University of Alberta

DESIGNING FROM WITHIN: EXPLORING EXPERIENCE THROUGH INTERACTIVE PERFORMANCE

by

Robyn Taylor

A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

Department of Computing Science

Fall 2012
Edmonton, Alberta

In memory of my friend and mentor, Frances Schuchard (1922-2012)

Abstract

This thesis describes a practice-based methodology in which an interdisciplinary team of computer scientists and musicians create, enact, and iteratively refine a series of technologically mediated participatory performances structured to investigate HCI research questions surrounding participant engagement with technological interfaces in public settings.

We choose to "design from within" by taking active roles as performers in each piece, experiencing the performance alongside participants within an authentic public use context. We draw upon McCarthy and Wright's pragmatic approach towards experience-centered design and evaluation, using their theoretical framework to interrogate the sensual, emotional, spatio-temporal and compositional aspects of collaborative behaviour through felt, lived experience. This self-situated manner of practice allows us to experience the enactment of our design interventions firsthand, and develop understanding of the performance scenario through our own personal processes of sense-making.

Our participatory installations are intended for public consumption, meaning the works must always maintain production quality suitable for professional exhibition. However, they are intentionally implemented so that they may be constantly refined and re-configured, changing and developing as our understanding of and relationship to them grows over time.

In this thesis, we describe the creation, performance, and evaluation of three interactive works: dream.Medusa (2007), humanaquarium (2009) and Nightingallery (2011). We explain how our experiences with the performances revealed insight into engagement with technologically mediated interaction in public spaces, allowing us to investigate how modifying performance design affected experiential issues

such as the reduction of stage fright, the encouragement of collaboration, and the exploration of the relationship between legibility and expressivity.

The novelty of our approach lies in how we have taken an active role as performer/designers within the use context of a series of performances, each subsequent performance being inspired by the research undertaken throughout the investigative trajectory. We draw upon personal, autobiographical experiences with the projects to develop understanding of public engagement with creative technologies, allowing our experiences with the projects to inspire avenues of HCI design intervention and research. Our method of investigation leverages interdisciplinary practice and expertise to inform interaction design for playful, ludic systems in a holistic, pragmatic, experience-centered way.

Acknowledgements

First and foremost, I would like to thank my collaborators, Guy Schofield and John Shearer. For three years we have worked closely together, creating these projects, touring, and exhibiting them. I have been exceedingly grateful over these years for John and Guy's friendship, and for the unique spirit of creativity, camaraderie and mutual respect which has characterized our working relationship.

My supervisor, Pierre Boulanger, has continually supported me in my work. Since I first arrived in his laboratory shortly after finishing my undergraduate degree, he has been a source of support and encouragement, and has been willing to allow me to develop an unconventional method of practice within his research group.

I would also like to thank Patrick Olivier, who generously provided me with the opportunity to work and study in his laboratory. His Digital Interaction Group is a challenging, stimulating environment which I have been very happy to be a part of. What was supposed to be a six week visit in the summer of 2007 has turned into five years of exciting collaboration. Patrick's guidance has taught me to approach interactive media in a holistic, pragmatic way, bringing together the social and artistic considerations as well as the technical.

I would also like to thank Peter Wright, Jayne Wallace, John Bowers, Maria Lantin, Walter Bischof, Vanessa Yaremchuk and Frances Schuchard for the professional advice and assistance they have given me over the years, as well as Stan Ruecker and Steve Benford for being part of my examination committee. Additionally, I must thank Cassim Ladha and Neil Davidson for providing photographic documentation of the performance projects, and David Green who contributed video footage used in the *humanaquarium* performances.

My research was supported financially by the Natural Sciences and Engineering Research Council of Canada, and Alberta Innovates, and for this I am deeply appreciative.

I am grateful for the support provided by my parents, my grandmother, my brother Ryan, his wife Kim and his daughter Julia, who have been unconditionally helpful during my years of study. I am lucky to have in my life my childhood schoolfriends, Sam, Melanie, Kasia and Kylie, as well as the many new friends I met when I travelled to the UK. I have had many adventures with my original PhD contemporaries Hooky and Dunphy, Wayne, and the rest of the Space 2 team. In particular I want to acknowledge the support and friendship I have received from the Ladhas (Kim, Andrea, Cas and Janet) who have provided me with a real feeling of family, and a home-away-from-home during my time in Newcastle.

Most of all, I want to express my love and gratitude for Qasim Chaudhry, who, by the time of this publication will have become my husband.

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Chapter 1

Introduction

If asked to describe a traditional "performance," one would likely imagine a unidirectional scenario whereby observing audience members receive the skilled presentation of an artistic work interpreted by trained, talented actors, musicians or dancers[1]. Many "new media" performances are also structured in this way, augmenting a performance with multimedia or responsive content that is controlled entirely by the expertly rehearsed performance team for the benefit of the observing audience.

Participatory interactive performances, however, leverage the use of interactive technologies to modify the directionality of the performance experience. By adding interaction mechanisms that allow the audience to contribute to performance development, the artist enables the public to participate in the enactment of the on-going work. Audience members who participate in a performance function not only as spectators and consumers, but also as collaborators and co-creators of the shared experience.

In 2007, our research team was commissioned to create a participatory art piece,

[1]Excerpts from this discussion have been published in two papers: Taylor, R., Boulanger, P., Olivier, P., Wallace, J. *Exploring Participatory Performance to Inform the Design of Collaborative Public Interfaces.* Extended Abstracts of the ACM Conference on Human Factors in Computing Systems (CHI'09). ACM, New York, NY, USA, 3721–3726. Taylor, R., Schofield, G., Shearer, J., Boulanger, P., Wallace, J., Wright, P., Olivier, P. *Designing from within: humanaquarium.* In Proceedings of the 2011 annual conference on Human factors in computing systems (CHI '11). ACM, New York, NY, USA, 1855-64.

dream.Medusa, for the Nuit Blanche festival in Toronto, Canada. It was intended simply to be enjoyed as a piece of art, however, as we presented the piece in Toronto and several other international art festivals over the course of several months, we became intrigued by the way participants interacted with the system and the interpersonal dynamics which developed between the novice participants, the experienced performer, and the observing audience. We realized that the participatory performance medium was providing us with a platform to investigate collaborative creative behavior in a uniquely authentic public setting. We began to see potential for using the interactive performance environment as an explorational tool in the design process, using the creation and observation of legitimate performance works in order to inform and refine the design of subsequent collaborative systems. Successful participatory performance pieces stand alone as viable and enjoyable pieces of media art, however, we believe that they can also be used as a tool to conduct non-traditional explorations of Human-Computer Interaction in public venues.

1.1 Overview

Our research explores public interaction with digital technology through the practice-based inquiry of an inter-disciplinary team of computer scientists and musicians[2]. In this thesis, I describe a methodology in which my collaborators and I create, enact, and iteratively refine technologically mediated participatory performances which are specifically structured in order to investigate research questions surrounding participant engagement with technological interfaces in public settings. We engage in a process of experience-centered design [71], interrogating collaborative behaviour in authentic, real-world settings. Our research practice sees our interactive performances situated in venues where they are encountered and experienced

[2]Our research team consists of myself and Pierre Boulanger from the Advanced Man-Machine Interface Laboratory at the University of Alberta, as well as Guy Schofield, John Shearer, Jayne Wallace, Peter Wright, and Patrick Olivier from the Digital Interaction Group at Newcastle University.

by members of the public.

In addition to creating and implementing the interface and creative content of our interactive art pieces, we choose to "design from within" by taking active roles as performers within the performance/use context. This allows us to experience the results of our design interventions firsthand – literally alongside the participants who take part in the performances. We purposefully present our participatory installations for public consumption in a format which is simultaneously finished and unfinished – the works must always be presented with a professional level of performance standards and production quality, however they are intentionally implemented and designed so that they may be refined and re-configured, changing and developing as our understanding of and relationship to them grows over time.

We propose that this method of investigation results in a software engineering strategy that leverages interdisciplinary practice to explore user experience, and approaches the goal of maximizing participant engagement in a holistic, pragmatic way.

1.2 Defining the Research Domain

Our research practice is inspired by the type of activity which we wish to study – public engagement with creative, playful technologies situated in public spaces. We specifically direct our inquiry towards what Gaver terms *ludic* activities – activities that focus not upon the completion of goals or tasks, but rather upon curiosity, exploration, and fully-present engagement with the world [31]. Gaver describes the difficulties inherent in investigating and designing playful, non-structured, ludic activities: *"It is difficult to conceive of a task analysis for goofing around, or to think of exploration as a problem to be solved, or to determine usability requirements for systems meant to spark new perceptions."* ([31], p.3.) He suggests that personal experience, subjectivity and idiosyncracy [31] must be considered relevant to an

investigation which attempts to explore ludic behaviour.

It is important, as well, to consider that public interactions happen in genuine public spaces. Context is criticial – the laboratory environment bears little to no sociocultural resemblance to a real-world public space. We focus, therefore, on adopting a strategy of investigation which examines the influence of social factors and allows us to conduct our exploration of public experience 'in the wild.'

A theoretical grounding for such research is found in McCarthy and Wright's framework for describing experience [71]. They consider a participant's encounter with technology to be encompassing of *sensual*, *emotional*, *spatio-temporal*, and *compositional* elements. The framework is well suited to exploring the experience of aesthetic content [116], as its representation accounts for not only the created artefact, but also the sociocultural context within which it is encountered. We adopt their pragmatic approach to examine our use of performance practice in the process of designing interactive applications for public spaces.

1.3 The Use of Creative Practice in Research

Goffman's use of theatrical analogy to describe human behaviour in social settings proposes that all social interaction bears similarity to dramatic performance. Individuals choose to manipulate their presentation of self [40] in order to be esteemed by their peers. We suggest that exploring how people conduct themselves within a literally theatrical, improvisational context can afford us insight into how people interact with technology in conspicuous public settings.

Creative practice has previously been used as an interrogative tool. For example, Gaver uses cultural commentators – professionals from the fields of cinema and documentary – to provide a polyphonic account of the design process "in which a multiplicity of perspectives encourages a multi-layered assessment" of the use context under investigation ([32], p.292.) Hook *et al.* also use documentarians

and video jockeys to provoke discussion and elicit response from user communities [49]. Attention to aesthetic detail is a fundamental principle in the making of 'cultural probes' [30] which use designed artefacts to pose open-ended inquiries, encourage lateral thinking, and enhance communication between participants and researchers. Wallace's implementation of cultural probes leverages her expertise in jewellery-making [109] and craft practice to foster enchantment [74] while stimulating dialogue and personal reflection. Approaches such as these illustrate how the methodology and output of creative practitioners can be used to enrich investigation.

We take an approach to investigating interaction in which we manipulate the *performance frame* (Benford *et al.*'s Goffman-inspired contextual framing [41] construct defining the interplay between performers, participants and audience in collaborative performance scenarios [4]) in order to explore how participants engage with technologies in public settings. Combining our expertise as creative practitioners trained in music and art practice as well our backgrounds in software and interface development design, we develop and enact interactive performances that encourage members of the public to share the performance frame with us, taking part in collaborative, ludic play.

1.4 Designing from Within

Boehner *et al.* argue that the nature of aesthetic experiences is that they are "bound by the ineffable: indescribable and irreducible aspects of being" ([10], p.1) and that they "cannot be fully understood through rational explanation but must be lived." She suggests that they are "tied to the particular, invoke the senses, command an immersion of the whole self, and result in a heightened form of engagement" ([10], p.1).

Our research practice recognises the value of a holistic, immersive approach to

studying shared aesthetic experience. To investigate public interaction as a *lived experience* [10], we break down the conventional construct often evidenced in software engineering that places the designer as an external observer, outside and separate from the experience under investigation. Instead, we present a strategy of designing experience from within, literally situating ourselves within the performance/use context and assuming the roles of performers as well as designers as we develop, present, and refine our participatory installations through ongoing, first-hand experience with and long-term exposure to each creative work over its one-to-two year lifespan.

Our use of performance as an investigation platform results in a research process that is literally hands-on, as the design and evaluation team also takes on the task of performing – authentically experiencing the interactive performance alongside collaborating participants. We engage in a practice similar to that referred to by Wright and McCarthy as *dialogical design* [115], allowing us to redesign and refine our technological and interaction strategies in direct response to the issues and observations that arise during the performances we share with participants.

During the course of our investigations we emphasize the importance both of self-situatedness and of fostering a long-term immersion within the design projects being explored. We present the interactive performances repeatedly over an extended period of time, developing and iteratively refining them based on the insights which evolve as a result of each performance experience. Through this practice we leverage a long-term process of *sense-making* [71] – a gradually deepening and intuition-based understanding which we use to inform and enrich our designs.

1.5 The Performances

During the course of this investigation we developed three participatory performance pieces. Each piece was performed numerous times, in a variety of contexts –

both professional and casual – including workshops, festivals, concerts, exhibitions, and museum settings. We had the opportunity to tour with the works, performing predominantly in the UK and Canada, as well as Spain, Germany, France, and Mexico.

Each piece was designed to encourage participants to engage with ludic, playful installations situated in public spaces, and provided an opportunity to explore how users experienced the technical and aesthetic content in real-world performance scenarios. We carried out a process of ongoing evaluation, revision and reflection during the course of performing the works. The observations and insights revealed were used to stimulate new avenues of investigation which were then explored in subsequent pieces.

1.5.1 *dream.Medusa (2007)*

dream.Medusa is a concert piece in which I invite four participants to join me on-stage. I guide the development of the performance by using my singing voice to control visual parameters of a responsive video stream. Participants are given abstractly shaped control devices which they can manipulate in order to contribute transformations to the video. The technology simulates the experience of lucid dreaming, in that the four participants drift in and out of control of the dream-like experience, initially unsure of their status, but gradually mastering the scope of their influence. Non-participatory audience members observe the piece in the manner of a traditional concert-style performance.

1.5.2 *humanaquarium (2009)*

The *humanaquarium* performance team consists of Guy Schofield, John Shearer and me. Participants interact with two musicians (Schofield and myself) who are situated inside a portable stage environment – a 1.5 metre cube that can be easily assembled and placed in exhibition venues. The structure is faced with a transparent

acrylic frustrated total internal reflection (FTIR) screen [45]. The system translates the position of touches into audio visual effects that alter the musicians' performance as they play. In this way, participants can 'jam' with the performers in order to collaboratively control the audio-visual content of each *humanaquarium* performance. In contrast with the more traditionally theatrical struture of *dream.Medusa*, *humanaquarium* borrows from the traditions of street performance and busking, allowing passersby to encounter and interact with it in a more casual, informal manner.

1.5.3 *Nightingallery (2011)*

Nightingallery represents a step further along the continuum away from traditionally staged performance and towards unstructured, participant-driven improvisation. *Nightingallery*'s interaction strategy allows a participant to determine how much attention s/he would like to draw to him/herself while interacting with the performance interface. Created again in collaboration with performers Schofield and Shearer, *Nightingallery* is an installation piece in which members of the public interact with a custom-crafted animatronic bird. Participants are encouraged to engage the bird in conversation or song by speaking or singing. The bird sings generated birdsong in response to participant interaction, allowing participants to perform with the bird via music-making. *Nightingallery* explores social communications in public spaces, as communicating with the bird requires participants to engage in audible interaction within earshot of others.

1.6 Contributions

While there exist numerous examples of HCI research drawing from the domain of artistic practice to inform interaction design, the novelty of our approach lies in how we have taken an active role as performer/designers within the use context of a

series of creative works, each subsequent work inspired by the research undertaken throughout the investigative trajectory. We explore and refine performance designs through firsthand, lived experience, sharing the performances with members of the public within authentic exhibition contexts. This manner of research-in-the-wild draws upon our personal experiences with each of the projects to develop our understanding of engagement with creative technologies situated in public spaces.

This thesis presents several contributions which have arisen through the research described:

- the practice-based methodology of 'designing from within' – using creative practice to shape and inform a system development and experience design process
- a theoretical interrogation of the participatory performance medium structured by McCarthy and Wright's experience-centered framework [71]
- the creation of three novel, creative, playful applications suitable for professional level exhibition
- the use of autobiographical, practice-based research as a means to inspire, evaluate and refine the design of engaging, ludic systems
- the identification of design issues and compositional tensions inherent in developing creative interactive experiences for social, public spaces

1.7 Thesis Structure

The thesis is laid out in two parts. The initial chapters provide an overview of the concepts which form the foundations of the research:

- **Chapter Two** introduces the concept of participatory performance and provides an overview of issues related to designing, understanding, and evaluating the experience of participants in collaborative performance.

- **Chapter Three** reviews methods of non-traditional application design, and describes the reasoning behind the use of art and performance practice in the design process.

- **Chapter Four** describes our practice of 'designing from within.' We explain how our design methodology influences our practice and relate how it builds upon existing methods of exploring and understanding participant experience in interactive encounters

The second half of this document describes our experiences with the performances we created during the course of our research:

- **Chapter Five** presents our initial participatory performance, *dream.Medusa*. We provide a pragmatic analysis of *dream.Medusa*'s design process and experiential characteristics, discussing the evaluation we carried out and the feedback we received from participants.

- **Chapter Six** describes our second participatory installation, *humanaquarium*. We explain how our creative practice was used to implement a flexible interface that facilitated ongoing, iterative research "in the wild". We discuss how experiences with *dream.Medusa* identified several barriers to participant engagement, and how these identified areas helped frame *humanaquarium*'s design brief. We provide examples of insights we obtained into maximizing participant engagement during the course of a year's worth of public *humanaquarium* performances, and explore how our experiences inspired our revisions of *humanaquarium* 's interface and interaction mechanisms.

- **Chapter Seven** illustrates how specially crafted performances can be used as a way to interrogate specific HCI research questions surrounding participant engagement in authentic public spaces. We describe how our experiences with *humanaquarium* inspired our third piece of interactive art – *Nightingallery* – that was designed to explore social behaviour in conspicuous public settings.

- **Chapter Eight** reflects upon compositional tensions we have identified through our practice of creating interfaces, interaction mechanisms, and content designed to encourage participant engagement.

- **Chapter Nine** concludes with a summary of the completed research, and describes potential avenues of further investigation.

