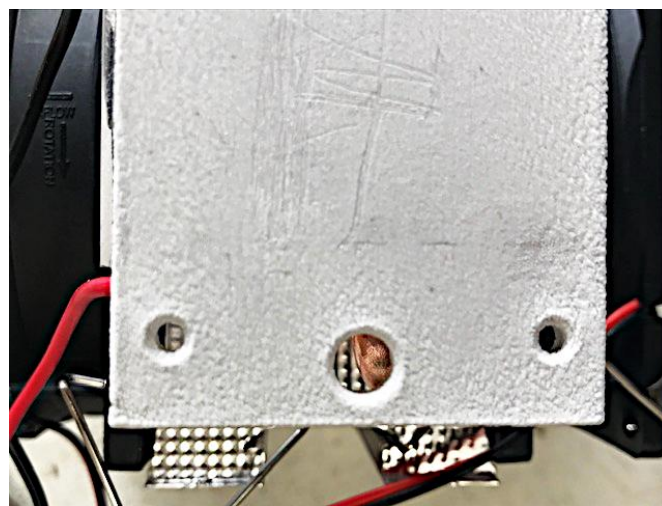


Fig 25. Aluminium plate with frost formed on surface

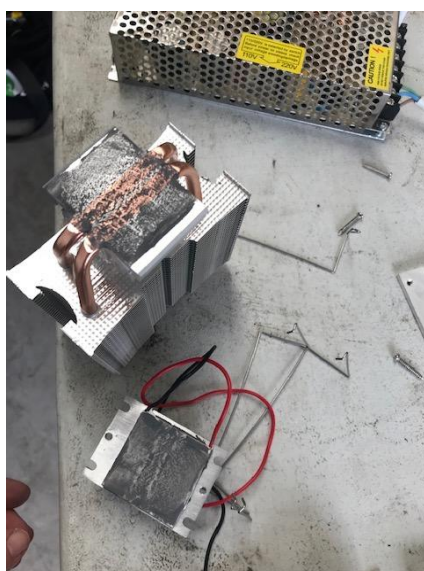


Fig 26. Peltier plate removed from top of heat sink

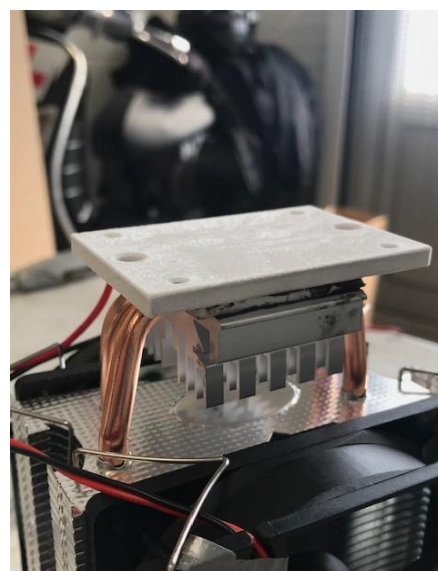


Fig 27. Frost appearing on aluminium plate attached to heat sink and fan.

The initial experiments here produced some success as frost appeared in the surface of an aluminium plate that I attached to the cold side of the Peltier plate. However, the result was far too subtle for me to be able to utilise in any artwork; as soon as you touched the plate it would raise the temperature of the plate sufficiently to lose the frosted coating. It was clear that I would need to cool the Peltier plate down far more than the home-computer fan system could cope with. Through further experimentation, I found that some central processing units utilise water cooling. They require a CPU water block which together with a pump can pump cold water continuously through the block in order to cool the Peltier plate at a faster rate than the fan system could do.



Fig 28. CPU cooling block (blue) with water pumping through cooling the Peltier plate on top.



Fig 29. Ice formed on surface of plate,

The outcome of this experiment, adding a home-brew version of an automotive cooling system to the Peltier plate, required some reworking in order to produce an effective work, one which would sustain the frozen surface to such a degree that it could be worked into a sculpture. Deciding not to plumb into mains water supply, which would have made for a permanently tethered work, I looked for an alternative solution. The final hacked work took shape in the form of a bucket of cold water which was replenished with ice, a domestic aquarium submersible pump, and a gravity feed. This worked well, and sustained ice formation on the Peltier plate.

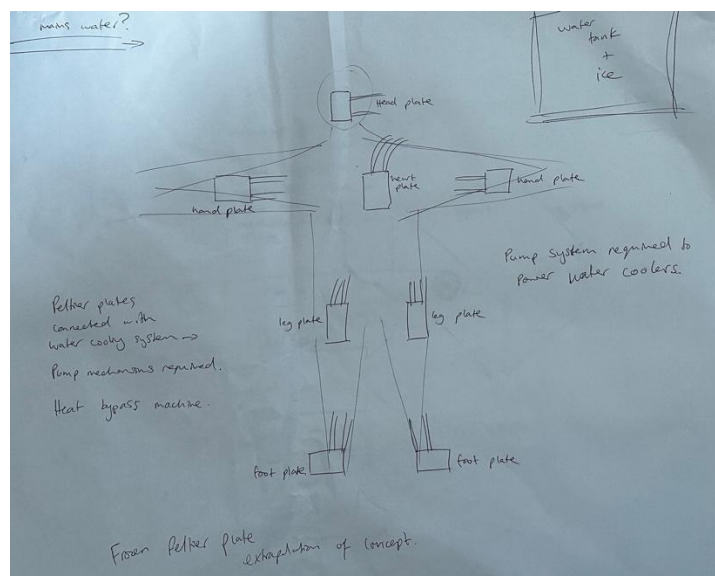


Fig 30. Sketchbook drawing of potential progression of the Peltier Plates to provide 1:1 correlation with human form



Reflecting on these outcomes, it was obvious that this work had marked a bit of a departure from my previous line of enquiry into VR and projection. The provisionality of the work was of particular concern as the frost covering would melt away and reform as the water became heated due to the circulation through the sculpture, before being cooled with more ice added. However, the DIY feel of the work and the contrast between the behind-the-scenes hardware and the clean look of the plate was interesting, and did fulfil the objective of a low-cost hacking approach to the work. The interaction and immersive quality is reliant on the freezing and refreezing element and so it was decided this needed more work to become fully developed and reliable without compromising on the hacker approach or costs of the project.