Chapter 2

Participatory Performance

This thesis presents a practice whereby firsthand engagement in participatory performance is used to explore creative experiences in public spaces. To begin our discussion, this chapter provides an overview of issues relating to the development and understanding of interactive, participatory performance media. We present various viewpoints regarding the role of the composer in interactive media, a theoretical framework for representing interaction in participatory performance, and review various presentation formats in which notable participatory performances have been staged. We then discuss literature exploring how best to engage audience members in active participation with interactive art, and overview commonly used techniques for evaluating and understanding experience in participatory performance scenarios.

2.1 Composing for the Interactive Medium

Composing for the interactive, participatory medium poses significant challenges for the artist [1]. The creator of a participatory work must knowingly give up absolute control over the execution and presentation of the finished piece, framing the creative content as a dialogue which includes the contributions and interventions of

[1] A version of this section has been published. Taylor, R., Schofield, G., Shearer, J., Boulanger, P., Wallace, J., Wright, P., Olivier, P. Composing for the Interactive Medium. International Journal of Design and Innovation Research Vol.6:1, 2011.

those who encounter it.

The degree of interactivity in a piece of participatory art can vary broadly. A conservative manner of encouraging participatory interaction sees the creative team tightly defining an interaction paradigm, allowing users to explore a small range of actions in order to trigger a known set of potential outcomes. More abstract forms of participatory art may treat the interactive experience as a broad framework and canvas within which participants may explore freely, contribute content, and take part unrestrictedly in the shaping of experience. Questions can be raised about the role of the artist who composes works that are necessarily so dependent upon the contributions of those who encounter them. If an artist defines his/her practice as a method of enticing participants to collaboratively shape a creative experience, is s/he actually functioning as the sole composer of the experience, or rather, to some degree is s/he instead responsible for a more facilitatorial role in designing the site and method of interaction?

Tanaka [101] addresses the question of authorship and agency, describing a participatory framework which allowed individuals to upload, remix, and re-present musical content via a shared network. He argues that his role as creator of that work was as the ”composer of the piece because I have created the system, I have created it as an environment where people must figure out how to react. [It is] an idiosyncratic artifact, a situation created by the artist that incites or naturally filters certain reactions. I am, as the composer, gently guiding or deviating the user or pulling him through my way of seeing things and inviting them to send in a piece of sound that becomes part of the piece.” [101], p. 279. Mandelbrojt et al. concur, stating “As in conceptual art or installation art, the import of a work of interactive art lies thus in the idea that sets it in motion.” [69], p. 214.

Winkler describes the challenge of composing content for the interactive medium as requiring the composer to achieve an aesthetically pleasing balance between pre-

determination and indetermination in the finished work. "Structure, form, timing, order, development and transition: these are some of the issues that are of primary concern to composers of a traditional score. A composer employing nonlinear structures must be willing to give up total control of these important compositional decisions, delegating them to a performer or to improvisational computer processes." [111], p.31. While a purely indeterminate composition may lack cohesion if executed unsatisfactorily by the participants who shape its enactment, a well-crafted interactive composition allows participant-led improvisation to enhance and interrelate with the predetermined content, contributing a sense of spontaneity and ephemerality to the work. The composer must judge how much of the piece s/he will control, and how much of the piece will be left open as a space within which participants can experiment and create.

Viewing the composition of interactive works as the implementation of a space for collaboration and co-creation - a space intended to facilitate interaction which is guided and inspired by the vision of the creative artist - allows us to consider the role of the composer of interactive art as the designer of the boundaries, transaction mechanisms, and communication protocols of a medium which is intended to be opened and shared with the participating public.

We consider the question of whether the interactive platform's dual requirements of functionality and aesthetic consideration necessitate the composer to perform the roles of 'artist' and 'interaction designer' alternately and sequentially, or whether the method of composing for participatory interaction is negotiated in a more holistic fashion, blurring the distinction between what is an aesthetic choice versus what is a functional one. If interactive art depends fundamentally on its functionality to shape the aesthetic outcome, we feel that our two concerns cannot be separated. Instead, a unique method of creative practice emerges when aesthetic content is considered in terms of a creative space which the artist crafts and shapes

in order that it may eventually be inhabited by its consumers.

2.2 Definitions of Interactors in Participatory Performance

Discussing participatory performance requires us to clearly define the roles of the people whose interactions form the performance frame. Much discussion in this area of research is founded upon Goffman's concept of "frame analysis", in which the frame of an experience can be thought of as the construction of the context within which the experience takes place [41]. The 'performance frame' [4] of an interactive performance experience can then be seen to encompass what Sheridan et al. [92] call the *Performance Triad model*, defining tripartite interaction in a participatory performance as the real-time interplay between 'performers', 'participants', and 'spectators', each of whom have particular influence upon the performance. Much development regarding the interpretation and formalization of these roles and framings is conducted in the works of Benford *et al.*[4], Sheridan *et al.*[92] [93], Dix *et al.*[25] and Reeves *et al.*[82].

2.2.1 Performers

In a technologically mediated participatory performance, the performers may perform traditional artforms such as music or dance, as well as interact with and operate the technologies that comprise the performance system. Performers may also interact with each other, with additional participants, and with the audience. Their status as "performer" gives them a weighted responsibility in ensuring the performance is aesthetically pleasing.

Performers, as described by Sheridan, are fully 'witting' [93], a term she uses to describe the fact that they are conscious of their role in the performance and committed to contributing to the development of the performance experience. Perform-

ers likely engage in substantial rehearsal and practice with the interactive system and performance medium, which results in a skilled understanding and execution of the artforms and technologies that are used in the performance. Their knowledge of the performance environment and their ability to interact with the performance environment in a controlled and perhaps even 'virtuoso' fashion makes them capable of not only interacting with the environment in a basic and functional way, but also in such a way that they may, through their nuanced interactions with the performance system, express and convey emotive content to the participants and the audience. This expertise and pre-existing ability to communicate expressively and intentionally with the artform and technology that forms the performance system differentiates them from the second group of individuals who contribute to the participatory performance: the participants.

2.2.2 Participants

Participants form the second tier of the performance's witting interactors. They are likely to be novice users of the system, non-experts, and untrained with the performance environment. They are witting, in that they choose to function as participants in the performance, attempting to interact with the system, but they are initially incapable of nuanced performance with the technologies or media, since they must learn, through experience and observation, how the performance interface operates. Sheridan notes that participants may, in fact, begin to transition to approximate the role of performers if they become suitably conversant with the performance medium [93]. They learn to interact with the environment with a suitable degree of control in order to convey expressive content rather than simple basic usage of the control devices. In general terms, however, participants can be considered to be novice users, who are committed to exploring the performance space and attempting to make basic contributions to the development of the performance rather than functioning as

expert or virtuoso performers.

Benford *et al.* describe how the participatory medium's inclusion of explicit participant interaction manipulates the traditional directionality of performance [4]. Allowing allowing audience members to enter the performance frame in an explicitly performative manner permits them to actively contribute to the development of the experience rather than primarily consuming it as observers. Manipulating the performance frame in such a way as to allow audience members to enter into the performance in a participatory context enables them to collaboratively shape the development of the experience – greatly enhancing their agency within the scenario.

2.2.3 Spectators

Spectators form the third group of interactors who contribute to the performance experience. Spectators can be considered as observers who are not currently functioning as explicitly active participants. They do play a role in performance development, however, either through the direct feedback they provide (via applause or visible attentiveness) or simply through their very existence – the fact that performers and participants know they are being watched is significant, in that they are conscious of being observed and perhaps evaluated by others [82]. Sheridan further partitions the 'spectator' group into 'witting' and 'non-witting' members, in order to account for the chance bystander who may wander into the performance scenario, however a traditional audience would be made up of primarily witting individuals who choose to attune their focus to the performance event [93].

Using these descriptors – performers, participants and spectators – one can therefore clearly refer to the roles played by the people whose interactions determine the course of the participatory performance.

2.3 Staging Participatory Performances

Interactive, participatory art does not necessarily have to be technologically mediated. Improvisational art forms such as busking or street theatre can incorporate elements of audience participation, bringing onlookers into the performance frame and allowing them to collaborate with performers for the entertainment of the audience. During theatrical productions such as those presented by *Cirque du Soleil*, audience members are selected to join clowns, magicians, and acrobats on stage in order to participate in stunts, magic tricks and comedy skits. As the participants are not trained performers, their nervousness, awkwardness and enthusiasm is honest and genuine, which is used to great effect in this theatrical tradition. Even cinematic productions can be presented in a participatory manner - interactive screenings of well-loved films such as *Rocky Horror Picture Show* and *The Sound Of Music* are often held. Audience members attend in character costumes, recite dialogue, and sing along to the soundtracks, resulting in an interactive event that more closely resembles a dynamic, live performance than it does a film screening.

In this thesis, however, we focus our attentions upon participatory performances that use digital media technologies to facilitate participant interaction. Using multimodal devices to bring participants into the performance, artists can enable participants to interact in a myriad of ways, including voice [61] touch-screens [105], mobile phones [60], or body movements [111].

Participatory performances can range in style and format, from the relatively traditional (staged in performance venues like theatres or concert halls) to the free-form. Impromptu'guerrilla' performance art can take place in any number of locations, existing ubiquitously in public venues where art and performance are generally unexpected [92]. The style of the interactions can similarly vary - as previously discussed, the artist/composer of a piece can allow the participant contributions to affect a tighly confined interaction space, allowing their actions to influence a por-

tion of the overall performance content, or instead can allow the performance to be completely participant-driven and dependent upon the situation it is enacted within.

Most easily recognizable as 'performances' are participatory pieces structured in relatively traditional ways, allowing participants to take roles in the enactment of familiar art forms such as music, dance, or theatre. Using a specified staging area to situate participants and performers, interaction with such performances takes place in front of an onlooking audience, much in the familiar manner of a stage play or musical concert.

Sheridan's theatrically staged *iPoi* performances [93] allow individuals from the audience to join professional poi dancers on a stage. Poi is a Maori art form in which performers swing balls attached to cords, making visible patterns around their bodies. Participants are instructed in the use of the augmented poi interfaces with which they can interact with video environments Together, participants and performers control responsive visualizations projected upon the walls of the staging area within a theatre or nightclub. Levin's *Dialtones: A Telesymphony* [60] operates within a similarly familiar cultural venue – his performance takes place in an orchestral concert environment, triggering the rings of participants' mobile phones in order to augment the sound of the symphony. Our own musical works, *dream.Medusa* and *humanaquarium* allow participants to join in the execution of what would otherwise be reasonably similar to mainstream musical productions - *dream.Medusa* is intended to be performed on a concert stage, while *humanaquarium* augments the performances of two improvisational musicians.

Stepping away from a conventionally collocated performance situation, a public poetry performance staged in a distributed virtual environment by Benford *et al.* [8] is virtually mediated rather than existing in a shared physical environment. Remotely located performers and participants are represented to the spectating audience via embodiment in a networked virtual cave [3]. *Daisyphone* [13] facilitates

remote collaboration as well, allowing musicians and participants to create and perform improvised music via a networked interface. *Trickster at the Intersection* [117] is a virtually networked theatre piece, where participants interact with a virtual representation of a dancer/actress who is sequestered at a remote location, teasing and coercing participants into exploring a virtual world inside a CAVE environment.

This manner of presentation is structured in a way which presents the actions of the performers and participants to a spectating crowd of focussed onlookers. It is easily recognized as what would typically be classed as 'performance,' as the manner of presentation indicates that the actions of those who are performing (performers and participants) provide content for those who are watching (the spectating audience.)

Other forms of artistic installation, while not 'performances' in this conventional sense, also allow untrained participants to interact with aesthetic content in an exploratory, publically conspicuous way.

Some such experiences are situated in immersive spaces, allowing the installation visitors' movements and actions to control the environment around them. Winkler's sound and video installation *Light Around the Edges* [111] requires audience members to step into a performance space and interact with a responsive visualization by dancing or moving within a tracked environment. Similarly, *Traces* [77] uses body tracking to integrate participants' bodies into immersive spaces, allowing the physicality of the human to combine with virtual content in the installation space to create an augmented reality experience which is perceivable by the participants themselves as well as by any onlookers within the sightlines of the space. Schiphorst's *whisper* [85], Ryan's *TGarden* [84], Diana's *Fragile* [24] and Oliver's *Singing Tree* [76] further embody the experience of creative exploration in the physicality of an interactive environment, providing participants with costumes [84], wearable apparatus [85], props [24] and immersive set pieces [76] to situate

an individual within the intersection of the physical and virtual space and integrate him or her within the augmented experience.

Other interactive experiences invite participant interaction within the context of exploratory, playful museum applications and exhibition content. Levin's *Re:MARK* and *Hidden Worlds of Noise and Voice* [61] installations allow participants to play with responsive voice visualizations by making sounds into microphones. Brightarcs' musical Tesla coils [56] allow exhibition visitors to use analogue input (guitar, voice, and keyboard) to play music and generate massive arcs of visible electricity. *Schizophrenic Cyborg* by Sheridan *et al.* [92] invites onlookers to participate in a 'guerrilla performance' stimulated by a performer dressed in responsive wearable technology who moves through the crowds, engaging participants in spur-of-the-moment creative dialogue. Responsive robots such as those designed by Suzuki *et al.*[100] and our own animatronic *Nightingallery* bird are deployed at art festivals and allowed to interact with passersby, generating audio-visual content in response to participant behaviour. While these interactive systems bear less resemblance to what is generally perceived as formal 'performance', they are still designed to convey aesthetic and artistic content, and share the characteristic of requiring those who wish to interact with them to overcome self-consciousness in order to interact with technology in a publically conspicuous way.

2.4 Encouraging and Facilitating Participatory Interaction

When participants first encounter the performance scenario, entering the performance frame, they are untrained novices, unfamiliar and inexperienced with the system. It is the prerogative of the artist who develops the piece to determine how the participants will be able to explore their influence within the performance space. Will they be explicitly instructed as to how to interact with the technology, the per-

formers, and other participants? Will they discover the scope of their influence by exploring technologies and observing their effects? Will they learn by observing others? All of these alternatives provide a very different experience for the participatory user.

Winkler [111] explains that the 'role' cast by the artist shapes the participant experience. If participants are expected to undertake actions that require substantial risk-taking (performing onstage with the associated risk of appearing foolish or entering an isolated space where the actions they will be required to perform are unknown at the outset of their experience are two examples he uses to illustrate high-risk participatory experiences) the artist/creator must anticipate that the barriers to participant acceptance and commitment to participation are higher than they would be in lower-risk installation projects. Levin observes this phenomenon in his *Re:MARK* and *Hidden Worlds of Noise and Voice* installations, remarking that they "seem to be extremely popular with museum visitors under 7 years old (and other visitors who are not too shy to bark or oink.)" ([62], p.3.) Winkler cautions that the artist must make his/her participants feel safe inside the installation/performance space in order to consistently encourage individuals to volunteer [111].

This is, Winkler maintains, not intended to discourage artists from developing installations and performances which challenge the comfort level of their participants and audience members. Isolating participants inside a fully immersive and mysterious space (such as the physical enclosure intentionally built for this purpose into the physical interface of the *Singing Tree* [76]) can provide a user experience that may make up for the potential hesitation a participant may feel when agreeing to participate. Liberation from self-consciousness when spontaneously participating in a public performance can be rewarding to non-performers when mediated by a supportive artistic team that encourages the participant to feel empowered to engage in activities which are outside of 'normal' social boundaries [111].

Sheridan addresses the issue of encouraging audience members to transition to to the role of participants [93]. Her work with the *iPoi* interface and public performance scenarios necessitates that untrained, non-expert audience members must self-select themselves to join the performance by agreeing to participate by playing with the augmented poi artefacts. She describes how she and her team encourage individuals to overcome shyness or hesitation and allow them to participate in the performance.

She encourages 'social infection' by encouraging participants to pass the *iPoi* around and communicate with one another. This strategy reduces the individual's sense of personal risk-taking, as numerous other people inside the space are also functioning as participants, and therefore no one individual has to feel overly exposed. It also reduces a participant's fear of the possibility of an extended period of embarrassment if s/he discovers a lack of proficiency with the interface, since s/he is obviously free to pass off the *iPoi* to another participant if the interface proves too challenging.

Additionally, Sheridan creates a secondary, less conspicuous interface for spectators who might wish to participate, but who find the widely gestural nature of the *iPoi* interface too intimidating. These users can interact with the video exhibit from a less obtrusive standpoint, by manipulating a stuffed toy equipped with sensors. This form of participatory interaction is visually less dramatic and allows less confident individuals to explore the environment in a less threatening way.

The issue of participant comfort level can even be exploited to encourage the exploration of artistic ideas. Winkler notes that the redefinition of "normal expected behaviour" in public places may be intimidating to the participant, "depending on social and personal factors, and the intention of the artist." ([111], p.3) One such installation/performance project which explores the participant's comfort level when faced with the exploration of an artistic space is Diana's *Fragile* [24]. *Fragile* is a

participatory experience in which a group of users enter a roughly hewn cave space, inside of which they find a variety of delicate artifacts constructed out of eggshells augmented with sensors. Participants can create musical experiences by moving the eggs from their precarious positions onto targets placed throughout the room. Diana describes her intentions in using such literally 'fragile' natural objects in a hazardous setting (the rough stone walls of a natural cave) as "evok[ing] a specific and ordered set of emotions involving a balance between feelings of apprehension and delight." ([24],p.2.) She maintains that when the participant overcomes the risk of public participation in a task that has a potential for social embarrassment or failure their confidence gradually builds, and the resulting reward is perceived as particularly pleasant. Her approach is methodologically designed to manipulate participants' emotions and create for them an experience that progresses from intimidating to satisfying by "forcing the tension between fear and desire." ([24],p.8.)

Participatory performance as an artform provides a mechanism for artists such as Diana to explore these aspects of human behaviour by providing the audience members with an experience allowing them to enact through participation hands-on interactions within the artistic space, and requiring them to overcome barriers of self-consciousness or anxiety in order to contribute to the development of the participatory experience.

2.4.1 Transitioning from Participant to Performer

From her observations of participants' interactions with the iPoi interface [93], Sheridan states that it is possible for participants to further transition from their participant status to performer status. If participants feel highly engaged in the experience [14] and devote their attention to becoming adequately conversant with the performance interface, this then allows them to communicate expressively within the performance medium. This is in contrast to participants who lack this level of

conversance and therefore confine their participatory actions to basic exploration and interaction with the performance environment.

Sheridan observed that participants who had previous experience with traditional poi interfaces found this transition from participant to performer to be possible, and soon were able to manipulate the *iPoi* devices in a way that was expressive and nuanced. This transition to a higher level of control made them more similar to the denoted performers (capable of expressive virtuosity due to their previous practice and skill with the interface) than to the experimental and novice participant group. Diana also reported this phenomenon [24], as confident participants in her *Fragile* installation began to take on an instructional and leadership role, using the placement of eggs within the space to form complex musical rhythms and create their own expressive content.

In the discourse of virtual reality, participants' level of commitment, engagement in an immersive world or simulation is referred to as their feeling of *presence* [112]. When participants are sufficiently present in an experience, they may focus their attentiveness on the experience of their participation rather than the mechanics of their interaction. As applied to the broader domains of musicianship, video gaming, sports or other pursuits, Csikszentmihalyi terms this experience of intense attunement, enjoyment and skillful task peformance *flow* [19]. Csikszentmihalyi's interviews with artists, musicians and athletes likened the experience of a successful and seemingly effortless performance of a task to the concept of drifting easily with the pull of a 'flowing' tide. He explains that if the factors that encourage a user to attain a sensation of flow are in place, the result is a reduction in distance between user intention and action, meaning that users need to concentrate less on the technicalities of how to enact a response in the environment, freeing them to experiment with the reactive environment in a more expressive and intuitive fashion.

A well designed performance environment that enables participants to establish

a strong feeling of engagement, presence, and creative flow, and which allows them develop the skills required for them to be able to approach the transition from novice explorers to expressive performers provides participants with a substantial amount of creative input into the development of the performance, resulting in a highly rewarding experience for participants, and an enhanced aesthetic experience for the observing audience.

2.5 Evaluating Interactive Performance

In order to evaluate the effectiveness of a piece of participatory art, it is important to first identify the goal of the evaluation process. A piece of artwork may arouse intensely positive or negative emotions, whether or not its mediating technologies function in a manner which would be considered acceptable if evaluated under traditional human-computer interaction paradigms. While provocative art may trigger an uncomfortable [7] or even intensely negative response, surely the intensity of such a response signifies the work's effectiveness in engaging the observer. Höök *et al.* caution against the notion that HCI-inspired evaluation of interactive media should attempt to answer the question "is this good art?" ([51], p. 241.) For the purposes of evaluating interactive media, we suggest that investigating a performance's ability to engage and stimulate the attentions of participants would be a better measure of creative sucess than a strict metric evaluating the conventional usability of the work.

That is, of course, certainly not to say that evaluation of the techological components of interactive media art is superfluous. The interface must be considered as a significant part of the artefact under investigation (the performance.) It is simply important to avoid overly reductive strategies that might tend towards overlooking aesthetic or contextual aspects of the work as a whole in favour of focussing on the particular mechanics of interaction. Höök *et al.* describe the "conflicted conver-

gence developing between human-computer interaction and interactive art" ([51], p.241) explaining how the differences between traditional HCI and art methodologies must be carefully negotiated in order to best reflect the merits of each practice. If practitioners of both disciplines can remain open to one another's perspective, however, hybrid approaches to evaluation provide new avenues of investigatory possibility.

There are numerous methods commonly used to evaluate interactive media art and participatory performance. Practitioners could choose to apply more than one of these methods, as each one is best suited to evaluate a different aspect of participant experience with the work.

2.5.1 Post-Event Reporting

A commonly used method of evaluating interactive performance is to address participants and audience after-the-fact, investigating experience through a medium such as a questionnaire or interview.

Surveys via questionnaire have the advantage of being easy to disseminate to large groups of people, allowing investigators to generate a large amount of data suitable for statistical research. Compliance and participation is of course a concern when relying upon anonymous, easily evaded methods of audience feedback – Latulipe *et al.* caution that audience members may decline to complete a questionnaire due to fear that the data collected may be used for mass marketing purposes or commercial research [57].

Many questionnaire format investigations often solicit numerical Likert-scaled feedback [63]. One prominent example of such an investigatory tool, designed for measuring engagement and immersion within virtual reality environments, is Witmer and Singer's *Presence* questionnaire [112]. Likert-scaled quantitative elements may be combined with open-ended responses to develop more sophisticated

questionnaire-formatted psychometric instruments such as the Audience Response Tool (ART)[96]. While numeric, Likert-style surveys allow researchers to easily collect large amounts of statistically valid data, the inclusion of open-ended discussion style questions permits the capture of rich, idiosyncratic and unique responses that differ from what can be understood via quantitative analysis of numerical data [106]. Concerns surrounding an overly heavy reliance on Likert-scaled discrete responses are illustrated by Slater and Garau's statistical analysis of attempts to quantize respondent feedback, indicating that subjects in presence studies are not good at numerical gradation of subjective responses, and tend to polarize ratings to the extreme measures of the scale [94].

An open-ended interview format has the advantage of allowing for a much wider bandwidth of communication (verbal rather than written.) This format allows interviewers to follow the respondent's lead and pursue interesting avenues of discussion as they present themselves [23]. However, interviews require a greater level of participant commitment. Interviews must be conducted in a specific time and place (as opposed to a questionnaire which can be more flexibly administered) and the verbal nature of an interview provides participants with less anonymity than does a written questionnaire. For these reasons, it may be difficult to find participants willing to undergo an interview [106].

Asking participants to self-report after the performance experience has concluded has several overarching limitations. Some participants may find descriptive self-reflection difficult to enact or communicate, making it hard for them to relate their experiences. Witmer and Singer's evaluation of the effectiveness of their presence questionnaire acknowledges that the subsequent nature of post-event reporting fails to account for the temporal nature of an experience, during which the participants level of presence will obviously vary [112]. Latulipe *et al.* [58] caution that the 'peak-end' effect [48] leads to post-performance reported emotional response

being strongly determined by the emotion most intensely felt at any point during the performance experience, combined with the emotion felt in the final stages of the performance, affecting the accuracy of the post-reporting process due to its retrospective nature.

2.5.2 Ongoing Analysis

Alternatively, there are a number of investigatory methods designed to run concurrently with the performance. These methods better account for the temporal nature of the experience, as they are designed to observe participants during the course of the performance's development.

Methods of continuous measurement such as continuous presence assessment [28], or emotional monitoring via *The Affect Rating Dial* [83]) avoid the need for after-the-fact reporting by allowing participants to continuously provide feedback about an experience by manipulating a gauge on a physical device. Cziksentmihaly proposes a similar strategy for investigating flow, using the *Experience Sampling Method (ESM)* [20] to interrupt individuals during the course of an activity and prompt them to answer a series of questions in order to pinpoint their perspective on an experience in a more immediate and temporally relevant way.

While these methods are often used in the performance realm (see research by Latulipe *et al.* [58][57], and Stevens *et al.* [97] [96] describing the use of personal digital assistants to obtain user feedback throughout staged performances) their obvious drawback is reflected by the fact that they diminish authentic engagement with the performance experience by disrupting and diverting the participant's sense-making process. Methods that require direct participant intervention during the performance distract him/her with the purely functional task of self-analysis and self-reporting instead of connecting with the experience as it unfolds.

Such disruption is reduced when a less mechanical method of eliciting user

feedback is undertaken, such as is the case with use of co-discovery or talk-aloud methods [51], whereby participants are encouraged and observed while talking amongst themselves during interaction with an artwork. Ethnographic studies [75] are less obtrusive still, as an external researcher examines and annotates an observation experience with no participant intervention or cooperation required.

There are numerous quantitative measures that can be enacted (with varying associated degrees of obtrusiveness) during ongoing performance. Mancini and Castellano's work using physical data provided by the EyesWeb system [17] addresses the identification and interpretation of expressive cues from human movement [68]. Latulipe *et al.* measure arousal via galvanic skin response (GSR) data [58]. Comprehensive recording systems such as that described by Benford *et al.* capture video feeds as well as logs of all system events generated during participant encounters with collaborative virtual environments [6]. These quantitative measures provide large volumes of relevant data, certainly, however the challenges in interpreting such data lie in indexing recorded data to 'real world' or ethnographic accounts in order to capture human-centered observation not necessarily represented in the machine-recordable dataset, the difficulty in processing and communicating large data sets, and the need to determine a method of easily identifying relevant content out of an extremely large body of information [6].

2.5.3 Evaluatory Considerations

It is important to consider that requiring participants to engage in an explicitly analytical process during or subsequent to their participation in a creative, aesthetic experience will inalterably affect their perception of the experience, interjecting the evaluatory instrument (e.g. the questionnaire, the interview, the electronic feedback device) into the narrative flow of the experience. While in some cases the side-effects of making direct interrogative contact with participants may be acceptable, it

does mean that investigation through direct participant interrogation is not necessarily always the optimal method of data collection in creative contexts. Alternatively, measures such as data recording, external ethnography or biometric measurements, while inobtrusive, may pose their own interpretational difficulties. It may be difficult to be certain that participant intention is being accurately understood from an external perspective.

As no measure of evaluation can be considered appropriate for all contexts or research scenarios, a combination of techniques is often applied in practice in order to address the complex nature of experience in creative, participatory performance environments.

Chapter 3

Non-traditional Design

In this chapter, we will overview how non-traditional, aesthetic practices have come to be used in human-computer interaction design. We will review the motivation behind the use of art practice and aesthetics in design, including the potential for stimulating open-ended discussion, promoting dialogue, and fostering increased self-awareness and reflection in the investigatory phases of design research. We will describe strategies for designing ludic, playful systems, and how ludic values can be used to inspire more mainstream design processes. Finally, we will introduce the use of interactive performance as a tool for investigation and experience design.

3.1 Aesthetics in Design Practice

Traditional usability-based HCI research practice conventionally involves an investigation of a target user community to determine the users' needs and goals, an implementation of an iterative series of prototype designs to satisfy the requirements determined by the needs analysis, and then a series of evaluative experiments and observation sessions carried out in order to refine the proposed system [11]. Formal user studies, whether quantitative or ethnographic, are considered to be proof that validates design concept [51].

Wright *et al.* suggest that while the commonly practiced *design-as-engineering*

approach to HCI, whereby design follows a linear trajectory from problem specification through abstract solution to implementation may be a successful method of practice within highly regulated, well-understood domains, this problem solving approach, abstractly modelling the domain space into 'goals' and 'tasks' may not always be the best way to adequately address the complexity of authentic experience [113]. Design-as-engineering approaches place a high value on usability, hierarchical task breakdown, and control over how the created artefact is interacted with by the user. While this is undeniably a sensible method for creating reliable, predictable, verifiable designs, reifying the design-as-engineering perspective inevitably risks reducing the design space to encompass solely that which can be formalised and represented within this abstraction of the problem domain [113].

Conversely, a growing body of HCI research has developed to explore design methods which feature alternative centres of value, such as ambiguity [37], and an openness to multiple, dialogical interpretation [91], [115]. Wright *et al.* propose a holistic, experience-centered design perspective, *design-as-craft*, which remains open to the influence of concepts and methodologies borrowed from alternative disciplines, such as that of art and craft practice [113]. By exploring creative practice as a method of design, we are able access art's fundamental valuation of the dialogue between a created artefact and the world who will encounter it. Ljungblad and Holmquist suggest that grounding an investigation in real, social constructs, placing high emphasis on considering what the community finds meaningful, helps facilitate the creation of designs that can be considered innovative rather than merely inventive [65].

3.1.1 Open-Ended Dialogue

Creative practice can be integrated into the early stages of design, allowing an open-ended dialogue to evolve between the designer and the world. These communica-

tions can happen between the designer and the target community, as in *participatory design* processes [53], or between the designer and other sources of inspiration, such as individuals outside the target user community who engage in *marginal practices* which, although only tangentially related to the target domain can provide alternative perspectives on creative innovation for later transfer [65].

Gaver *et al.*'s Cultural Probes [30] are one such example of the use of aesthetics and craft practice used to stimulate open-ended investigation. The probes are crafted objects, intentionally ambiguous in nature, used to elicit personal information and feedback from a user community in a playful, provocative way. Individuals are given a packet of small, handcrafted objects with which they must interact and tell the design team information about themselves and their community. The original series of probes was a set of cards, maps and cameras, directing members of an elderly Italian community to take a series of personally meaningful photographs on modified disposable cameras, label maps of their region with sociocultural information, and mail the design team the answers to a set of open-ended questions via customized postcards [30]. They used the replies they received to inspire the design of several new technologies for enhancing the daily living of elderly citizens in the region. Gaver's team felt the probes had provided them with a better understanding of the community's conscious and unconscious perceptions of community life, as they allowed the participants to lead the information sharing, allowing them to choose which pieces of information they found relevant and important to share.

Such an open-ended approach to information gathering is particularly suitable for broad and open design briefs [30]. Gaver's belief regarding the Probes is that they should be used as exploratory tools to provide new opportunities for discovery. He cautions that customizing and rationalizing them to address direct questions, would restrict their flexibility and force them to rigidly function as requirements gathering mechanisms [38]. Gaver's view is that the Probes' ambiguity and crafted

'playfulness' frames the investigatory design team as 'provocateurs,' uniquely capable of stimulating insight of issues which lie under the surface of even the target community's conscious recognition, making the ambiguity of the Probes' methodology a benefit rather than a limitation [30].

The use of aesthetic consideration and visual arts practice when physically crafting the Probes is recognized by Gaver as a way of developing a dialogue between the design team and the respondents. Their often whimsical appeal is intended to communicate that the exploratory task should be undertaken in a creative and playful way. Gaver's Probes are handcrafted, with a thoughtful and home-made aesthetic, emphasizing the fact that the objects are unique and that the communication is personal in nature. Wallace [109] extends Gaver's emphasis on aesthetic communication in Probe design, building beautiful objects for respondents to modify and interact with, such as small pillows upon which to write their dreams, or tiny jars of clay within which to imprint representations of meaningful objects. This use of visual arts methodology is designed to stimulate a sense of enchantment [74] and delight in respondents, in order to frame the respondents' perspectives when sharing personal information and insight. Wallace's use of the traditions of visual arts to convey emotional vulnerability and promote honesty and openness in communication facilitates a dialogical view of the information sharing process, making the exploration akin to a conversation between designer and respondents [116].

The idea of inspiring design through dialectic is also explored through the use of documentary film as an exploratory tool [80]. Using the traditions of documentary filmmaking, Raijmakers *et al.* stimulate group discussion via specially created 'design documentaries,' using filmmaking techniques and strategies to highlight interesting issues surrounding the needs, feelings, and requirements of heart patients. The documentary is shown to a design team with the intention of stimulating discussion between members of the design team and the research team who created the

design documentary based on their interpreted understanding of the heart patients' perspectives. Using aesthetic content to illustrate research questions and explorations, documentary filmmaking as a medium of communication allows both sides of the dialogue - the creators and the viewers - to enter into a discussion framed by an explicit demonstration of the filmmaker/researcher's perspective as portrayed in the documentary.

Increasing the 'Bandwidth' of Communication

Building upon this dialectic between filmmaker and observer, Hook *et al.* [49][50] use the expressive potential of documentary filmmaking to stimulate discussion and characterization of artistic performance practice in a participatory design project involving video jockeys (VJs) in the creation of specialized digital instruments. In order to better understand the VJs' performance methodology, Hook and a professional documentarian presented deliberately provocative mini-documentaries about the working practice of each VJ. The VJs were then encouraged to 'remix' the footage to rebut and further elaborate upon Hook's observations. Using documentary filmmaking and the dialogue of visual art as the medium in this exploration, the research team and the VJs were able to highlight and identify aspects of their performance practice which neither of them could explicitly address without using visual art as language for discourse.

This concept of using aesthetic content and artistic tradition to increase the expressive 'bandwidth' of the communication protocol is also central to the practice of 'informance design' [15] which uses theatrical improvisation techniques and live re-enactments to enhance team meetings. During an informance session, team members function as actors, adopting the roles of prospective users. Informance has been employed in ethnographic research, requiring an ethnographer to interact with a panel of researchers in the character of a subject which he/she has observed

[108]. Informance is designed to spark creativity and empathy amongst members of the research team, helping them through improvisational exercises to better understand the needs and desires of the people they are designing for, and allowing them to communicate in a less self-conscious or ego-motivated way, instead focussing their attentions on the character they are portraying [15].

3.1.2 Stimulating Respondents' Self-Awareness

When aesthetic content is incorporated in the investigatory phase of the design process, participants may find that this stimulates new awareness, enabling them to make additional observations in response to issues or situations. While conducting a participatory design session to develop alternative music-listening devices, Tanaka *et al.* [102] instructed participants to recollect meaningful incidents in which they shared the experience of listening to music with another individual or group. The participants were encouraged to elaborate on the emotive content of the music, how they felt about the music, and the way sharing the music made them feel. This use of musical rememberance in connection with the use of a critical incident technique investigation strategy triggered vivid and evocative responses in the participants, who were very receptive to discussing the incidents surrounding music-sharing in a very personal and descriptive way, highlighting their awareness of the significance music and the practice of listening to music had in their everyday lives. Guiding participants to this awareness, and encouraging them to discuss how the aesthetic content of music affected their interpersonal interactions provided Tanaka *et al.* with unexpected starting points for subsequent artefact design.

Incorporating the physicality of the dance and theatre traditions into the design process allows yet another level of engagement between respondents and the investigatory medium – the process then becomes *embodied*. Embodied interaction [26] accounts for the fact that an experience takes place both inter-body (between an

individual and the environment) and intra-body (within the individual him/herself.) Schiphorst [87] conducted a workshop process to develop a physically based participatory installation by situating her workshop participants in a series of dance and theatre-sports styled exercises in order to explore their embodied interaction with artefacts, one another, and themselves.

Her methodology, using biofeedback and borrowing from theatrical and dance tradition to devise a series of investigatory activities, provided a mechanism for participants to learn to focus on their somatic [86] embodiment in the environment. They learned to recognize their bodies' responses to stimulus in order to achieve greater awareness of their own physiological functions, such as breath cycles, heart rhythms and listening skills. During a series of interviews, they were then able to communicate with the design team about these increasingly acuitous experiences, which were then used to inspire the design and refinement of the installation space.