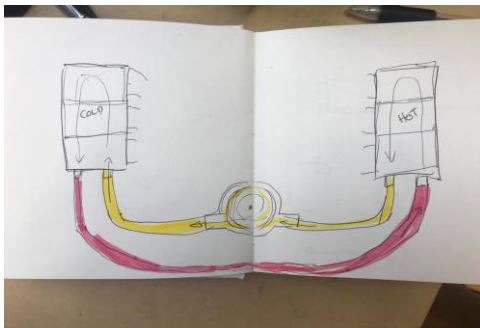


Fig 33. Further sketchbook development of Peltier plate experiments

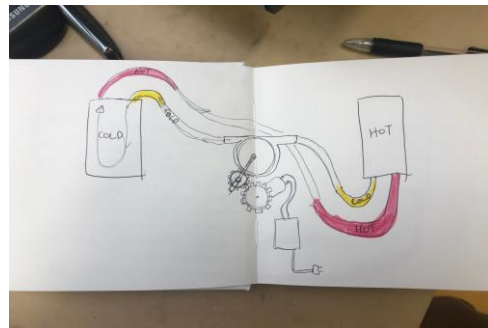
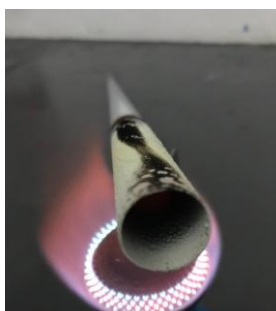


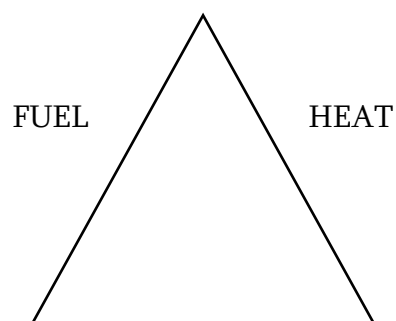
Fig 34. Potential pump mechanisms to be used for multiple plates

I began working on some ideas to take this forward in sketchbook form, the next steps being to try and create a self-contained loop of heating and cooling in order to provide better operational reliability. The ultimate development of this would be a fully functioning sculptural piece that would have plates installed at various heights that would echo the points on the human body such as the heart, head, hands etc. The closer that the viewer came to touching these with their body would then evoke a reaction in the plate by melting the ice formation with the heat from the body. This vulnerability in the ice formation to the proximity of a heat source, would further emphasise the fragility of human life itself. Ultimately, restrictions imposed by the pandemic meant that no exhibition of this installation could be realised.

Alongside this progression I was also working on a piece centring on heat. I started out using a gas flame to heat a metal pipe in order to experiment with causing a change in atmospheric pressure and potentially drawing in air from one end of the open pipe through to the other. This is similar to the way that a chimney works by hot air rising creating low pressure beneath and pulling air into the space, the oxygen thus further fuelling the flames. This is essentially what happened in the infamous Grenfell Tower fire. I realised pretty quickly, however, that the amount of heat required to perform this act was greater than safety allowed.



The solution to this was to focus on the air pressure itself and to eliminate the heat from the experiment. To achieve this I placed a fan in the end of a copper pipe and this immediately created the effect I wanted, the air was being drawn in through the pipe into the fan. My initial desire was to effectively move air from one compartment to another. I use the word compartment here to indicate different self-contained spaces, for example two adjoining rooms. The immersive component would be the atmospheric conditions in each separate space and the ability to control them. As in my firefighting work, the ability to alter conditions can mean the difference between a survivable fire to losing a whole building to the flames. By way of an illustration of this the most basic way of describing it would be through the fire triangle.



In order to sustain combustion, all three of the above components are required. If one is removed, then combustion is no longer sustainable, and the fire will go out. So in my experiments I was attempting to control the atmospheric conditions of the gallery space through immersive installations.

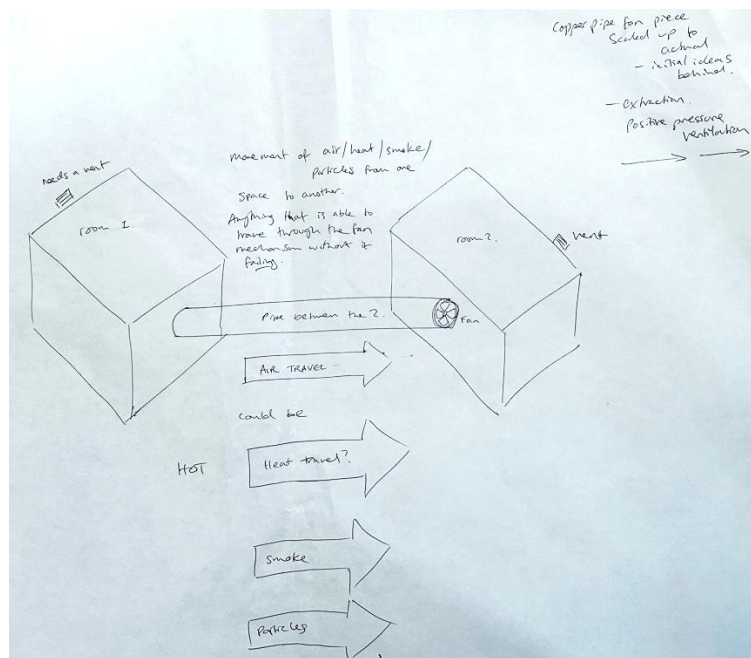


Fig 38. Sketchbook work illustrating the potential for copper pipe to duct large volumes of air across a pressure differential between one space to another