3.2 Designing Ludic Systems

Being mindful of the aesthetic component of design is particularly important when designing experiences and systems intended to stimulate creativity and curiousity. Ludic design, as interpreted by Gaver's [31] study of Huizinga's 'Homo Ludens' [52] refers to the design of systems created to appeal to people's creative nature, and their sense of 'play.' Ludic systems are designed to encourage "curiousity, exploration and aesthetic enjoyment" [36], and need not be designed to fulfill any specific goal or purpose. In fact, Gaver *et al.* maintain that a purely ludic system's designed ambiguity and absence of external goals is beneficial in the encouragement of playful exploration and creative engagement [31][39][34].

Gaver's designs encourage ludic behavior through deliberate functional ambiguity, obfuscation of any actual computerized technology, and the ability for 'flaws' in the system to be interpreted as features (digital artifacts visible due to computer

imaging, for example, can be viewed as additional aesthetic content.)

Guidelines such as those devised by Makela and Suri to faciliate 'pleasurable experiences' [67] can as well be applied to the creation of collaborative performances. These guidelines concur with the strategies outlined by Gaver *et al.* [39], proposing a physically robust, open-ended and flexible system design which not only allows users to personalize their strategic interaction approach but also facilitates social collaboration and communication. They suggest that such a system helps motivate participants to engage fully in an experience highly characterized by each individual's personality, past history, and current perspective.

The idea of a system which is highly contextualized by the situation of the individual in real-world surroundings is explored by Gaver *et al.* in what they call 'threshold devices'[34]. Ludic devices such as the 'Video Window' [36], a simple camera display which brings to his family home a birds-eye view of the surrounding city as seen from a rooftop vantage point, or the 'Plane Tracker' application designed to stimulate awareness of the passage of planes flying overhead London homes [34] emphasize how ludic systems which situate users in their immediate surroundings are experienced in a holistic way. Threshold devices provide users a novel way of recognizing their geographic situation in the 'real' world, fostering a sense of engagement by allowing each user to directly interpret the experience from the literal context of their physical surroundings.

3.2.1 Using Ludic Values to Inform Generalised Application Design

While purely ludic systems exist for the purposes of facilitating creative and playful user experiences, there is no barrier preventing the strategies used to create ludic systems fostering engaged and playful exploration from being extrapolated to apply to more mainstream system design.

Hekkert and van Dijk's 'Vision in Product' (ViP) design strategy [47][46] ex-

emplifies an approach whereby systems are conceptualized around a core set of values designers wish the finished product to embody. The ViP method of product design encourages designers to imagine the desired emotional responses they would like their designed product to evoke. The resulting designs may then incorporate the emotive content in an unpredictable, even poetic way - a photocopier machine designed using the ViP method is created using physical constructs such as responsive arms and liltingly paced interactions which evoke the metaphor of a dance between machine and user. Similarly, Desmet and Dijkhuis' 'emotion-driven' design methodology [22] defines first the attitude and emotional impact they wish to convey using a designed artefact (such as a 'cheerful' wheelchair) and use that emotional context to define the artefact's parameters while maintaining functionality (the wheelchair must as well be easily transportable and maneuverable.)

By making emotive and aesthetic implications a primary concern in a design context, a strategy similar to the methods described previously can be applied in order to encourage ludic engagement with everyday systems. Such a strategy is employed by Mathew and Taylor in their 'AuralScapes' project [70] whereby an internal windowless room buried deep inside a research facility is metaphorically connected to the outside world via a set of ambiguous audio-visual stimuli which are projected inside the isolated space. The AuralScapes design was centred around ambiguity and context sensitive interpretability, two fundamental characteristics of ludic design, thereby making use of ludic values to mediate the practice of architectural design.

Lindlay proposes that ludic values are easily applicable to the design of a wide range of application contexts [64]. He suggests strengthening the relationship between computer games (a well known form of ludic activity) and mainstream applications in order to stimulate high levels of user investment and engagement. Lindlay suggests an incorporation of the ludic values found in video game design, and a re-

duction of the differentiation between work and play in interactive systems. This, he purports, could lead to a more compelling user experience and facilitate users' ability to enter a *flow* state [19]. Lindlay defines the gaming gestalt as an interaction between the rules of game play, the narrative or 'story' conveyed by the game, and the game model defining the flexibility of the available performance space afforded by the application. Successful games facilitate flow by striking an appropriate balance between a controllable yet challenging game play and an explorative model of the game world, couched in a compelling (or conversely inobtrusive) narrative which allows the user to feel invested in his or her performance. He proposes that this same gestalt could be applied to mainstream system design to create an opportunity for users to experience high levels of engagement or flow by redefining the rules of game play, the narrative and the model in order to suit the requirements of the more generalized application context.

3.3 Using Performance in the Design Process

Art practice can be used in interaction design in order to provoke reaction and critical thought [35], and to welcome ambiguity into the design space [37] in order to open dialogues which encourage personalized interpretation [91].

Höök *et al.* suggest that art practice itself need not be considered separately from user study: the desire to provoke reaction to the artwork is inherently built into its design, and the manner in which this reaction is triggered and observed forms part of the message communicated by the work [51]. They cite the example of Garabet, whose wearable computing devices were specifically designed as tools to provoke and observe reflection about social issues of privacy, trust, and communication in public spaces [29].

Benford *et al.* suggest that interactive performance provides a unique medium from which to study user behaviour in collaborative virtual environments [6]. They

explain that the performance medium has several unique properties that make it particularly well suited for exploring collaborative experience. Viable public performances are necessarily slick, well-packaged and robust – the values which make them good performances also make them effective and well-implemented tools for investigation. They leverage the creative skills of established professionals to create situated environments in which risk-taking is permissable – in a playful space, social norms are less restrictive. Their attractiveness engages the public, and can result in high-profile media exposure, critical media review also providing an external source of evaluation. The performance experiences take place in truly public settings, making the use of public performance an interesting and authentic alternative to the artifice of the laboratory in terms of its ability to interrogate legitimately situated experiences. While Benford *et al.* also identify potential difficulties inherent in using performance as an investigation platform (high operating expenses, the inaccessability of traditional funding models due to the interdisciplinarity of the approach, and the difficulty of creating a work that will be credibly received as simultaneously both 'good art' and 'good science') [6] they maintain that using performance as an exploratory medium allows investigators to uncover new design avenues and stimulate research.

In the next chapters, we will describe how we have undertaken a research trajectory in which we have designed and taken part in a series of interactive performances used to explore social behaviour in public spaces.

Chapter 4

Designing From Within

We have overviewed a variety of literature describing the participatory performance art form, as well as examples of how art and aesthetic content have previously been used to stimulate HCI investigation. In this chapter, we will describe how we have used participatory performance as a medium for HCI research, exploring how best to engage users with playful technologies in social settings. In the tradition of the practices we have described previously, such as Gaver's cultural probes [30] [35], Wallace's bespoke jewellery [109], and documentary design as practiced by Hook et al. [49], we leverage the aesthetic properties of the participatory performance medium in order to conduct research into how to engage members of the public in creative play.

Using performance as an exploratory platform provides us with unique benefits, such as the ability to interrogate social behavior in an authentic, real-world setting and the opportunity to use aesthetic content to encourage participants to overcome sociocultural barriers in order to immerse themselves in the somewhat risky activity of being playful and creative in public view. This choice of investigatory medium, however, does pose unique challenges with regards to how to develop and refine legitimate performances that maintain artistic authenticity and contextual integrity while providing avenue for research and design exploration.

In this chapter, we will discuss the practice of 'designing from within' which

emerged in response to these challenges over the course of several years of investigation during which we created, enacted and refined three participatory performance investigations 'in-the-wild'. We will elaborate on our strategy of self-situated, dialogical exploration, and relate the characteristics of our methodology to other forms of practice. We will also address the challenges of evaluating participant engagement in creative scenarios, and elaborate upon how co-experiencing our designs 'from within' allows us a unique vantage point from which to explore user experience.

4.1 The Practice of 'Designing from Within'

In this section, we will describe the principles which characterize the practice of *designing from within* as undertaken by myself, Guy Schofield, and John Shearer over the course of several years of performance-based research under the guidance of Patrick Olivier, Peter Wright, Jayne Wallace, and Pierre Boulanger. Our practice emerged and evolved through the creation and exhibition of three interactive works, *dream.Medusa*, *humanaquarium*, and *Nightingallery*, enabling us to refine a method of interrogating creative, playful behaviour when presenting interactive media in public. Each of the works was performed repeatedly over one to two years, allowing us to engage with the public via the performances numerous times, under widely varied performance conditions.

Our research and performance practice can be characterized by several qualities;

- Self-situated
- Longitudinal to facilitate sense-making
- Explicitly dialogical
- Open to participant-led interaction and the influence of place

- Implementationally flexible

In this chapter, we will explore how each of these aspects of our practice allowed us to interrogate shared, social behavior in public spaces from a holistic, pragmatic perspective.

4.1.1 Self-Situated

In each of the three interactive projects that have formed our research trajectory, we have taken active roles, not only as designers and developers, but also as performers, taking part in the performances alongside participants. In *dream.Medusa*, I sing on stage during the performance. In *humanaquarium*, Schofield and I perform live music inside a portable, interactive enclosure. In *Nightingallery*, Schofield, Shearer and I function as theatrical minders and assistants to an animatronic bird character.

By taking active roles as performers in the interactive artworks, we are able to experience the effects of our design interventions firsthand, accessing our own *lived* [10] and *felt* [72] impressions of the shared experience. Taking part in the performances alongside participants affords us an embodied awareness [26] of what has taken place - awareness grounded through our own personal experience, the viscerality and authenticity of which cannot be reproduced through external observation or second-hand recounting.

In addition, by explicitly engaging with participants through the performing arts we attempt to access and understand the shared experience from a firsthand perspective which has been contextually trained through our own long-term, professionally honed and cultivated craft practices (in my case, working from a basis of over twenty years of vocal performance experience and training.) Schiphorst theorizes that this form of *connoisseurship* over a somatic, body-based activity can allow us to benefit from enhanced experiential acuity and understanding (comprising intuitive skills of observation, discernment, synthesis, empathy, and focus) derived

from years of ingrained and practiced expertise [86].

By engaging in a form of autobiographical design [89] whereby we create and refine an interactive platform used by ourselves, performing artists, as part of an ongoing creative practice, we knowingly, as Sengers describes,"embed [our] personal subjectivity into the system" ([89], p.1) allowing our intimate knowledge of our own life experience and professional craft to inform and enrich our design concepts. Being situated within the use context under evaluation (the participatory performance) enhances our ability to interrogate and explore the evolving design firsthand. We also have the opportunity to self-study our own design process through critical practice evaluation [90]. Through examining our own practice, we can attempt to unpick how personal experiences lead to refinements and reframings of a developing design over the course of its trajectory. This is explicitly explored in Chapter 8 of this thesis, in which we identify and discuss compositional tensions which have emerged through our design practice.

Cultivating personal subjectivity as a feature of our methodology results in a practice which fundamentally differs from externally-imposed, objective evaluation as is traditionally undertaken in HCI research. We suggest that our approach offers opportunity to complement conventional HCI practice by allowing us to explore participant experience from an unusual, situated vantage point as designer-performers within the shared experience, uncovering insights visible from a first-hand, autobiographical perspective.

4.1.2 Longitudinal to Facilitate Sense-making

In order to maximize the benefits obtained from a self-reflective examination process, we favour a longitudinal approach to the use of performance as an investigatory practice. Each of the performances described in this thesis were performed repeatedly over the course of one to two years. During those time periods, we were

able to benefit from the ability to examine and reflect on our experiences from an ever-changing and enriching perspective as our understanding of the performance scenario was allowed to develop over an extended period of immersion and reflection upon the work.

McCarthy and Wright refer to understanding gained through firsthand, felt-life - life that is personally lived and experienced [72] – as the process of sense-making [71]. Making sense of an experience does not happen in a vacuum. Experience is understood by an individual, with his/her own unique perspective on the world - a perspective that is shaped by past experience, present context, and future prospects. McCarthy and Wright draw upon the pragmatic, holistic philosophy of Dewey, explaining that the meaning of a situation is made sense of through intuitive reflection upon previous experience. Even the immediate, visceral sense of an experience is necessarily shaped by the context in which it is encountered and understood.

Sense-making of a situation must account for the sociocultural context within which the situation is encountered, framing the encounter through the eyes of s/he who experiences it. McCarthy and Wright use the example of seeing a film [71] to explain the personally reflective process in which sense-making takes place: the filmgoer's anticipation of the film (due to previous knowledge of the director's work, for example) colours how s/he evaluates the film against expectation, and allows him/her to refine a conception of how s/he might appreciate future work by that same director. They also highlight the social aspect of sense-making within the context of filmgoing: the filmgoer's reaction to a piece of work might be affected by what s/he has previously heard about the film from friends, peers, or critical reviewers, and might consider the merits of the film relative to how s/he could later discuss the film with others.

McCarthy and Wright describe sense-making as encompassing several stages, including the anticipatory phase of interaction, the connection phase in which a

situation is encountered, an interpretational phase during which the experience is explored, a reflective phase during which the experience is evaluated, as well as an appropriation phase where the experience is integrated in relation to one's sense of self. Sense-making can also encompass a stage of recounting, whereby an experience is further understood through dialogue, narrating the experience to another person or internally to oneself. These stages should in no way be considered to be linear or implicate a causal or progressive relationship, as they can occur in any order, simultaneously, or repeatedly during the ongoing process of sense-making that happens as we formulate meaning and understanding of our world over time [71].

In our practice, we deliberately allow ourselves to live with our performance projects long-term, integrating them into our ongoing creative practice over an extended period of time. In this way we are able to experience a sustained temporal period over which our sense-making of the project matures and enriches. As previously explained, this long-term process is not simply one in which a succession of distinct incidences produce a large amount of experiential data over the course of an extended timeframe. Instead, it is better to consider how the accumulation of ongoing experience which occurs over a substantial time period allows us to unlock greater meaning as the perspective base from which we can examine and reflect upon our experiences broadens through increased exposure to and awareness of the scenario being explored. McCarthy and Wright explain:

> [Our] sense of any particular situation depends on previous experience and reflection. Objects and situations attain a meaning for [people] in [their] ongoing experience with them and reflections on them. As meanings developed through reflection are absorbed by the object or situation, the sense of that situation changes." ([71], p.116.)

Sengers and Gaver suggest that the ability to form multiple interpretations of a system during a temporal course of interaction is beneficial in that new oppor-

tunities for understanding unfold as the interpretation process is channelled [91]. Our process of sense-making spans the months or years of the performance's lifespan, allowing us to formulate multiple interpretations of the performance scenario as our experiences living with and appropriating it evolve over time. The extended duration of our investment with the projects allows us to inhabit multiple perspectives from which to explore the performances as our relationship to them naturally changes during the course of their lifespan. We can shift between evaluating the performances from our position as their developers and designers, through the lived experience of live performance, through reflective self-critique, via the external critique we receive from audiences and media, and as well from the mediated perspective of re-watching videotape footage.

Naturally, these multiple perspectives do not remain static over time. Our practice of self-critique as performers, for example, may have temporary changes in focus so as to attenuate upon specific issues raised through external critical commentary, to concerns triggered by earlier performance experiences, or to evaluate against intrinsic creative goals we wish to further explore within the performance scenario. It is similarly true that there are many different things to be learned about one's relationship to a creative work during the early stages of a project (in workshops or small exhibition settings) than are learned at the peak of a performance's success when exhibitions happen on tours or at high-profile venues.

Over time, we have the benefit of understanding and appropriating personal meaning in the performance scenario, through sense-making processes which allow us to view each new encounter with our performances within the context of an ever-growing body of reflection which spans previous experience and appropriation of the work. Gaver *et al.* describe how a user community of nuns intentionally withhold any early conclusion on the convent-situated *Prayer Companion* project:

> *'A month is nothing to us'*, they explained. In a year, or two years, they

will have an idea." ([33] p.2063.)

Our early experiences form an understanding of the situation which evolves over time as the projects mature, and our longitudinal practice ensures that our processes of sense-making are allowed to be enriched by extended reflection, living with the performances for the duration of their exhibition lifespan. By deliberately planning to live with and engage with the performances over a period of months or years, and intentionally designing them as malleable over time, we explicitly remain open to widening our exploration as we benefit from the broadening of perspective one naturally gains through long-term exposure, reflection, and appropriation.

4.1.3 Explicitly Dialogical

Performance is an inherently dialogical phenomenon. A composition outlines the structure of a performance, but its actualization is achieved through a performer experiencing the performance of the content alongside an audience. While the traditional conceptualization of performance places high emphasis on the directionality of communications transmitted from performer to audience, in fact it is more accurate to explore the communications between performer and audience as bi-directional. By maintaining attentiveness to the audience's reactions, the performer can intuit how his/her efforts are being received, and, if necessary, modify his or her performance accordingly in response. Seen in this way, the interplay between performer and audience can be considered as a dialogical relationship.

Through our explicit manipulation of the performance frame to invite participatory interaction as an integral component of our performance pieces, we make this dialogue between performer and audience even more explicit. As explained by Winkler, development of non-linear, interactive works allows us to invite indetermination in our composition [111], enabling each presentation of the performance to be enacted in collaboration with participants whose interventions realise the com-

position. By deliberately crafting each performance context to facilitate specific manners of dialogical participant engagement we can stimulate the occurrence of particular socio-cultural interactions which we want to explore.

Participants who choose to improvise with us during one of our performance pieces directly interact with us during the shared experience. We formulate performative responses to their interventions, allowing their improvisations to influence the way the performance is enacted. This very literal facilitation of dialogue through participatory performance has been an aesthetic goal of our work from its inception.

In addition to the dialogical possibilities offered by the improvisational medium of our work, our performance-based practice stimulates further dialogical exchange during after-the-fact recounting and discussion amongst social groups. The performances are often discussed, either in situ by participants, audience, and sometimes ourselves, or later, via mediated communications such as external reviews or reportage. When possible, we try to observe or take part in these exchanges, engaging in the recounting and narrative building aspects of the sense-making process which are fulfilled through such dialogues [115].

We are careful to caution, however, that a critical component of our practice requires that we understand our role as designers within these dialogues. We are not intending to supplant ourselves into an imagined perspective *as* the user. Instead, corresponding to Wright and McCarthy's dialogical appropach to empathy in design, we focus our investigation on what we can observe of the user's world from our positional perspective as the designers of the experience [114]. However, rather than examining the performer/audience relationship from a dialectic perspective whereby the audience is treated as an external entity to be evaluated, our approach accesses the opportunity to examine a shared performance scenario from within – from our own own vantage point as designer/performers within the performance frame.

There is a third sense in which dialogue forms a central component to our design practice. Each subsequent performance of our work is influenced by the enactments of the performances which came before. We explicitly adapt and redesign the performance interfaces in response to ideas which are triggered through authentic, shared experiences with participants. In that sense, the very manner in which our performances are refined can be considered dialogical: our adaptations are in fact our responses to interventions contributed by the participants during previous performance exhibitions.

4.1.4 Open to Participant-led Interaction and the Influence of Place

In keeping with our desire to learn through dialogue with participants during authentic, situated performance practice, the participatory media we create has to be open-ended enough to allow participants to take agency within the system, personally engaging with the works rather than being overly constrained by the interaction paradigms we devise. Through the course of our research we found ourselves placing ever greater emphasis on participant-led interaction and participant agency within the collaborative performances. Facilitating this aspect of composition became a large stimulus driving the trajectory of our performance series, and can be considered to be one of the fundamental aesthetic goals which developed during the course of our practice. We wanted, and encouraged participants to creatively engage with, and even subvert, the ludic, playful systems we devised. Unexpected, serendipitous interaction [59] was welcomed and valued. By acknowledging and facilitating the unpredictability inherent in working in authentic scenarios, we were positioned in such a way as to use the dialogues which emerged via unexpected, participant-led contributions and interventions as avenues to inform future performance design. This illustrates one aspect in which the unpredictability and uncertainty built into researching-in-the-wild has been beneficial to our practice.

In order to best leverage the opportunity to learn from repeated performances in an array of diverse venues, it is also important that our designs be flexible enough to be performed under a wide range of conditions. McCarthy and Wright suggest that dialogical relationships occur not only between people who share an experience but also between the participants and the place where the encounter takes place [73]. The context in which our performances are held inevitably shapes the manner in which they are experienced by participants, audience, and ourselves.

In contrast to performance works that make location and place an integral component of content (see Benford et al's *Uncle Roy All Around You* in which participants are led on a city-based adventure [5] or Allen *et al.*'s *From Here On Out* [2] which augments the city of Newcastle upon Tyne with fantastical visualizations), we have focused on crafting self-contained performances that can be easily adapted to be performable in a variety of different kinds of spatial and cultural contexts, ranging from concert halls, to exhibition venues, to festivals, to informal public spaces. Deliberately creating highly adaptable performances, we ensured we could stage the portable performances under a variety of circumstances in order to explore the effects place and situation had on experiential context. The experience of performing the works was very dependent upon the context they were performed within. High profile appearances at BBC literary festivals felt much different than having the performance environments installed in a muddy UK festival field. In a way, we considered our performance media as forms of cultural probes [30] designed to provoke situated dialogue in authentic, varied public spaces. We found it fascinating to see how much the influence of *place* impacted the experience of performing the work.

4.1.5 Implementationally Flexible

Through enacting the performances repeatedly, we have multiple opportunities to engage in dialogue with participants from our standpoint as designers and performers [114]. These dialogues can occur both immediately (onsite as performers reacting to participants during the performances) and more extendedly through ongoing refinements and extensions made to the developing design in response to things that occurred in previous exhibitions.

As we undergo a longitudinal process of sense-making with our performance projects, it is critical to our practice that we be able to iteratively refine and revise the projects' implementation as new insights or design avenues are revealed to us through experience and use. Latulipe *et al.* [57] describe how the technically and creatively complex requirements of the performance medium make it particularly difficult to explore alternative design choices and test new strategies in authentic use contexts, as generally a piece of work is only considered performance-ready once it reaches its final form. We specifically implemented our works with the intention that they would be refined as our experience with them evolved, enabling us to adapt them over time to investigate new avenues of inquiry that arose as we performed them with the public.

Beginning during the development of our *humanaquarium* project, we scheduled week-long cycles of public performance, analysis, revision, and re-exhibition during the earliest stages of our investigations. This allowed us to immerse our attentions and intensely dedicate ourselves to project development within a short, focussed timeframe. This was essentially a similar practice to traditional HCI iterative prototyping, however, instead of creating test-bed laboratory prototypes, each performance iteration was required to be a polished, finished work, suitable for public presentation.

To enable us to revise and extend the project so rapidly, feasibly ensuring it

could be performance-ready within the weeklong turnaround time, we made a number of software engineering choices from the outset of the project's development. Adopting principles similar to those of *agile development* [1], a software development strategy intended to facilitate the creation of working, malleable software that can be adapted to satisfy fluid, changeable requirements and circumstances, we focused on the collaborative, team-based creation of software that supported flexibility even in the later phases of development and deployment. The performances had to be adaptable long after they were first exhibited to the public as viable artwork. As our projects were constantly subject to public scrutiny, it was crucial that the software always remained in a form that was in stable and working condition despite our practice of making frequent, small, revisions. This necessitated that changes be carefully thought through before implementation, and that attention always be paid to testing. Minor code instabilities would be perceived as major defects if system failures occurred during public performance. To support this, we valued simplicity and straightforwardness in software design. In order to produce robust and flexible code that remains stable across numerous small revisions and extensions, we strove to achieve a compelling aesthetic result through extending a thoughtful and intentional base design. Whenever possible, we tried to reuse good, stable code modules across projects, and leverage reliable and accessible third-party tools when suitable.

We developed the projects within the visual programming environments of Max/MSP/Jitter [21]. The visual environment allowed us to graphically lay out the system design in two dimensions [43], enabling us to literally visualize the dataflow of our applications. As we generally engaged in team-based programming, visualizing the dataflow helped us to program together as a group. We found that the visual metaphors provided by Max/MSP enabled us to more readily intuit one another's intentions while programming, and as well, the graphical nature of the environment

accommodated our varying levels of experience in software development.

Green provides an analysis of what he terms *cognitive dimensions* of the visual programming paradigm, indicating that visual programming languages (VPLs) are particularly suitable for use in collaborative, rapidly changing development scenarios [42]. Green's framework has been applied to interrogate interactive environments, software packages [44] and musical notation systems [9], identifying positive and negative aspects about the suitability of system environment to creative task.

When Green's framework is used to assess the Max/MSP environment for use in collaboratively creating the flexible, mutable performance systems we use within our development practice, we recognize Max/MSP's suitability for the task domain particularly due to its:

- *closeness of mapping:* Max/MSP's dataflow paradigm makes it easy to graphically identify the various processes used to solve modular problems, visually corresponding task-domain issues onto their respective program entities. In our group-programming scenario this helped our team ensure that each of us had the same understanding of the semantic functionalities of the code structures created.

- *reduced error-proneness:* VPLs reduce the number of syntactical errors which creep into conventional coding. Max/MSPs syntax is relatively simple and consistent, making it suitable for use in rapid development cycles such as ours.

- *lack of reliance upon premature commitment*: VPLs greatly reduce the need for developers to prematurely commit to all aspects of the design from the outset. Max code modules can be developed in any order, isolating functionalities that can later be replaced or re-ordered within the dataflow by adjusting

the box-and-line connections which specify the order of operation. Due to our need for flexibility and robustness, such modularity was extremely beneficial.

- *role-expressiveness:* the Max/MSP environment is particularly well suited for electronic musicians who may be less experienced in traditional programming. The environment models itself after the physical dataflow of electronic mixing desk layouts, and uses music-technology metaphors such as patch cords and effects modules to convey its syntax to inexperienced programmers.

- *visibility:* Max/MSP's *patcher* interface allows for submodules to be collapsed and unfolded so they can be viewed, and their execution observed as needed. This can occur during development, or at runtime – a feature which can be exploited during performance if undesirable or unusual behaviour is noted.

4.2 Exploring Experience from within the Performance Context

Sengers *et al.* explain that there are conventionally three approaches [90] taken to technology evaluation:

- the evaluation of the system itself,

- the analysis of the design practice undertaken,

- the exploration of how the technology is appropriated and used by those who encounter it.

For our purposes, we take a viewpoint comparable to that which she and her colleagues apply to the longitudinal design and evaluation process of a similarly

aesthetics-driven piece of interactive technology, *Affector* [10], in which two coworkers created and lived with an evocative video interface that allowed them to abstractly communicate and intuit one other's moods during the course of the working day: these three avenues of investigation are not mutually exclusive; they each necessarily overlap when considered holistically. We focus our investigation on understanding how our performance environments are used and appropriated by the shared community of participants and ourselves, and on exploring how our own longitudinal process of sense-making could stimulate design evolution to improve participant engagement. By attending to system evaluation in this fashion, technical development and system improvement intuitively follow from our desire to facilitate ever-increasing engagement with the performance experience.

By positioning ourselves inside the use context under investigation (the participatory performance) we experience both the design process and the results of our design interventions firsthand. We examine the shared performance experience from our own unique perspective as both the performers and designers of the collaborative work. We genuinely share the use context with the participants, and from this situated vantage point can investigate the interactions and dialogues we collaboratively undertake. We are deliberately mindful of the research aspect of our performance work, taking great care to be attentive to the interactions going on within the performance frame so that we may better benefit from considering their relevance.

Our strategy of investigation is to evaluate the performance experience from our own perspective as designers and performers experiencing the scenario alongside participants. We focus our data gathering methods upon ourselves, the designer/performers taking part in the shared experience. Our primary method of data gathering is through post-event reporting and video documentation. After performances, we take detailed notes about the experiences we shared with participants,

and compare these notes against videotaped documentation of the performances. We view the videos both shortly after performances as well as again, later in the development cycle of the project after an extended period of exposure to the work, when our experiencing of repeated performances has allowed us the opportunity to reflect more deeply upon the trajectory of how the project has evolved. Complementing these firsthand experiences we document on-site during the performances, overlooked memories can be triggered, or alternative perspectives revealed by the spatiotemporally removed medium of video.

A dialogical approach to investigation must be sensitive to the sense-making process of appropriating personal experience which extends beyond the duration of the performance act, and would be influenced by many external factors including artificial constraints added to the performance context for the purposes of data collection. For this reason, we do not focus our efforts on formalized gathering of explicit participant feedback. We are eager to speak with participants after the performances, if such interactions take place naturally within the social context of the exhibition, but we feel that attempting to engage in traditional interviews on-location in performance venues is both practically and ideologically problematic (although in Chapter 5 we describe a small interview session we carried out within a research workshop.) Oftentimes, attempting to engage in formal methods of data gathering that require participant cooperation would be socially disruptive to the authenticity of the performance and exhibition context, compromising the narrative we wish to explore.

While our manner of exploration would not preclude the concurrent deployment of unobtrusive, low-level recording techniques to obtain quantitative data about user interaction (system log event recording for example) our emphasis on exploring authentic experience of participants who encounter our works in legitimate public use contexts means that many of the commonly used data gathering methods described

in Chapter 2 (formal participant interviews, questionnaires, PDA-enabled feedback devices, etc.) are far too obtrusive to be suitable for our purposes. We choose instead to explore experience through our own reflection, recounting and observing of captured video footage.

We are interested in exploring our experience from multiple perspectives. During our performances, our performance team (Shearer, Schofield and myself) inhabit different vantage points from which to explore: from our points of view as performers performing the work, and as well as while mingling with the crowd and interacting alongside the audience. After the performance concludes, we can observe the experience from a more external vantage point, by reviewing video captured from the audience's perspective. Watching back the videotapes allows us to take a birds-eye view upon the interactions we lived, enabling us to reflect upon how the experience we felt firsthand may have been perceived by others. Raingruber [81] argues that when people watch themselves engaging in an experience on videotape, the videotape footage

> "helps participants re-collect, reexperience, and interpret their life world. The immediate nature of the videotape captures emotional nuances, climates of meaning, embodied perceptions, spatial influences, relational understandings, situational factors, and temporal manifestations of a person's life world in addition to verbalized comments. Participants view the video and self-identify meaningful moments, stopping the video to reflect on the significance of those moments. This dialectical approach brings together prereflective lived understandings and a reflective grasp of the situation. Videotaping enables participants to notice aspects of their response that had been lived rather than understood in an explicit way." ([81], p.1156)

By re-watching our own experiences, both shortly after the performance, and later, after some time has passed and numerous other performances have taken place in the interim, we are able to compare our own perceptions of the experience with this more impartial record of what transpired. Through this practice, looking at the audience mindful of our recollection of having shared the performance experience alongside them, we can attempt to interpret audience behavior from a more removed vantage point. Our sense-making process is informed by our own point of view as performer/designers with firsthand memories of having co-experienced the encounters documented on the tapes.

We can rewind and review individual moments in the video record, helping us explore and discuss the meanings of critical incidents and provocative occurrences that we noticed during peformance. Small, unique, one-on-one interactions documented in the videotapes often inspired animated discussion amongst our team, as each of us had our own recollection of the incidents in question which could then be compared and contrasted against the video footage for further investigation.

In a set of field studies that observed individuals interacting with custom-built technologies situated in family homes [34], Gaver *et al.* emphasize that the most interesting findings they obtained were the unpredictable 'one-off' choices that individuals made when reacting and interacting with the enhanced environment. Rather than attempting to generalise about an aggregation of participants as a whole, we similarly focus our explorations upon learning from each of the very specific, individual, and personal encounters we have with the people who join us in the performance frame during the presentations of our works. If, as Boehner *et al.* suggest, aesthetic experience is "an irreducible, lived event that cannot be fully understood at a rational, formal level" ([10], p.3) then we must address and explore it "in ways that do not primarily reduce complexity and reify abstract categories of practice." ([10], p.3)

As mentioned at the outset of this discussion, and in keeping with the principles of autobiographical design practice [89],[10] and an arts-design tradition highlighted by the works of Gaver [30][35], Wallace [109], Schiphorst [86] and others, we feel that the innate subjectivity of this reflective, self-situated form of research is an advantage rather than a liability. This manner of exploration offers an experience-centered manner of practice, complementary to that which is more commonly undertaken in conventional HCI investigations, valuing the very personal processes of sense-making [71] and felt-life [72] in understanding encounters with creative technologies and art content.

In the following chapters, we will describe how our practice has evolved and refined through our experiences with our three interactive performances: *dream.Medusa*, *humanaquarium*, and *Nightingallery*.

Chapter 5

dream.Medusa

As described at the outset of this thesis, we began our use of participatory performance as an investigatory medium through our experiences with the *dream.Medusa* project. The *dream.Medusa* art piece was commissioned by an artists' collective for exhibition at Toronto's 2007 *Nuit Blanche* festival, where it was included in an installation space dedicated to the stages of sleep and dreaming. The project was developed in Patrick Olivier's interdisciplinary research laboratory based in Culture Lab at Newcastle University, making this my first collaboration with the team who I would continue to work with on the subsequent *humanaquarium* and *Nightingallery* projects.

dream.Medusa is a 15 minute interactive performance exploring the experience of lucid dreaming [107]. Participants interact with and control aspects of a simulated dream by manipulating specially created objects and exploring how their manipulations change a large, projected video visualization. I contribute to the shared performance by translating my sung vocalizations into colourful imagery that is integrated into the video stream. Using music and voice, I try to draw participants and audience into a restful, enchanting sensory experience. Each performance of the work is necessarily unique, as the discovery and exploration process each participant undergoes as s/he learns to control the video environment using the control devices is different, allowing the participants to take part in an ephemeral, collabo-

rative, shared experience.

The performance was exhibited numerous times in Canada, and was included in several festivals held in the UK, Spain, and Mexico. During these performances of the work, my colleagues and I were fascinated by the varied feedback participants and audiences shared with us, and the way cultural and social differences affected how each performance was received. We found the nature of the participation, as well as the nature of the audience reception to be very much affected by the social factors surrounding the exhibition. The formality and size of the venue, the demographic of the attendees, even the time of day of the presentation affected how adventurous, engaged, and attentive our participants and audience became.

We became interested in pursing an investigation which would address the complex phenomenon of participant engagement in interactive performance. We began by analyzing the participatory medium, engaging in a critical reflection upon our design process guided by McCarthy and Wright's pragmatic framework which addresses *technology as experience* [71].

This chapter relates how our experiences with *dream.Medusa* led us to develop the method of research practice that we have called *designing from within*. We begin by describing the *dream.Medusa* performance, then explain how we applied McCarthy and Wright's theoretical analysis of the *threads of experience* to explore our own method of practice, analyzing *dream.Medusa*'s *sensual*, *emotional*, *spatio-temporal* and *compositional* components within the context of live, interactive performance. We also explore the *sense-making* process participants undergo when interacting with such a work, and describe the participatory medium's potential for encouraging designer/user dialogue through performance. We present an interview session undertaken by myself and a group of selected participant/researchers, and describe how, through our experiences with *dream.Medusa* we laid the foundations for our method of *designing from within*, which was later more fully realised

Figure 5.1: Participants interacting with the responsive video environment

through the research and performance methodology we undertook with our subsequent projects, *humanaquarium* and *Nightingallery.*

5.1 The *dream.Medusa* Performance

In a lucid dream, a dreamer becomes aware that s/he is not awake, but rather s/he is dreaming [107] [1]. Through that conscious realisation that reality is in fact fantasy, the dreamer becomes able to interact with the dream environment and can enact change in the dream world. Of course, as anyone who has experienced this phenomenon knows, control of a lucid dream can be fleeting, and the dreamer often either loses conscious control of dream events, or awakens entirely.

We attempt to explore this idea of conscious control of dreamscapes through

[1] A version of this section has been published. Taylor, R., Boulanger, P., Olivier, P. *dream.Medusa*: A Participatory Performance. 8th International Symposium on Smart Graphics, Rennes, France, August 27-29, pp. 200-206., 2008.

the *dream.Medusa* performance. The 15 minute performance sees four participants joining me, the singer, in the staging area, sitting on the floor amongst a pile of soft, colourful pillows and blankets. We sit with our backs to the observing audience, in a semi-circular arrangement (see Figure 5.1.) We sit facing a large projection surface. The size of the screen, and our proximity to the display ensures that the visualization fills as much of our visual field as possible. The rest of the spectating audience watches from a distance, in the manner of a traditional theatrical production.