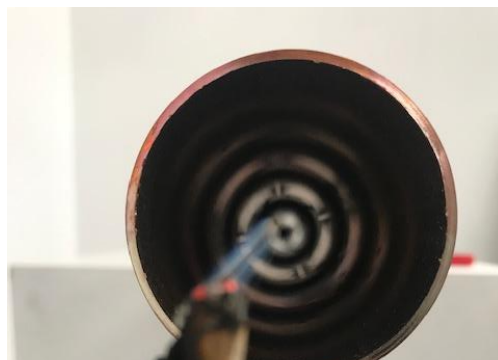




Fig 40. Copper pipe with fan mechanism
image from above.

This piece can be seen as a small scale experiment for a larger work that would be capable of producing a distinct change in atmospheric pressure. This work if scaled up would be used to draw air from one space into another, thus creating an immersive experience with possibilities for installation as a complete piece. For example the fan mechanism would be situated away from the viewing compartment and so the experience would be of a strong wind being pulled through the gallery. Unfortunately due to the continued lockdowns and inability over this period to get hold of raw materials, this work was left unresolved at this stage, to be picked up again when resources were available. However, it was capable of

being viewed in experimental form, and so has contributed as an integral part of this exploration into elemental immersive techniques. I was able to explore the potential in drawings and would like to have the opportunity to produce a working scaled up version in the future.

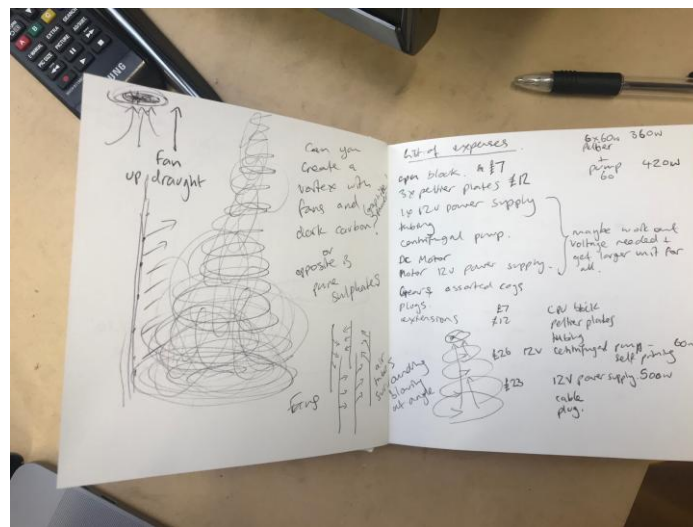


Fig 41. Sketchbook work showing the progression of the fan experiments.

The final practical pieces returned to the projection work that I had addressed earlier on in the research. This time, combining the work with natural elements, utilising water vapour as a volumetric projection screen that one could interact with by walking through. Inspired by the work of Fujiko Nakaya²⁰ and Random International²¹, my previous experimentation with air pressure led me to using water vapour. The challenge was to find a way of creating a volume of vapour substantial and stable enough to project onto without disrupting the image too much. This proved to be far more difficult than I had anticipated. I began with an irrigation hose with nozzles that would spray out water; unfortunately even pin-hole-

²⁰ Fujiko Nakaya Fog sculptures featured in Guggenheim Bilbao online at <https://www.guggenheim-bilbao.eus/en/the-collection/works/fog-sculpture-08025-f-o-g>

²¹ Random International, Rain Room and other works online at <https://www.random-international.com/>

sized apertures proved far too large, providing a rain rather than a mist. I then explored the idea of boiling water in order to provide the vapour. This was successful and directly went to the heart of my hacking research ethos. However, the movement of the steam meant that the picture was still distorted too much to discern the image.

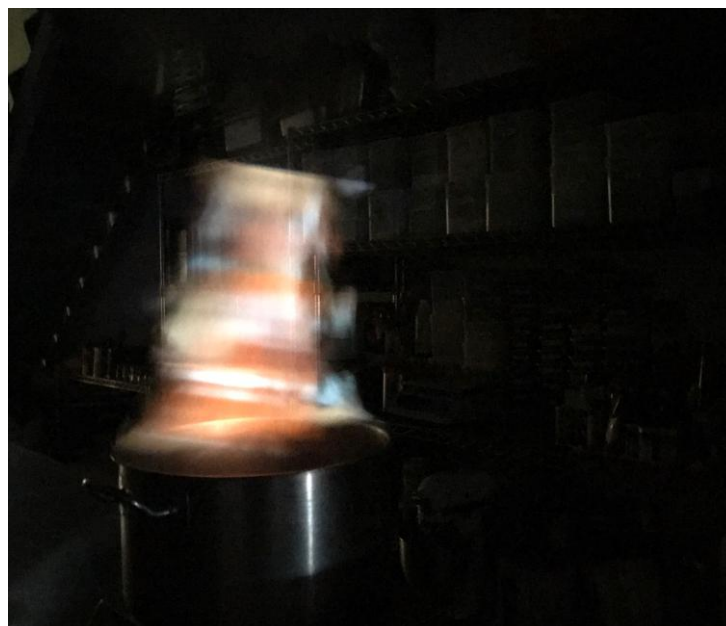
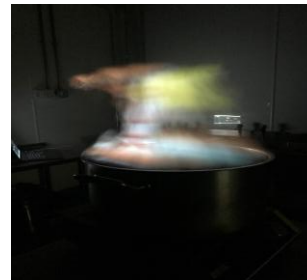


Fig 42. Images that show the studio experiments of boiling water as a steam projection medium using a large pan of boiling water and projector.