The piece is performed in three phases. The first phase is guided completely by me, as I perform a five minute audio-visual improvisation, whereby my sung vocalizations are visualized through responsive imagery (videos of floating and drifting jellyfish) triggered and colourized based on the nuances of my vocal timbre (see Section 5.1.1 for a discussion of this process.) The participants and I sit close together, while the audio-visual improvisations fill our visual and aural fields, immersing us in the sensory components of the simulated 'dream' experience we are sharing. The music is intentionally repetitive, hypnotic, and restful, in an attempt to relax and focus the participants and audience.

The second phase of the performance sees participants brought in to the shared dream through the use of ambiguously constructed control devices which allow them to each manipulate a parameterized aspect of the visualization. The participants must determine, firstly, how to manipulate the devices (they are featureless mirrored tubes, the decorative casing containing accelerometer-equipped Nintendo Wiimotes) and secondly, how their manipulations of the devices help effect change in the 'lucid dream' scenario (see Section 5.1.2 for detail on the control implementation.) During the second phase of the performance, the participants' controllers are activated and deactivated at intervals, letting the participants move in and out of control of the visualization, as they would move in and out of control in a lucid dreaming scenario.

In the third phase, all of the participants' controllers are activated, and I return to overlaying colourful imagery through vocal improvisation, allowing us to visually 'jam' together. The combination of my vocal manipulations and the interactions of the participants creates the most vibrant visualizations during this, the climactic phase of the performance.

The participants are in no way practiced users of the system – they are audience members who choose to adopt the role of participants within the performance frame. They are given the interactive objects, and instructed to explore them as they experience the performance for the first time while participating in its creation.

5.1.1 The *dream.Medusa* System Structure

dream.Medusa was implemented in Max/MSP/Jitter [21] (see Figure 5.2) incorporating third-party external Max objects to implement Bluetooth Wiimote connectivity and fast fourier transformation of vocal input. There are two main technical components to the system[2]:

- the voice analysis and visualization
- the Wiimote-controlled video manipulation routines

5.1.2 Voice Controlled Interaction

A large component of the *dream.Medusa* performance is the voice visualization mechanism which allows me to make subtle changes in vocal timbre that enable me to vocally control the overlaying of colourized jellyfish imagery which floats, superimposed, upon the projection surface.

The timbre of a sound describes that property which permits it to be distinguished from another sound of the same pitch and loudness. [16], p. 142. Vocal

[2]Refer to Appendix A for detail of the Max/MSP/Jitter structure and implementation.

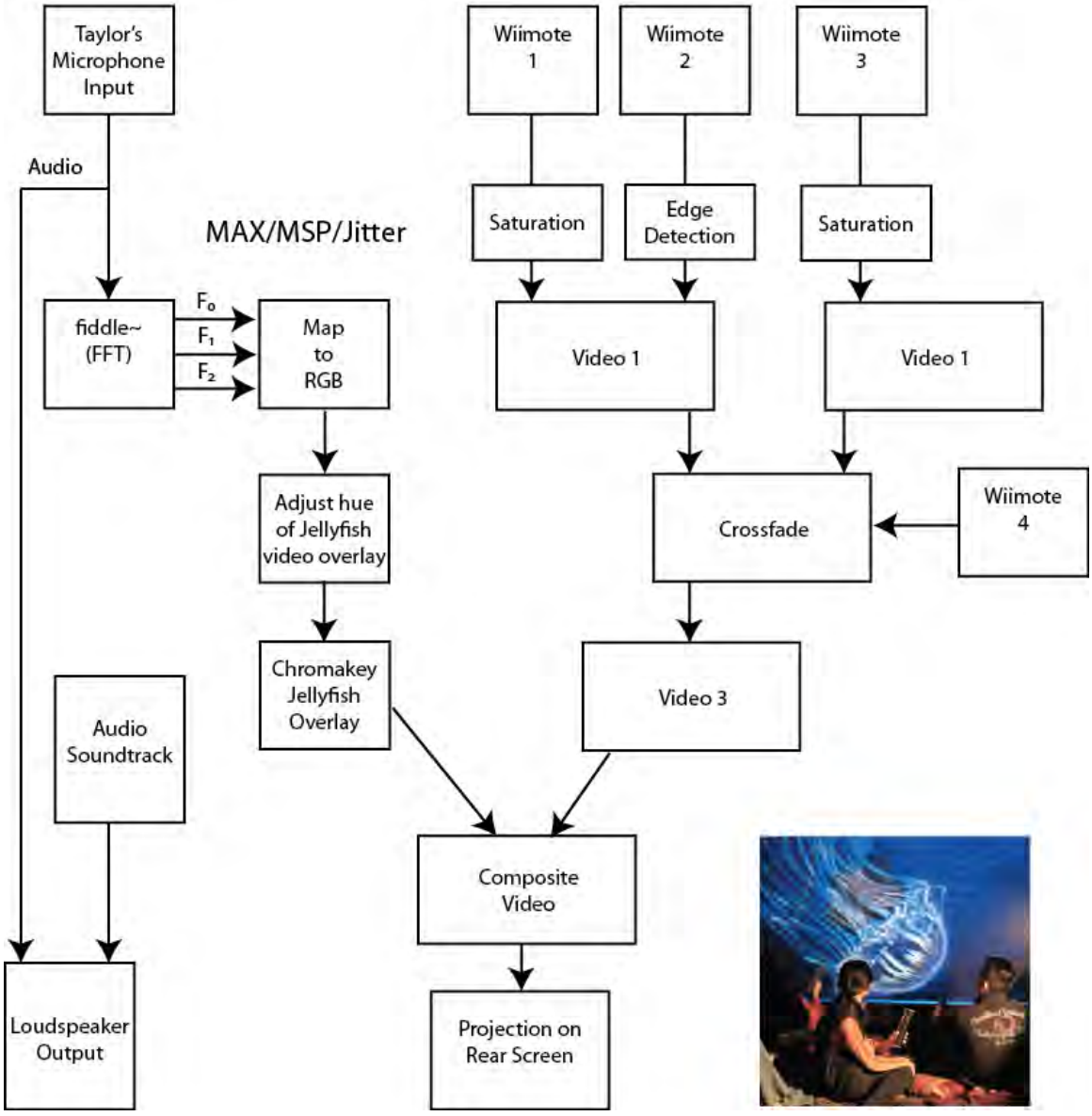

Figure 5.2: The *dream.Medusa* system structure

timbre might also be referred to as 'vocal colour' or 'tone colour.' The timbre of a singer's production also reflects the singer's vowel choice.

In order to allow me to interact with the video environment in such a way,

- My live singing must be analyzed and processed to extract timbral characteristics
- Extracted features must be mapped to visual parameters

To do this, we re-use a system of voice visualization first created for one of our previous performance pieces, *Deep Surrender* [104][103]. We use the `fiddle~` object developed for Max/MSP by Puckette *et al.*[78] which implements a fast fourier transform to analyze and extract the harmonic spectrum of the vocal stream. To understand how this can be used to create a nuanced vocal controlled input mechanism, it is important to understand characteristics of the human voice.

The Human Voice

The human voice resonates in such a way that the spectrum of the sound we produce contains a harmonic series of frequencies. What we think of as 'pitch' is the *fundamental frequency* of the sound, whilst there exist also a series of *overtones* which together with the fundamental form a harmonic series of *partials* that make up the spectrum of the sound. Each partial F_i has a frequency i times the frequency of the fundamental F.

Each of the partials has an associated amplitude. It is the proportional relationships between these amplitudes which determine the character and vowel quality of the sound we produce [99]. Each overtone in the harmonic series is present at a different amplitude within the vocal sound spectrum due to the way the resonance of the vocal tract affects the produced sound. To intentionally make sounds (such as those we can distinguish as particular vowels) humans instinctively adjust the vocal tract (the path the sound travels from our glottis to our lips) while speaking

or singing. These physical manipulations of the tract affect the resonance of the vocal instrument, increasing the amplitude of certain partials while reducing others, resulting in a perceivable change in the sound spectrum. We can recognizably identify these sounds as different vowels, or what is often described as difference in vocal timbre or vocal colour.

Using an FFT to examine the sound spectrum it is possible to measurably observe the relationships in amplitude amongst partials that determine this perceptable vocal character.

Mapping Vocal Timbre to RGB Colour

To allow me to control and colourize video imagery using vocalization as an input method, we re-used a strategy first developed for our 2004 performance piece, *Deep Surrender*[104].

This mapping strategy associates the first three partials in my singing voice (the fundamental frequency or 'pitch', plus the first two overtones) to the red, green and blue components of a RGB colour descriptor[3]. As described in detail in [103] this mapping system results in a controllable colour parameter that I can affect by manipulating the timbral colour of my voice.

- Sharply focussed sounds (such as the closed vowels /i:/ as in 'free' or /u:/ as in 'fool') concentrate tone amplitude most heavily at the fundamental frequency. Very high soprano singing also exhibits this characteristic [99]. As our mapping process links the 'R' component to the fundamental frequency, red would be associated with these types of sounds most dominantly. Therefore, focussed, closed vowels, or high, focussed pitches result in imagery that is a vibrant red/orange.

- Less focussed sounds (such as the open vowel /a:/ as in 'car') spread tone

[3]Refer to Appendix A for the Max/MSP/Jitter code used to implement the analysis and mapping.

amplitude in a broader fashion, with more amplitude found at the second and third partial frequencies. As our mapping scheme links the second and third partials to the 'G' and 'B' RGB components respectively (using a scalar multiplier to make the impact of these frequencies more visually obvious) vocalizing these more open sounds allows me to visualize imagery that is a more restful blue/green.

- The voice-driven RGB parameter is used to colourize a Jitter video stream (which is activated only when sung input is detected, making it visible only when I am singing.) This video stream is then superimposed over any other imagery projected on the screen, allowing me to improvise using my voice as not only an audible but also a visual creative tool.

This manner of mapping the partials in my the voice to the colours in the video allows me to manipuate the colour of the imagery by making very subtle changes to my vocal timbre. This mapping is highly responsive, allowing me to exercise fine control over the imagery by being carefully attentive to the video manipulations as I modify my vocal tone, minutely adjusting and refining my vocalization as I observe the visual effects of my vocal production.

5.1.3 Wiimote Participant Control

Four audience members are pre-selected to function as participants during the second and third phases of the performance. We provide them with deliberately mysterious objects – mirrored tubes, which (unbeknownst to the participants) contain Nintendo Wiimote devices (see Figure 5.3.) Symbolically, the appearance of the devices themselves (the mirrored tubes) references a classic technique described in lucid dreaming literature, whereby dreamers are encouraged to examine mirrored reflections in order to identify oddities which may signify that reality is in fact a dream [55].

Figure 5.3: A participant holds the controller object.

Each of the four participants' controllers is able to modify a visual parameter of the projected visual imagery[4]:

- the colour saturation of two video streams (one controller mapped to each stream)
- the degree of crossfade between the two video streams, which are compositted together
- edge detection which transitions the imagery from realistic to line-drawn

When being briefed about the performance, participants are told that at various points during the experience their object will signal to them, via a pulsating 'heartbeat' sensation, that it is activated. When their object is activated they are able to interact with the visual dream environment. They were not instructed as to how

[4]Refer to Appendix A for the Max/MSP code used to implement the wiimote control.

to use the object. Instead, they were instructed to play with it, manipulate it, and attempt to learn how to control their contribution to the performance. During the performance, different combinations of objects become activated simultaneously. Participants' attention must remain focussed in order to maintain understanding and control of how they are changing the video playback.

The mirrored tubes contain four standard Nintendo Wiimotes transmitting data to the system wirelessly, using a Bluetooth connection. Using Akamatsu's `aka.wiimote` plugin for Max/MSP [66], we obtain orientation data from the 3-axis accelerometers contained in four Wiimote devices and use it to interact with the Max/MSP and Jitter environments. The `aka.wiimote` plugin also provides support for activating the vibration functionality of the Wiimote device, enabling us to implement the 'heartbeat' signifier. When participants move the control devices, the accelerometers contained in the Wiimote provide Max/MSP with readings indicating the orientation of the device. These orientations are then mapped to the control parameters of the video playback. As participants wave and rotate the device, they adjust the parameterisation of their associated video affect.

While the participants could simply focus on their own interactions and responsive parameters, they could also choose to deliberately work together in order to create pleasing visualizations. During performance, we have on occasion observed participants attempting to coordinate their actions with those of other participants in order to explore the visualization space, while at other times the group dynamic has been such that participants chose to function independently, each only focussing on his or her own controller object.

Neither approach was explicitly encouraged or discouraged – the participants were free to directly talk or communicate with one another, or with me. As will be discussed, the manner in which participants chose to interact with one another became an interesting discussion point, stimulating our interest in participatory per-

formance as an investigation platform.

5.2 Applying a Pragmatic Examination to the Design Process of the Participatory Performance

Although our initial project goal had been simply to develop an engaging, entertaining piece of interactive art, we rapidly became intrigued by the social dimensions of participatory performance. The unique experiences and interpersonal interactions we were observing during each exhibition made us interested in exploring how performances like *dream.Medusa* could be used as a way to interrogate participant experience.[5].

While *dream.Medusa* had not been conceived as an investigatory platform (in contrast with the two works discussed later in this thesis, *humanaquarium* and *Nightingallery*) our initial approach to conceptualizing the methodology which we would later define as 'designing from within' began by examining the aesthetic experience of *dream.Medusa* in a holistic fashion, guided by the theoretical framework of McCarthy and Wright [71].

Wright *et al.* describe their approach to evaluating aesthetic experience to be one of pragmatism:

> "[Pragmatism] sees aesthetics as a particular kind of experience that emerges in the interplay between user, context, culture, and history, and should not be seen exculsively as a feature of either the artifact or viewer. Rather, it emerges in the construction of relations between artifact and viewer, subject and object, user and tool." ([116], p.2).

Wright et al. suggest that pragmatic aesthetics allow us insight into how partic-

[5]Excerpts from Sections 5.2 and 5.3 have been published. Taylor, R., Boulanger, P., Olivier, P., Wallace, J. Exploring Participatory Performance to Inform the Design of Collaborative Public Interfaces. Extended Abstracts of the ACM Conference on Human Factors in Computing Systems (CHI'09). Boston, MA, USA. April 4 - 9, 2009.

ipants' contextual relationship with designed interactions shape their experiences [116], suggesting that this manner of approach can therefore allow us opportunity for critical reflection upon how experiences are designed to be aesthetically pleasing, and how sociocultural factors influence how aesthetic experiences are perceived.

McCarthy and Wright's framework has previously been applied as an experience-centered method of analyzing technologically mediated procedures such as internet shopping or aircraft operations [71], as well as wearable technology and digital jewellery [116][110]. To begin our investigation, we applied it to the aesthetic experience of participatory performance, using it to 'unpick' the design process we entered into when creating our performance, and to better understand how participants experience the performance context.

They organize their framework into three themes [71], which we have used to guide our intial explorations of the *dream.Medusa* participatory performance as a collaborative medium:

- A holistic addressing of the multiple threads of experience (*sensual*, *emotional*, *spatio-temporal* and *compositional*)
- An analysis of the sense-making process whereby a person engages in continuous, developing engagement with an experience, grounded in personal expectation and cultural context
- A recognization that experience is dialogical in nature, and characterized by the multiple centres of value associated not only with the artefact or process under examination, but also with the perspective and identity of s/he who encounters it

5.2.1 Examining The Threads of Experience

As the first component of their framework, McCarthy and Wright propose a holistic examination of aesthetic experience, aiding in the understanding of how such an experience is comprised of four threads, representing its *sensual*, *emotional*, *compositional*, and *spatio-temporal* aspects [71]. In order to assist us in our critical reflection of our *dream.Medusa* design process, we explored each of these threads as it related to the performance experience.

The Sensual Thread

The sensual thread explores the way the physical phenomena of sight, sound, smell, touch and taste engage the human senses, triggering a 'pre-reflective' or 'visceral' response.

Performance as a medium places a heavy focus on engaging users by crafting sensual cues to stimulate emotive response. *dream.Medusa* uses sound and visualization to shape the character of the performance experience in a way that facilitates a sense of hypnotic intensity, enchantment[74], security, and collective intimacy, encouraging participants to explore within the performance frame, and promoting immersion and connectedness between performer, participants, and audience.

Our audible content was designed using ambient sound textures, echoes, and non-verbal vocalization in order to maximize the ethereality and serenity of the sonic atmosphere. During the performances, my intention as a musician is to sing as 'beautifully' as possible, emphasizing smoothness and sweetness of tone, eliminating harshness, and striving to envelop the listeners in a restful sensory experience contributing to the performance's sense of other-worldliness.

The visual content is similarly fluid and abstract, using organic imagery and large screen displays in order to transport participants and audience into an alien yet soothing environment. The rhythmic motions of the jellyfish were chosen in

order to further foster an atmosphere of restful engagement.

Additionally, participants onstage are provided with reassuring tactile stimuli in the form of a staging area comprised of a soft and vibrantly multi-coloured satin duvet and numerous lush and bejeweled pillows. This setting was devised both as a whimsical reminder of the 'dream' context, but also, more importantly, as a way of providing an intimate space within which participants are contained and moderately isolated from the barren physicality of the theatrical stage and auditorium venue. Tactile stimuli is also provided by the triggered 'heartbeat' sensation that was transmitted to participants when the by interactive objects became activated. The heartbeat rhythm was selected due to its convergence with the pulsing rhythm of the jellyfish imagery as well as its symbolic connotation of organic life.

These audio, visual and tactile stimuli were designed in the hopes that the sensual experience of participants and audience would encourage an atmosphere of immersion, engagement, and warmth.

The Emotional Thread

The emotional thread addresses the emotions stimulated by social constructs and interpersonal relationships, and explores how socio-cultural values, judgements and projections affect the perception of those taking part in an experience.

Most immediately, the experience of the participatory performance is emotionally shaped by the casting of each individual's role – either that of 'performer', 'participant' or 'audience member.' Each of those roles carries with it emotional context, and frames each individual's perception of their own experience and the experience they ascribe to the other people who share the performance frame.

In the context of collaborative performance, participants' emotional context is particularly complex and interesting to explore. The participants' emotional reflection of their experience is shaped in part by their own history, their self-esteem and

self-consciousness, and their attitudes towards being in a visible and conspicuous setting. While the participants judge their own individual performance, they also can imagine being judged by the viewing audience, to whom they may ascribe varying perceptions. They may imagine them to be welcoming, indifferent, or hostile, their perception of which of course framed each participant's own personal history and projection.

The participants and audience can also ascribe emotions to me, the performer/designer. In a self-situated work like *dream.Medusa* in which I perform as well as design the content, my presence and participation not only as a performer but also in an authorial, compositional capacity is an additional factor in the social experience. It is not unreasonable to imagine that participants and audience may feel a sense of empathy or curiousity relating to my participation.

My role of designer/performer naturally means my experience is highly motivated by my emotional investment in the outcome of the performance. As the performance unfolds, my emotional perception is shaped not only by self-evaluation, but also by the emotional experience I ascribe to participants and audience members. Attentiveness to the responses of the participants and audience is necessary in order to remain attuned to the practicalities of operating and managing a complex technical performance, as well as a natural aspect of a performer's craft. In later chapters of this thesis we will explore how this intuitive attentiveness presents an advantageous aspect presented by the use of performance practice in experience-centered investigation.

The emotional thread of the experience also extends to the audience members, who form their own judgement of the performance they are observing, as well as being provided the opportunity to empathise or project upon the performer and participants who are taking a more active role in the performance's creation.

The Spatio-Temporal Thread

The spatio-temporal thread relates to the space and time within which an experience is situated.

The nature of performance is such that the spatio-temporal aspects of the experience are highly influential. The physical space within which the performance is undertaken, the cultural context of the city within which it is produced, and the perceived prestige, openness, or professionalism of the sponsoring venue or event all have a strong impact on the way *dream.Medusa* is experienced by performer, participants and audience. The relationships between the participants is of particular importance, as well. Performing the piece with strangers results in a different dynamic than is achieved if participants are friends or family who know and trust one another.

Even if factors of participant and venue selection are made constant, the development of the participatory performance is also highly dependent on the particular undertaking of each repetition of the performance event. Wright et al. remind us that "seeing the same movie in the same cinema for a second time is a different experience" ([116], p.5.) This is doubly true for a multi-media performance structured like *dream.Medusa*. The same group of people, in the same place, would never be able to viably duplicate their performance. The interaction mechanisms are non-discrete, and the performance paradigm is dependent upon a continuous stream of small interactions, as the audiovisual production is directly dependent on the improvised and exploratory interactions of the four participants and the performer.

As the fact that the performance experience is particular and unrepeatable is apparent to performer, participant, and audience members, the ephemerality of the performance experience shapes the nature of how it is perceived. It is hoped that all people involved in the performance know that they are experiencing something unique.

The Compositional Thread

The compositional thread describes the way an experience's narrative structure is defined.

The compositional structure of *dream.Medusa* was created in such a way as to encourage the development of a narrative allowing participants to increase their sense of control and agency within the 'dream' scenario.

The structure of *dream.Medusa* was designed so that participants are encouraged to explore their control over the 'dream' environment by manipulating visual effects through a mysterious tangible interface. The visual manipulations are continuous rather than discrete, and the mechanism of interaction is subtle and explorational rather than obvious and readily controllable. The composition of the piece is such that participants progress through explorational stages where they are encouraged to experiment with the interface, hopefully achieving moderate mastery of the interface in order to feel an element of creative control. This then allows them to contribute to the performance development in an intentional way.

The audience, not being afforded the sense of creative agency that is available to the directly contributing performer and participants, is affected by the compositional design in a more traditional way. Music-theoretical composition strategies common to Western tonal music [18] such as harmony and discord, the repetition of motifs, tonal resolution and the ambient texture of the soundscape are employed in order to encourage a sense of narrative development that is perceived by performer, participant and audience. As well, the visual imagery is similarly structured using emotional intensity and thematic repetition in order to communicate a story arc intended to convey the concept of an explorational lucid dream experience.

5.2.2 "Sense-making" During a Participatory Performance

As the second aspect of their pragmatic approach to experience-centered design and evaluation, Wright et al. explain that an individual derives meaning from an experience by continuously engaging with the sensual, emotional, spatio-temporal and compositional aspects of the experience. They call this formulation of meaning "sense-making" [116] and further deconstruct it in order to address six aspects of the process: anticipating, connecting, interpreting, reflecting, recounting and appropriating. Applying our awareness of these sense making processes to filter our observations of participants who are taking part in a collaborative participatory performance helps us further understand how the sensual, emotional, spatio-temporal and compositional choices we make in our performance design shape the experience of our participants.

Anticipating

Anticipation refers to our expectations of an experience. Anticipation occurs prior to the experience and continues to evolve during the experience, as our expectations are ongoingly revised during the course of the experience. In the case of participatory performance, audience members enter the theatre space with certain preconceptions of what taking part in a technologically mediated collaborative performance would be like. These preconceptions differ between each individual. Each individual has different levels of previous involvement with live performance, exposure to and proficiency with technology, self-confidence and enthusiasm. Due to their preconceived notions of what would be required of them if they chose to participate, and their belief that they would be capable of enjoying the experience, certain audience members will voluntarily transition into the role of participants, based on their anticipatory expectation that they will enjoy taking an active role in the collaborative experience.

Connecting

The connecting stage as described by Wright et al, refers to the moment of "immediate, prelinguistic sense of a situation" [116]. In the case of participatory performance, this immediate sense of connecting to the experience happens in two stages. An impression is first formed when the audience and participants enter the performance venue, relating to the spatio-temporal aspects of the theatre space, the dynamic of the people in the space, and the visible cues about the performance to come – the lighting, sets, and any visible equipment, musical instruments, or performers. This "pre-reflective" awareness of the theatre space and event dynamic then shapes the individual's perception of a second opportunity for "connecting" – the moment when the participatory performance begins, and the artist's creative vision commences.

In our experiences performing *dream.Medusa*, we often find that our initial influence over the spatio-temporal dynamic in the existing theatre space is out of our control. The piece is generally performed as a part of established multimedia concerts and events, so we have little ability to influence the entire character of the setting that our audience immediately perceives. To combat this, we take great care to establish the "emotional climate" we wish to instill in our audience through dramatic sensual cues which figure prominently in the earliest seconds of the performance. The soundtrack to the piece begins with a dark, thrillingly ominous ringing bell-tone, while my singing triggers an immense green floating jellyfish image to appear gliding through the darkness of a large-screen display, projected directly in the field of view of the participants, and figuring prominently in the view of the audience. By beginning the performance with intense and dramatic sensual cues, we hope to establish an initial impression of our artistic concept which is less dependent upon the physicality and dynamic of the space we are performing within. We hope that our audience's future interpretations of the experience will then be

shaped by the atmosphere created in the initial moments of *dream.Medusa*.

Interpreting

Interpreting the experience, participants and audience 'find narrative' in the way the performance is unfolding, and how their interactions relate to the development of the experience. If they interpret their performance as such that they feel that they are participating effectively with control over their role in the participatory piece, they may feel very positive about the experience, and the narrative they construct will reflect their feelings of success and mastery. If, however, the participants' anticipation of agency is not fully realized in a timely fashion, they may interpret the situation as stressful or anxious.

Reflecting

By reflecting upon the participatory performance experience, both while it is ongoing, and after it has completed individuals judge the experience and assign value to what they have partaken in. If they felt happy with the narrative as they interpreted it, they may feel that the experience was a positive one, while if they felt frustrated by the narrative (perhaps they never felt agency during the performance due to a conflict between their expectations and the reality of the collaborative experience) then their reflections may have a more negative character. To combat this, we attempt to produce a stimulating and multi-sensory experience for participants and audience, so that the emphasis need not be on their 'achievements' or treating interface mastery as a game, but rather that they find the overall experience pleasurable and enchanting, and will reflect upon it with fondness.

Recounting

In the recounting process, participants, audience and the performer can interact, share their impressions, and gain additional context from which to evaluate the

experience by receiving insight into how others perceived the performance. This communicative recounting is highly linked to the emotional 'thread' which runs through the performance experience, in which the individuals in the roles of performer, participant and audience are aware of their own interaction and they way in which they observe one another. Recounting the experience between participants, performer and audience lets the group debrief after what is an energetically charged experience – the experience of public performance.

Recounting is of particular importance in the performance realm, as friendly feedback provided by a supportive community yields reassurance that the environment was a safe one, and that no participant need feel anxious about their participation in the performance. This reassurance and acceptance is influential on how the overall experience will be appropriated by each participating individual. In Chapter 7 we describe how our interactive art piece, *Nightingallery* was specifically designed to explore the phenomenon of recounting in creative spaces.

Appropriating

In the appropriation stage of undertaking a participatory performance, individuals integrate the experience into their personal lives. It may have particular significance to some individuals, perhaps if they felt intensely moved by the experience of being immersed in a collaborative creative task in front of an observing crowd, or if they felt particularly unnerved by being conspicuous in a public place. It may have little significance on other people, other than that they have experienced participation in a form of performance that is relatively new, so still may hold a novelty value within their cultural context.

5.2.3 Participatory Performance as Dialogue

The third theme characterizing McCarthy and Wright's pragmatic exploration of experience recognizes the fact that experience is dialogical in nature, defined not

only by the artefacts and processes that comprise the activity undertaken, but also shaped by the perspective of s/he who takes part[6]. Wright et. al highlight this property of aesthetic experience, stating that "self and others, technology and setting are creatively constructed as multiple centres of value, emotions and feelings and the experience is completed simultaneously by self and others, not determined solely by one or the other." ([116], p.7.)

As a musician, this concept of experience as dialogue appears intuitively apt as a descriptor of the performance process, whether the performance is traditional or technically mediated in nature. The most critical aspect of my role as performer is my ability to engage my fellow musicians and my audience in a dialogical process each performance is uniquely shaped by the momentary experience of singing a particular piece, with that particular group of musicians, in that particular location in front of the individuals forming that particular audience at that particular time. Each performance is dependent not only upon the way I use my voice to communicate via music, but as well by the way the audience receives that communication and responds in turn via their energy and attentiveness. I feel that the most valid moments in performance occur when this relationship between performer and audience is fully actualized, enabling the artist to connect with her observers and share emotions in an authentic way. In these moments, the very room feels alive, and the sense of complete absorption in the creative experience is palpable.

Technologically mediated participatory performance, as well as being interesting due to its potential for engaging participants in a form of creative play and ludic activity [31] can be argued to be a literal interpretation of this dialogue between a performer and her audience. The performer communicates via the tools of their artistic craft, while the participants are afforded the opportunity to communicate in response via the controller interface. Ideally, the emerging dialogue between per-

[6]A version of this section has been published. Taylor, R., Boulanger, P., Olivier, P. Creating *dream.Medusa* to Encourage Dialogue in Performance. Smart Graphics 2009: 275-278.

former and participants could evolve in an improvisational fashion, allowing the collaborative team to react and play off one another much as jazz musicans 'jam'.

By giving several audience members the ability to literally co-create the performance content in *dream.Medusa*, we hoped to enhance this interplay between performer and audience in order to better illustrate and explore how the dialogue of experience is shaped by their relationship. As well, we hoped that giving the participants direct influence on the performance's development would increase their level of engagement and commitment to the performance process. The action we take together shapes the character of the performance. The collaborative medium gives untrained, novice participants the opportunity to step beyond their role as audience members, and more clearly illustrates how a performance is dependent upon a multitude of small contributions.

5.3 Investigating Participants' Experiences

While we had had the opportunity to observe participants in situ in numerous performance and exhibition contexts, we also wished to create an opportunity to discuss the experience with participants in a more structured, in-depth way. To do this, we recruited several members of our laboratory community who had had no involvement or exposure to the project. They agreed to take part in a performance of *dream.Medusa* held as part of a workshop at Culture Lab, and afterwards sit with several other teammates to participate in a short, guided interview and discussion in order to provide feedback on the project.

When determining how best to conduct these sessions, an important consideration for us was the maintenance of the authenticity of the performance experience. Although these participants were fellow researchers, we still wanted to maintain the integrity of the aesthetic experience, feeling it critical that they not be made to feel as if they had been snatched out of a creative experience and whisked into a

science experiment. Indeed it was crucial not to corrupt their experience entirely, which would both undermine the quality of their provided insights, as well as also their ability to internalize and appropriate what we hoped had been a positive and creative personal experience.

We arranged to conduct open-ended interview sessions that could be individually administered to each of the four *dream.Medusa* participants immediately following the performance. To reduce the sterility of the interview format, we were careful to choose personable interviewers, and took care to keep the language of the inquiries informal rather than clinical. The researchers that interacted with the participants were skilled interviewers, and were briefed on the necessity of maintaining a relaxed and creative atmosphere to keep participants feeling comfortable during the interview process.

We designed questions which would encourage participants to qualitatively describe their experience using emotive and descriptive terms. The series of questions was organized to reflect McCarthy and Wright's framework exploring the four threads of aesthetic experience. This provided a coherent structure for our interview subjects, directing them through an exploration focused sequentially on their perception of the sensual, emotional, spatio-temporal, and compositional aspects of the experience. We also included a small number of questions referring to the phenomena of presence [112] and flow [19] (see Appendix E for a full listing of interview questions.)

Each interview session lasted roughly 30 minutes.

5.3.1 Participant Feedback

We conducted a simple theoretical thematic analysis [12] of the observations obtained during the the *dream.Medusa* experience. Participants' feedback and our own insights were codified in terms of how they related to McCarthy and Wright's

four threads of experience. Examination of the data yielded three additional themes which emerged from the discussion transcripts: *stage fright*, *collaboration*, and *legibility*.

Stage Fright

> "I came in cold, I wasn't expecting to be up on the stage, I was going to be in the crowd. And I was very much conscious of the fact that there were cameras on us when I first sat there, and there were a lot of people in the crowd, more kept coming in... but the second it started, I mean, , I completely lost track of what was going on. I would say it was almost one hundred percent absorbing."

As expected, participants were very aware that they were being watched. This self-consciousness is obstructive to flow and reduces enjoyment of the interactive experience. Any system that requires users to interact in a publically conspicuous way must address this concern in order to reduce users' distraction due to "stage fright." Our participants, however, noted that the sensual components of the performance (the hypnotic visualizations and the relaxing ambience of the musical performance) helped to focus their attentions and reduce their anxiety.

Table D.6 in Appendix D contains excerpts from participant interviews describing how stage fright manifested in the *dream.Medusa* performance.

Collaboration

> "I was very keen to ask the guy next to us if he could work out what his remote was doing, and I also wanted them to stop at certain points, I wanted to tell them all to stop so I (laugh) could work out what I was doing, you know, but I felt that that might have been a little rude!"

Users also described a desire to explicitly collaborate with one another, wishing they could assist one another or strategically combine their individual video manipulation effects to create more complex visualizations. They expressed concern, however, whether direct communication and planning between participants was appropriate, or if it would disrupt the aesthetic experience of the performance.

Table D.7 in Appendix D contains excerpts from participant interviews illustrating this desire participants expressed to better understand how they could collaborate with one another during the performance.

Legibility

> "That idea of trying to control something that you're control over but that you're actually not quite sure how to control. Yeah, I mean that kind of works for me [...] It was enjoyable to be part of the performance, to have some kind of control, no matter how concealed that control was to me it was still, you know it was a challenge and a challenge is always fun and exciting and interesting."

Compositionally, *dream.Medusa*'s interface was designed to be exploratory and ambiguous. It was intended to encourage participants to discover and master the interaction technique through focused attentiveness to their actions and their results. We hoped that this would increase their engagement with the experience. Our participants provided mixed feedback upon this notion. Several of them enjoyed the challenge of gradually mastering the interface through experimentation, while others indicated that this strategy was frustrating, leaving them feeling unsure of their competence when they could not be certain how to control the environment.

Table D.8 in Appendix D contains excerpts from participant interviews discussing issues of legibility and ambiguous control that arose during the performance experience.

In the next chapter, we will describe how we attempted to address these three concerns, using participant feedback to inspire the design of our subsequent performance, *humanaquarium*.

5.4 Using Performance to Inspire Further Design

As *dream.Medusa* was not originally devised as a research platform, it was obvious that there were ways in which we could specifically plan to improve the design of subsequent performances so they could be better used to stimulate and explore participant experience.

In assessing the viability of *dream.Medusa* as an effective platform for exploring user behaviour, we found that it provided several advantageous characteristics making it suitable for experience-centered investigation:

- As a performer within the performance frame as well as the designer of the experience, I was allowed to be self-situated within the use context under investigation (the performance itself)
- By submitting the work to numerous festivals and exhibitions, it was possible to enact and explore the performance many times, allowing us to develop a longitudinal, evolving understanding of the experience across numerous repetitions
- The participatory nature of the work allowed me to directly explore the dialogical relationship between participants and myself

However, we realised that its potential for investigation was somewhat hindered by a lack of flexibility and extensibility:

- Although the system was programmed in the visual language of Max/MSP/Jitter, the heavily composed nature of the performance (three distinct phases of the

composition using a pre-recorded soundtrack with a fixed time length) made it unfeasible to redesign and iteratively refine aspects of the experience across performance repetitions.

- The nature of participants' interactions was highly structured – they could only interact at prescribed times, in a prescribed fashion, with only one aspect of control in the creative environment.

- The performance was very traditional in format. Requiring a concert setting to stage the work limited opportunities for presentation, and as well, heavily coloured the experience due to the formality of the performance context.

By analyzing the use of *dream.Medusa* as an investigatory medium we were able to identify which aspects of its performance platform could be generalized as being beneficial to the investigatory process (self-situation, longitudinal exposure to a project, direct dialogue with participants) and which aspects of performance design could be improved upon when composing subsequent performances for the purposes of future research (increasing flexibility for the purposes of iterative revision, increasing the interaction space extended to participants, and reducing the dependence of the performance upon formal presentation contexts.)

The experience described in this chapter details our earliest work with performance as an investigatory medium. This process we underwent with *dream.Medusa* helped us crystallize and clarify the aspects of performance design which would allow us to more effectively *design from within* during the development of our next performance project, *humanaquarium*.