For me there was potential in these experiments to become something more resolved, but the difficulty of producing a legible image meant that the desire to use this as a projection screen for moving images faced a fundamental problem. I also wanted a way to bring more

immersive qualities to the installation, so it wasn't simply something you walked around and looked at. I had been working on producing images from sound by utilising the sound input control on the Isadora package, the idea being to present the more easily-read image of the sound-waves, rather than any figuratively representational content. The sound-wave imagery would be created in real time and by the audience. The final visual effect would be dependent on the nuances of the differing sounds created within the space, without the requirement for the viewer to decode the image as anything other than an abstracted representation of their own presence. The fact that the soundwaves were generated by the audience would immediately make the work an interactive one, articulated by the audience's engagement with it. This represented the final development of ideas prior to the suspension of the current research due to the Covid pandemic and other contingent factors. The final showing of my work prior to this point was through a virtual symposium organised by the School of Art and Design for the university at the end of 2021.

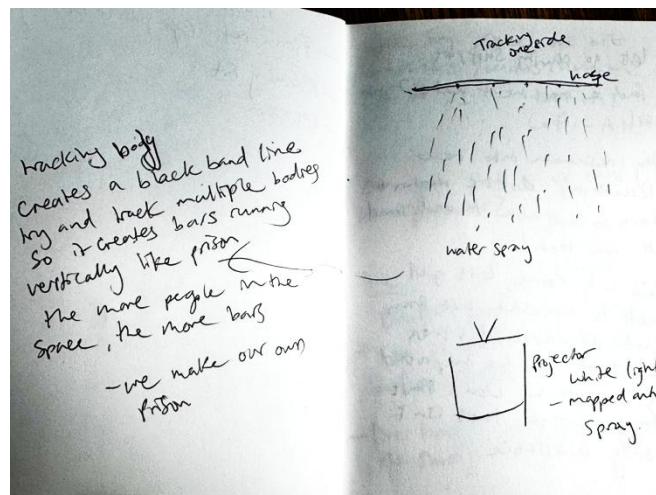


Fig 43. Sketchbook work exploring the relationship between sound input and projected image. Idea for installation where the audience influence the image using voice, movement, gestures

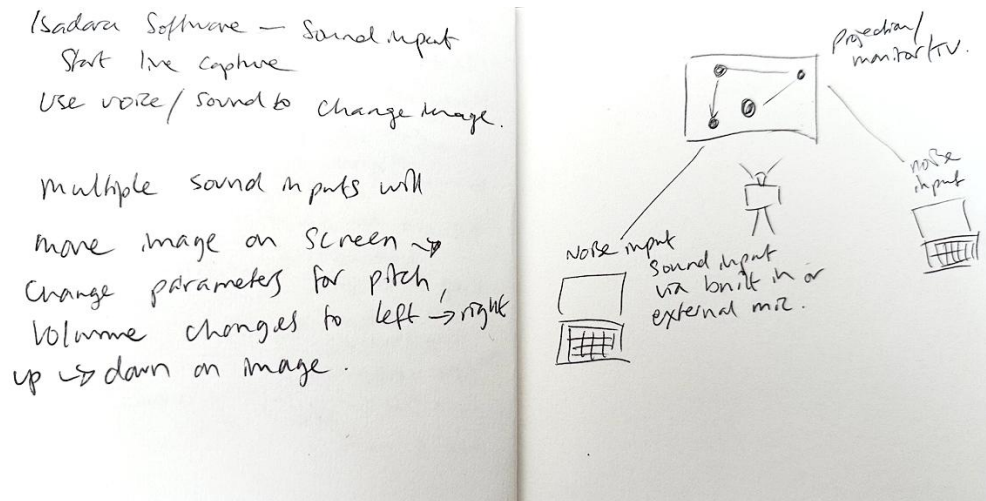


Fig 44. Sketchbook development of work in fig.43, using an internet connection so the symposium audience can use their computer microphone to remotely alter the image

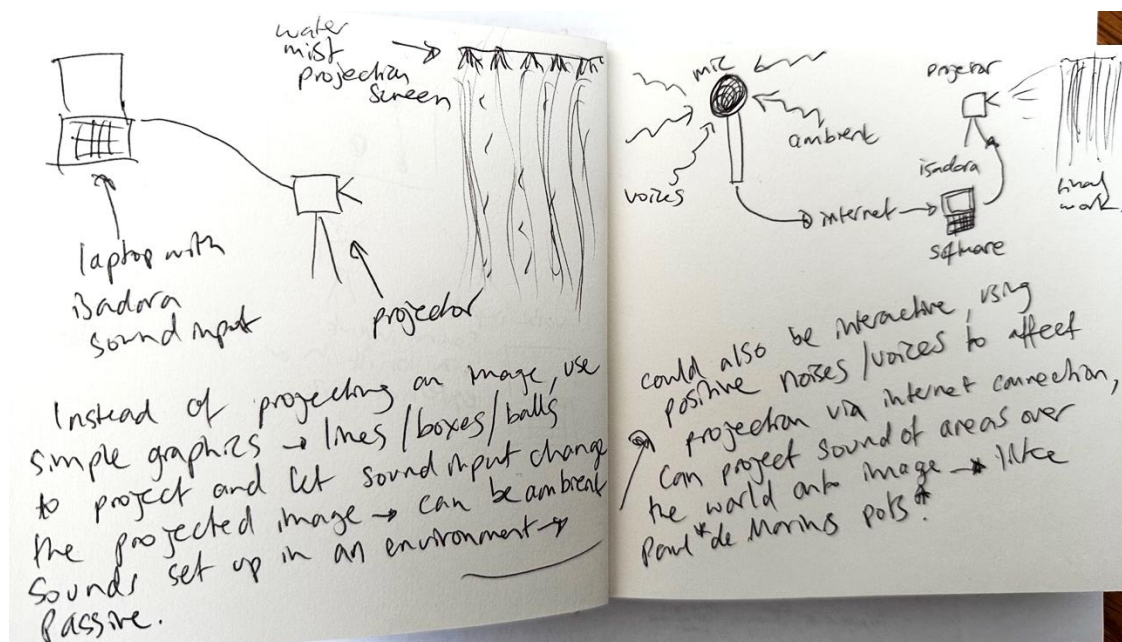


Fig 45. More complex exhibition-focused development of work in figs. 43-44

This symposium was a chance to expose my current research to members of the research community who had not previously had knowledge of my practice. Despite this being an online event, it was an ideal opportunity to test out the interactivity and effectiveness of my work. I ran through a presentation that I had outlined, which aimed to introduce my work, background and the context for my research before engaging the audience in a virtual interactive work. The sound input was used to great effect here. I developed a game

whereby the audience had to make enough noise to move a red dot on their screens; to win the game the audience needed to house the red dot inside a cube and use the pitch and volume of their collective voices to keep it there.

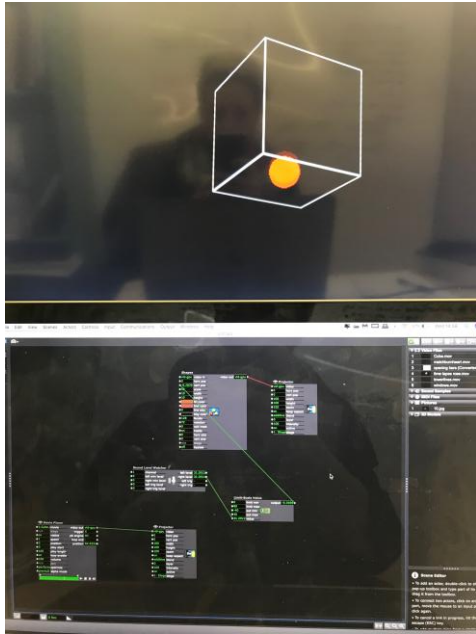


Fig 46. Isadora patch for interactive game

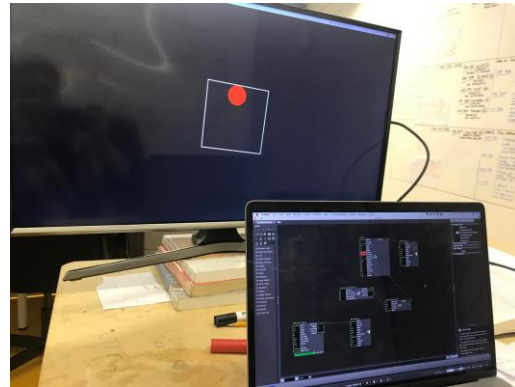


Fig 47. Demonstration of game as it would be viewed by audience

The outcome of this virtual symposium was of greater significance than I had anticipated. This was the first time that I had been able to produce a playful interaction, shared directly with an audience, and without the audience being present in the room. It was engaging to an unexpected degree, generated a lot of enthusiastic collective noise, and proved to be instrumental in offering a practical outcome to my initial line of questioning:

How can advanced electronic means be deployed by the solo artist to such ends, while keeping resourcing low-cost and hands-on?

Using my laptop, a software package, an external monitor and an internet connection, it showed me I could simplify my approach to immersive content and ensure engagement through play. At the heart of this research has always been the desire to engage the audience with the work, whether that be physically in the form of installation or virtually over the internet. The audience has to feel included in the process, free to experience the work in a way that keeps them engaged and interested in the art, without concentrating on the technicalities of the execution. Immersion of the viewers in the work had to be unconscious and natural. Importantly, what I hadn't initially foreseen, or factored in, but was a genuine revelation to me, was the ways in which a strong performative element (on my own part as well as the audience's) could inflect the nature of the work, and add a different dynamic to it.

CONCLUSION

In reflecting upon what has been achieved through this research, it is important to balance its stated aims and objectives against an awareness of the twin threads of autobiography and playfulness that run through it all. Both aspects need evaluation. As artist and researcher, my reflections must inevitably be tempered by an awareness of initially unarticulated factors that nonetheless proved central to the whole research process.

My work throughout has not required any expensive kit or advanced electronic systems that are either unobtainable to the solo artist due to the commerciality of the technology, or demanded extensive knowledge of programming. The work which I have produced under these constraints has however been emotionally expressive. The virtual reality content has been led by my own experiences and desires for the audience to come closer to uncomfortable or dangerous situations, without the need to expose themselves physically to this danger.

The technical components and systems that I have utilised in this research have been available to an ordinary person through everyday channels and at relatively low cost. The most significant of these were repurposed to help create the qualities of immersion and audience engagement set out in the research aims. The work that has been created is self-evidently (and through the additional evidence of this thesis) the product of an individual artist working on her own, adapting what is easily available, to create the kind of advanced effects that might ordinarily involve more extensive technical and financial support.

As is the case with all art, it is for others, and not the artist, to pass final judgement on the degree to which the work succeeds in generating or communicating expressive qualities. As an artist, you become used to putting your work 'out there' in order to gauge the responses of others, it is part of the process of testing your work; as a creative researcher, you also rely in a similar way on feedback from your peers – fellow researchers and fellow artists – and from your supervisors. I can only say that I have been encouraged by the ways that audiences have engaged with my work, by direct responses it has gathered, and by the critical discourse it has engendered. My exhibitions at the Gardens Gallery, Cheltenham (twice) and Nau Arts Gallery, Cheltenham, alongside supervision meetings, provided me with the opportunity to showcase my developed pieces that included work with virtual reality headsets, motion tracking technology and projection mapping, and gain constructive feedback towards its further development.

What have I learned from the research? I have learned a great deal, not only about the technicalities of making works based around components and systems used in ways their originators never intended, but also about the unpredictable factors inherent in exhibiting it in public spaces – such things as connectivity issues, software glitches, and the unscripted nature of audience interaction. I have learnt not to overcomplicate ideas with layers of technology which are not integral to the aim of the work. I have learned, through the bump in the road represented by my adventures with the Raspberry Pi, not to lose time and focus on unplanned digressions that might well be integral to a different research programme. On reflection, this particular distraction caused my research to temporarily stall. Subsequent discussion led me to re-visit old ground but from a fresh perspective, the more 'elemental' work with water, heat, fire etc., so ultimately there was a positive outcome.

Have the original aims set out for the research been satisfactorily realised?

Taking each of these in turn:

- Show how a solo artist can produce nuanced emotionally-expressive immersive installational work, supported by advanced electronic means, without the extensive resourcing (financial, material, human) behind most other exhibited work of the same kind:

I believe that I have succeeded in this with pieces of work that are either complete or have been studio-demonstrated as full-scale tests or as proofs of concept. However, a significant caveat is that time was ultimately not available to return, as I had intended, to the projection-mapping experiments, in order to apply them to a fully realised immersive piece of work carrying its own expressive content. This represents a personal frustration for me.

- Evolve low-cost DIY/'hacker' ways of working with industrial/prosumer electronic devices and systems, in a multi-sensory installational/sculptural arena, where the audience engages interactively:

Overall, I believe that this has been demonstrated, despite the fact that opportunities for audience interaction were brought to a rude pandemic-induced halt eighteen months into the research period, after three trial exhibitions, and that the ultimately unrealised projection-mapping project (in particular) remains a work of potential rather than of reality.

- Demonstrate how the individual hand and touch of the artist can be sustained alongside (as well as through) the use of advanced digital technology in an installational arena, and how a working process promoting both can provide insights into innovative approaches to using such technology:

I believe that this thesis, and the exhibited work (both complete and work in progress) that necessarily preceded it, has shown that there is a way for personal, autobiographically based, expressive touch to co-exist with the use of advanced technologies. In one way, I was prepared for this, through awareness of the work of artists like Jean Tinguely (which is electro-mechanical but not electronic) and Nam June Paik. This was reinforced during

the course of the research through discovering the work of (and talking with) an artist like Rachel Ara. Of course the research project required me to demonstrate through my own work, with different electronic systems, how these important signs of hands-on individuality can be sustained. As noted above, it is ultimately the viewer and not the artist who must determine the validity of such claims; but the feedback I have received, and my own evolved critical evaluation, tells me that those signs of personal touch are there and contribute to the expressivity of the work.

Part of my original research question was to ask how could advanced electronic means be deployed by the solo artist to achieve an immersive work of art. One of the answers that the research led to was as enlightening as it was unanticipated; the realisation that a particular kind of playfulness, a familiar aspect of my studio working process, could be directly shared with a remote audience through a kind of performative online presentation, aided by video-conferencing software and a virtual game I had devised. Both the shared playful interaction, and the potential to grow a performative dimension to my practice, were serendipitous discoveries with interesting future potential.

I have mentioned that I do not buy in to widespread views about virtual reality. My considered feelings are that the completely digitally-constructed or fabricated 'realities' of conventional VR misunderstand some of the finer points of the way our minds comprehend what is actually real, and what is plausible in one sense, but in fact has been cleverly faked up and does not fully correspond to our understanding of where we are and what is tangible. This kind of popular VR maybe takes to a logical conclusion the kind of representational space found in paintings or films, but forgets that we always know the difference, and aren't taken in. In other words, we know a fabrication when we see it! In this research, in my experiments with providing the VR headset with filmed footage of the space you are actually standing in (rather than some digitally-constructed 'other' space), I have tried to rebalance or reclaim our sense of believable space, with the aim of making the other thing you see with the headset (the artist, set alight, in this case) all the more

believable. Although I have experienced them, I have not yet explored the augmented reality devices specifically designed to place digitally created content within the field of view of the physically real spaces. As with other work done through this research, all this is something I would like to pursue further when circumstances allow.

I cannot responsibly conclude my reflections on the relative successes and shortcomings of the research without mentioning some effects of the pandemic, which hit eighteen months into what had been intended as a four-year research programme. Unfortunately we do not live in a perfect world, and it is important in reflecting upon the ways that my research was conducted, to acknowledge ways in which it was impacted by these events. I want to stress that what follows is as objective an account as I can make it, and offered with reflective hindsight.

Most immediately, these events impacted on supervisory studio critiques (with the best will in the world, as others involved concurred, many of the sensory qualities relating to the work turned out to be highly resistant to remote online 'viewing' and so also to the relevance and richness of related discussion), and through the complete disappearance of public exhibition opportunities and thus interaction with available audiences. I am not sure if 'double whammy' is in the approved research lexicon, but it did come to mind.

It was also the case that through this period, circumstances unfortunately forced the retreat from a dedicated studio with generous testing space for installational and immersive works that had been rented for the research, to the much tighter constraints of a small balcony annexe in an industrial production unit (we all know that challenges can stimulate invention, but ultimately this was an undeniable loss to in terms of amenability and feasibility). In retrospect, the quality of playfulness on my own part was also compromised by the challenges of this episode. The artworks that I had been working with in anticipation of a final exhibition had progressed to the stage at which they had to be set aside, or (as with the freezing Peltier plate experiments, and even more so the work with projection

onto bodies of water-vapour) developed in circumstances that constrained their scale and disallowed full-scale testing of installed work with all of the rich feedback that generally comes with that.

Lastly, it is probably unnecessary to point out that the pandemic-induced closure of public exhibitions around the country, and the related disappearance in the art press of critical reviews, put a rude stop to an important arena for theoretical information and first-hand knowledge (it is often by immersing ourselves in another artist's work and the reviews that follow that we expand our critical toolset, and gain clearer critical insight into our own work). I will leave the reader to make sense of the accumulated pandemic-whammy-coefficient...

That part of the account out of the way, the final exhibition of my work should be seen not as a full stop to the creative output, but as a snapshot of a moment in time that will no doubt go on to be revisited and developed through my further career as an artist. I would prefer that exhibition (documentation of which is in the thesis appendix) and this critical account to reflect on all of the positive achievements of the research. The context is in the end its background, against which as a solo artist I fully intend my interactive and immersive work to continue its future development. My life alongside this research has changed beyond what I would have ever imagined possible when I began this journey. It is a journey that will continue.

IMAGE CREDITS

Note: where no other artist is credited, the images are mine and made in the course of this research.

Fig 1. Gabo, N., Standing Wave, 1919-1920. *Tate.org*. [Online]

Available at: <https://www.tate.org.uk/art/artworks/gabo-kinetic-construction-standing-wave-t00827> [Accessed 28 April 2022]

Fig 2. Tinguely, J., Homage to New York, 1960. *MoMA*. [Online]

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Fig 3 & 4. Tinguely, J., Mengele Totentanz, 1986. *Tinguely.ch*. [Online]

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Fig 5 & 6. Paik, N. J., Nixon, 1965-2002. *Nam June Paik, Nixon*. [Online]

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Fig 8 & 9. Anderson, L. & Yee, L., Tape Bow Violin, 1977. *Laurie Anderson, Trisha Brown, Gordon Matta-Clark: Pioneers of the Downtown Scene, New York 1970s*. New York: Munich : Prestel

Fig 10. Random International, Rain Room, 2012. *Rain Room*. [Online]

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Fig 11. Sketchbook work showing development of ideas following early discussions with Squidsoup and Marshmallow Laser Feast

Fig 12. Marshmallow Laser Feast, We Live in an Ocean of Air, 2018. *Marshmallow Laser Feast*. [Online]

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Fig 13. Goksu, K., How Not To Be Seen: A Fucking Didactic Educational .MOV File, 2013. *Hito Steyerl: Zero Probability and the Age of Mass Art Production*. [Online]

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Fig 15. Anise Gallery, This Much I am Worth, 2017. *Rachel Ara*. [Online] Available at: <https://anise.gallery/rachel-ara-2/> [Accessed 28 April 2022]

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Fig 17. Guggenheim Bilbao, Fog Sculpture #08025, 1998. *Fujiko Nakaya*. [Online] Available at: <https://www.guggenheim-bilbao.eus/en/the-collection/works/fog-sculpture-08025-f-o-g> [Accessed 23 April 2022]

Fig 18. Cladding (2018) Sculpture installation using projection mapping techniques

Fig 19. Kinect and Isadora screenshot, Kinect is picking up my body (green) and transferring the data points into Isadora

Fig 20. Data points relating to parts of body being picked up by Kinect sensor

Fig 21. Square tracked to the human head co-ordinates from Kinect sensor

Fig 22. Gallery installation view of equipment and projection set up, Kinect sensor is positioned above projection screen, looking towards viewer. Laptop is running the software package converting the input to tracking data, before outputting to the projector behind

Fig 23. Film stills from 360 degree film footage of burning hands and feet, 2019

Fig 24. VR headset installed in Nau Arts exhibition, 2019

Fig 25. Aluminium plate with frost formed on surface

Fig 26. Peltier plate removed from top of heat sink

Fig 27. Frost appearing on aluminium plate attached to heat sink and fan

Fig 28. CPU cooling block (blue) with water pumping through cooling the Peltier plate on top

Fig 29. Ice formed on surface of plate, capable of holding a fork upright

Fig 30. Sketchbook drawing of Peltier Plates aligned with the human form

Fig 31. Reverse of Peltier plate experiment showing bucket with iced water and power supply

Fig 32. Front side of same board, showing frozen aluminium plate, positioned at height of an adult human head

Fig 33. Further sketchbook development of Peltier plate experiments

Fig 34. Potential pump mechanisms to be used for multiple plates

Fig 35. Gas flame, metal pipe

Fig 36. Fan drawing in air illustrated by smoke pulled into pipe

Fig 37. Fire Triangle diagram

Fig 38. Sketchbook work of copper pipe progression

Fig 39. Fan mechanism at work, image looking down the centre of the pipe

Fig 40. Copper pipe with fan mechanism image from above

Fig 41. Sketchbook work showing the progression of the fan experiments

Fig 42. Images that show the studio experiments of boiling water as a steam projection medium using a large pan of boiling water and projector

Fig 43. Sketchbook work. Idea for installation where the audience influence the image using digital sound input picked up by software and translated into image

Fig 44. Sketchbook development with an internet connection and computer microphones

Fig 45. Sketchbook development for gallery installation

Fig 46. Isadora patch for interactive game

Fig 47. Demonstration of game as it would be viewed by audience

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APPENDIX

The following images represent the final showing of my installations held at Nau Arts Gallery on 3rd May 2022.

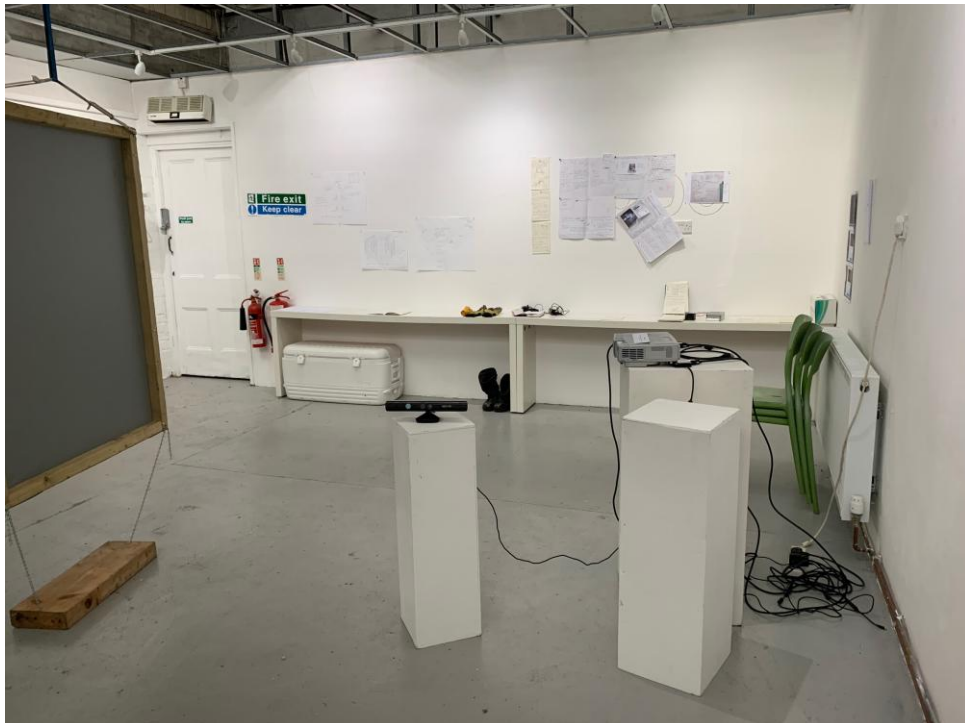
I would like to thank Sophie Wardle of Nau Arts for providing the space and time to ensure this show could be put on for the benefit of this research and examination.



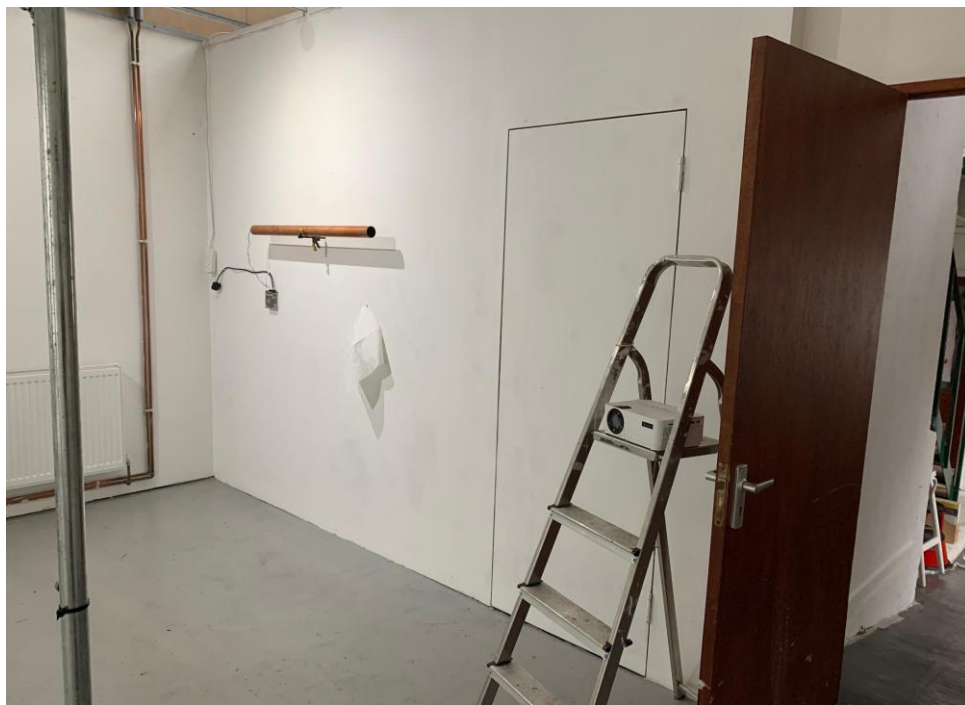
Isadora Kinect interaction



Sketchbook notes and background research displayed



Kinect sensor with sketchbook work in background



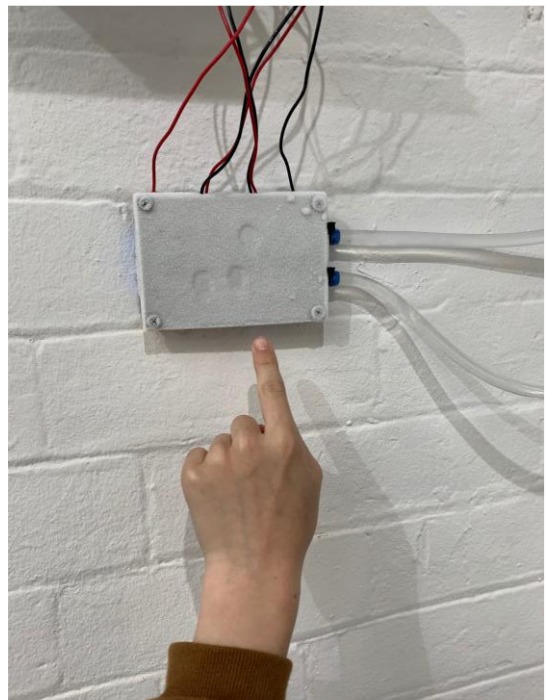
Mist projection sculpture installation shots



Copper pipe sculpture with paper napkin to test suction



Copper pipe interaction and installation shots



Peltier plate interaction



Replenishing ice bucket and VR piece interaction