5.4.1 Contributions

In this discussion we have:

- Explained how we applied McCarthy and Wright's pragmatic framework to

conduct a critical reflection of the design decisions we made during the development of *dream.Medusa*, using the framework to structure an investigation of the participatory medium in terms of its:

  - threads of experience (*sensual*, *emotional*, *spatio-temporal* and *compositional*)
  - process of continuous sense-making
  - potential to illustrate the dialogical properties of the performance experience

- Identified several avenues for further investigation in our next performance project (stage fright, collaboration and legibility)

- Used our experiences with the *dream.Medusa* work to inspire the strategy for *designing from within* that we previously introduced in Chapter 4 of this thesis. By evaluating the efficacy of *dream.Medusa* as an investigatory platform, we identified that an optimal performance designed for use as an interrogative tool would be:

  - self-situated
  - longitudinal (in order to facilitate sense-making)
  - explicitly dialogical
  - open to participant-driven interaction and the influence of place
  - implementationally flexible

Chapter 6

humanaquarium

This chapter describes *humanaquarium*, the second participatory performance piece in our series of works investigating social behaviour in public spaces.[1] *humanaquarium* was created and performed by myself and two collaborators from the *Digital Interaction Group* at Newcastle University, Guy Schofield, and John Shearer, whose research interests also explore music and interaction design. Together, we formed a close-knit team, working collaboratively on all aspects of the project, conceptualizing the design, coding the interface, creating audiovisual content, and touring the performance extensively through Europe and North America.

The holistic nature of our collaboration became integral to the design process we have come to term 'designing from within.' Each team member played multiple roles in the creation of this work: designer, performer, composer, and programmer, resulting in each of us firsthandedly experiencing the entirety of the project's development and evolution.

In this chapter, which is adapted from our CHI '11 publication, we describe how the year-long process of creating and exhibiting the *humanaquarium* project led us to formulate the methodology discussed in Chapter 4 of this thesis – the practice of 'designing from within'. We focus upon how our experience as designer/performers

[1] A version of this chapter has been published. Robyn Taylor, Guy Schofield, John Shearer, Jayne Wallace, Peter Wright, Pierre Boulanger, and Patrick Olivier. 2011. *Designing from within: humanaquarium.* In Proceedings of the 2011 annual conference on Human factors in computing systems (CHI '11). ACM, New York, NY, USA, 1855-64.

Figure 6.1: A *humanaquarium* performance.

situated within the use context under evaluation – the *humanaquarium* performance itself – enabled us to access our own firsthand, 'lived' experiences[10], in order to gain greater insight into the nuances of the design as our understanding and immersion with the project intensified over time.

The *humanaquarium* performance centers around interaction with a 1.5 metre cube, inside of which sit two live musicians, Schofield and myself (see Figure 6.1.) The structure is faced with a transparent acrylic frustrated total internal reflection (FTIR) screen [45]. The system translates the position of touches into audio visual effects that alter the musicians performance as they play. In this way, participants can jam with the performers in order to collaboratively control the audio-visual content of each *humanaquarium* performance. Performing from within the interface allows us a unique vantage point from which to explore participant experience with the *humanaquarium* project. We propose that this method of research provides a valuable complement to more traditional forms of experimental investigation, leveraging perspectives from the inside as well as the outside of the design space, and allowing design insights to emerge through the performance experiences we share with the audiences

We begin this chapter by presenting the methodology that we used to design *humanaquarium*, beginning with an explanation of how we used our experiences with *dream.Medusa* to identify emergent concerns about participant engagement, and stimulate new design ideas for *humanaquarium*. We describe our initial concept for the project and how it was iteratively refined and evaluated using practice-based research. We then identify the insights into public behavior we gained from incorporating performance practice into our research process, and explore how designing the *humanaquarium* art piece from within yielded insight into overarching tendencies and trends including intuitive shifts in design focus occurring almost unconsciously at the time.

6.1 Conceptualizing *humanaquarium*

The first stage in our design process required us to reexamine our experiences with *dream.Medusa*, which had highlighted a number of factors influencing participant engagement in interactive performance scenarios.[2] Identifying these factors helped define the design space within which we would focus when creating *humanaquarium*, and provided the starting point for our design:

- Stage fright: the stage-based nature of the traditional performance medium increased participants concerns about being observed, making mistakes and appearing foolish in front of the audience

- Collaboration: participants wanted an understanding of how they were permitted to interact with one another, what the boundaries of shared interaction were, and how they could create shared effects

[2]Sections 6.1 and 6.2 contain material excerpted from an additional publication. Taylor, R., Schofield, G., Shearer, J., Boulanger, P., Wallace, J., Olivier, P. *humanaquarium*: A Participatory Performance System. In Proceedings of the 2010 Conference on New Interfaces for Musical Expression (NIME 2010), Sydney, Australia, pp. 440-443.

- Legibility: participants wanted to know how their actions affected the performance, and to understand the domain space of actions they could take.

In the previous chapter, we described how we had conducted an investigation of the *dream.Medusa* performance environment based upon McCarthy and Wright's pragmatic framework addressing technology as experience [71]. We used their framework to structure a critical reflection of our design process, and as a basis for conducting several interview sessions. Participants' feedback was codified in terms of how it related to McCarthy and Wright's four threads of experience.

To begin the design process for what would become *humanaquarium*, we examined the *dream.Medusa* data associated with each thread of experience in turn. Temporarily narrowing our focus to sequentially explore each thread helped us to unpick the insights contained within the body of complexly interrelated sociotechnical observations. It enabled us to scrutinize elements participants had found enjoyable about the *dream.Medusa* performance experience, and also recognize the source of issues participants had raised regarding barriers to their engagement with the performance interface.

We considered how manipulating each thread could allow us to address the previously identfied concerns of stage fright, collaboration, and legibility in interactive performance. This strategy generated ideas used to inspire the design of *humanaquarium*.

6.1.1 The Four Threads of the *humanaquarium* design.

Tables E.1-E.4 in Appendix E itemize the design ideas generated in association with each of the *sensual*, *emotional*, *spatiotemporal*, and *compositional* threads of experience, referencing example quotations from the *dream.Medusa* observation data.

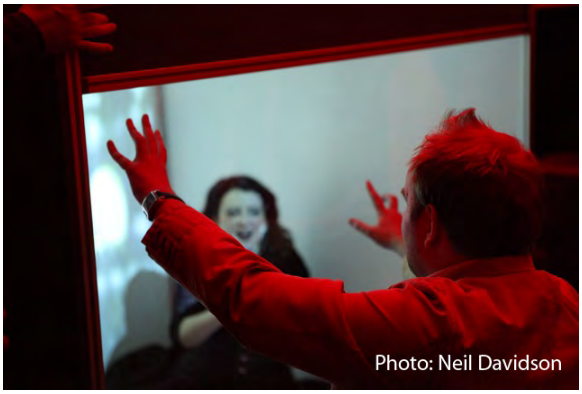

Figure 6.2: A participant uses the *humanaquarium* interface.

Sensual

The *dream.Medusa* performance had been characterized by an ethereal soundtrack with sweeping strings and a pulsing bass rhythm. Visually, it was equally hypnotic, with vividly-coloured images of jellyfish slowly drifting across the screen. Participants had described how the audio-visual content focused their senses and helped them immerse themselves in the performance, indicating to us that our crafting of the performances sensual elements had been successful in promoting participant engagement. In order to reduce participants' anxiety at being observed, audio-visual elements of the *humanaquarium* performance were designed to have similarly soothing characteristics, even repeating the use of the jellyfish imagery in two of our *humanaquarium* compositions. Repetitive rhythms and flowing imagery were used to relax and focus the participants. In order to tempt participants to take the risk of entering the performance frame and interacting with the installation, the *humanaquarium*'s visual design was intended to be highly noticeable - the uncanny nature of a human-sized transparent-fronted cube sitting in an unexpected place was intended to attract attention and stimulate curiosity.

Emotional

The very site of interaction (the transparent FTIR surface of the box) was also a response to the emotional and interpersonal issues raised during the *dream.Medusa* experiences. Participants had reported feeling uneasy being in close proximity to me as I sang. The *dream.Medusa* score required me to sing using formal, classical technique, with the majority of my melody sung in the high soprano range. Most audiences would naturally have no experience of the sheer volume and dynamic energy projected by a classical singer who is engaging in the physically demanding act of producing supported sound. Participants described it as fascinating yet somewhat uncomfortable, as they wanted to observe but felt that they weren't sure if it was appropriate to stare.

When designing *humanaquarium*, we decided that a physical barrier between performers and participants would provide a sense of socially appropriate personal space. This decision inspired the transparent front of the aquarium structure. As the transparent screen was also touch-responsive, it became the site of interaction, functioning as a tangible membrane where co-operation and jamming between performers and participants recognizably took place. The screen was positioned in such a way that Schofield and I could establish and maintain sightlines with the participants while interaction was taking place, allowing us to use eye contact and gesture to indicate approval and encouragement, and improving our collaborative relationship with participants (see Figure 6.2). This configuration, with participants directing their attentions to the audio-visual content located within the humanaquarium structure while having their backs to the spectating audience was also designed to minimize participants' awareness of being observed.

Spatio-Temporal

Negative issues that were brought up in the *dream.Medusa* discussions had often focused on issues triggered by the formality of the staged performance experience. People reported fears of appearing foolish in public, of overstepping personal boundaries in terms of personal space on the stage, or of failing to operate the technology properly during the performance and upsetting the artist responsible for the conception of the work. This feedback suggested to us that the theatrical medium of the *dream.Medusa* performance was increasing participants' feelings of stage fright. The visibility and conspicuousness of participants' interactions exacerbated their occasional frustration with the ambiguity of the interface due to their natural social desire to appear competent in public. We were eager to investigate how participants would interact with a participatory creative environment if the stressors triggered by the theatrical context of *dream.Medusa* were reduced.

We decided that exploring a less intimidating manner of performance would be beneficial. Drawing upon the improvisational tradition of busking (a casual, street-based form of performance) we designed *humanaquarium* to be experienced in a less formal context, hoping that novice, untrained participants would find this platform more comfortable and accessible. Allowing participants to join the performance with the knowledge that they were free to stop participating and remove themselves whenever they chose removed a barrier of entry due to the relatively low level of commitment required. Interacting with two street performers residing in a glass fronted box is an inherently transient act. When participants no longer wished to interact they could move away from the interface, leaving the performance frame. We envisioned the *humanaquarium* piece as a way to facilitate laptop-based busking inside a mobile performance space, permitting passersby to observe the performance and decide when or if they chose to take part.

Compositional

Although they did not always understand the functionality of the ambiguous gestural interface of *dream.Medusa*, participants had felt invested in the work simply because they believed that their actions impacted its execution. They had been curious to play and experiment with the interface in order to try to understand what agency they had with which to contribute to the performance. We decided that the ludic ambiguity [36] and playfulness of the interface was an interesting avenue of exploration, and that we could use *humanaquarium* to investigate further how a process of discovery affected participant engagement and satisfaction. *humanaquarium*'s audiovisual compositions were specially created to guide participants through varying levels of complexity in order to assist them in learning the intricacies of the interface. We hoped to build the experience's narrative in such a way that participants could engage in explorational, playful discovery, leading to increased mastery of the interface. As *dream.Medusa* participants had expressed a desire to perform more expressive and elaborate contributions once they had mastered the basics of their interaction, in the *humanaquarium* design we recognized that making a wide range of nuanced creative controls accessible to participants would allow a dedicated participant to approach a more 'virtuoso' performance contribution.

6.2 Implementing a Flexible System Design and Compositional Practice

Although the process of designing, performing and then evaluating *dream.Medusa* had produced interesting feedback about user engagement, we realized that this did not fully leverage the dialogical potential offered by the designer taking the role of performer during the performance. *dream.Medusa* was in most respects composed traditionally, with a fixed temporal structure. Although it allowed improvisation and participation it was presented from the outset as a finished piece and was performed

with minimal variation between repetitions.

In order to take advantage of the opportunity provided by having the designers available to continually refine and extend the art piece, the *humanaquarium* system was deliberately structured so as to facilitate ongoing evaluation and revision over an extended period. This allowed us to gradually re-imagine content and interaction strategies in response to a deepening understanding of the design space gained through performing the work in public. The involvement of the designers throughout the process allowed immediate adaptation of the work in response to the shared performance experience.

The second stage of our design process required us to build the *humanaquarium* interface, as well as an initial, performance-ready audio-visual composition which could then be exhibited and refined.

The *humanaquarium* project has two interconnected elements: a physical interface comprising the hardware and software components of the performance space itself (hereafter referred to as 'the box'), and a performance practice designed to best exploit the affordances of the interface. We use the term '*humanaquarium*' to describe what is conventionally considered to be the performance – everything which occurs in the course of deploying the work in a public setting.

6.2.1 Physical Structure

The staging environment is a 1.5m box, placed directly upon the ground. The space is large enough for two performers – Schofield and myself – to sit cross-legged inside, with laptops and instruments in front of us, imitating the manner of traditional street performers or buskers. The transparent front of the box allows us to see and be seen by passersby, and also allows us to use gesture and eye contact to encourage people to come closer and touch the screen.

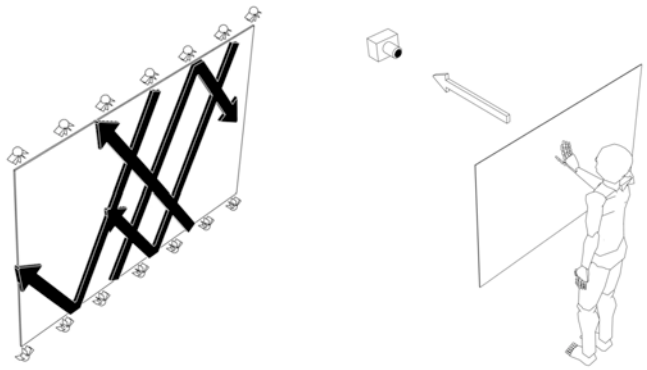

Figure 6.3: Infrared light fills the transparent acrylic pane. The IR light is reflected back towards the camera when participants make contact with the pane's surface.

External Case

The external case of the box is crafted out of lightweight materials in order to facilitate ease of transportation and assembly, aligning with the intention for *humanaquarium* to be taken to and performed in public spaces. Each wall is made of 8mm plywood casing, which slides inside an aluminium frame. The entire structure can be quickly dismantled and reconfigured as a flat package for ease of transport and storage. The insides of the casing are painted white, and the front and rear walls form the transparent window and projection surface. The responsive imagery that appears on the back wall of the box is displayed by a projector mounted at the bottom of the front of the frame. The projection is bounced off a mirror hidden on the ceiling, so that the performers inside do not obstruct the visualization. A camera is mounted upon the rear wall above the heads of the performers in order to have an unobstructed view of the front window for the purpose of tracking participant touches.

Frustrated Total Internal Reflection (FTIR)

The front screen of the aquarium is a 1.0 by 1.5m piece of 8mm acrylic. We outfitted the top and bottom edges of the screen with an array of infrared (IR) LEDs

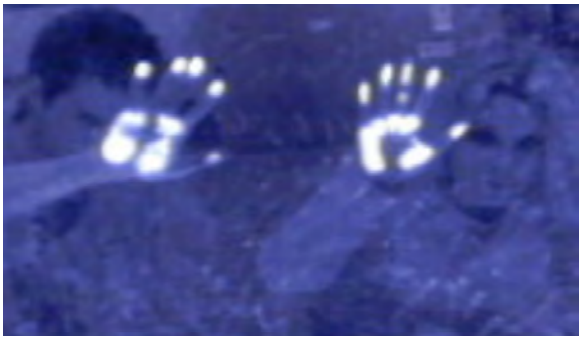

Figure 6.4: The IR webcamera-view of touches on the screen.

that emit a wavelength invisible to the human eye[3]. The IR emissions are contained through total-internal reflection within the smoothly polished acrylic. When a participant touches the acrylic, the effect of his/her fingers pressing against the surface causes an effect known as frustrated total internal reflection (FTIR) to occur [45]. IR light escaping from the acrylic due to the FTIR effect is partially reflected by the finger doing the touching (see Figure 6.3) and is captured by the (IR sensitive) camera mounted inside the box. To alleviate the requirement for a specialized IR camera, an IR pass filter was used in conjunction with a low-cost webcam with the hot-mirror filter removed. Open-source image tracking software (Community Core Vision) was then run upon the webcam feed (see Figure 6.4) to identify multiple simultaneous touches upon *humanaquarium*'s front window which were then sent to the Max/MSP environment for further processing.

FTIR technology is often used to implement multitouch surfaces, frequently seen in the form of interactive tabletops or display panels. Generally the touch responsive surface is also used as a projection surface so that imaging components of the interactive system can be used to visualize what is being touched [88]. The *humanaquarium* separates the physical situation of the touch from the perceptual results of the touch, disassociating the locations of input and output, and making our use of FTIR in a transparent window a departure from the common uses of

[3]FTIR illustrations by Guy Schofield

multitouch panels.

6.2.2 Software Infrastructure

The *humanaquarium* software system was created in a distributed fashion, using three computers to handle the separate tasks of camera tracking, audio control, and visualization (see Figure 6.5.) Three software packages were used: Community Core Vision for camera tracking, Ableton Live for real-time audio generation and sequencing, and Max/MSP/Jitter to implement system logic and generate visualizations. One of the primary goals in our software development process was to ensure that the behavior of the performance environment could easily be modified and adapted as we gained experience and understanding of its effectiveness through the process of performing with real participants and audiences. We created a flexible mapping model using the visual programming environment of Max/MSP to define the relationships between participant touches and system reactions, in order to decouple the dependencies between input and output.

Visualization

Video imagery was projected onto the rear of the case, filling the back wall of the *humanaquarium* performance space. Using Jitter to manipulate the video imagery, multiple videos were mixed and layered on top of one another. The most vibrant and prominent layer was a voice-responsive overlay generated using *dream.Medusa*'s voice visualization technique (previously described in Chapter 5, Section 5.1.2.) Additionally, a graphical icon (in one case a small jellyfish, in another a floating chandelier) was projected onto the rear of the case. This icon glided across the screen following the path of participants' touch locations in order to provide visual feedback and aid in legibility.

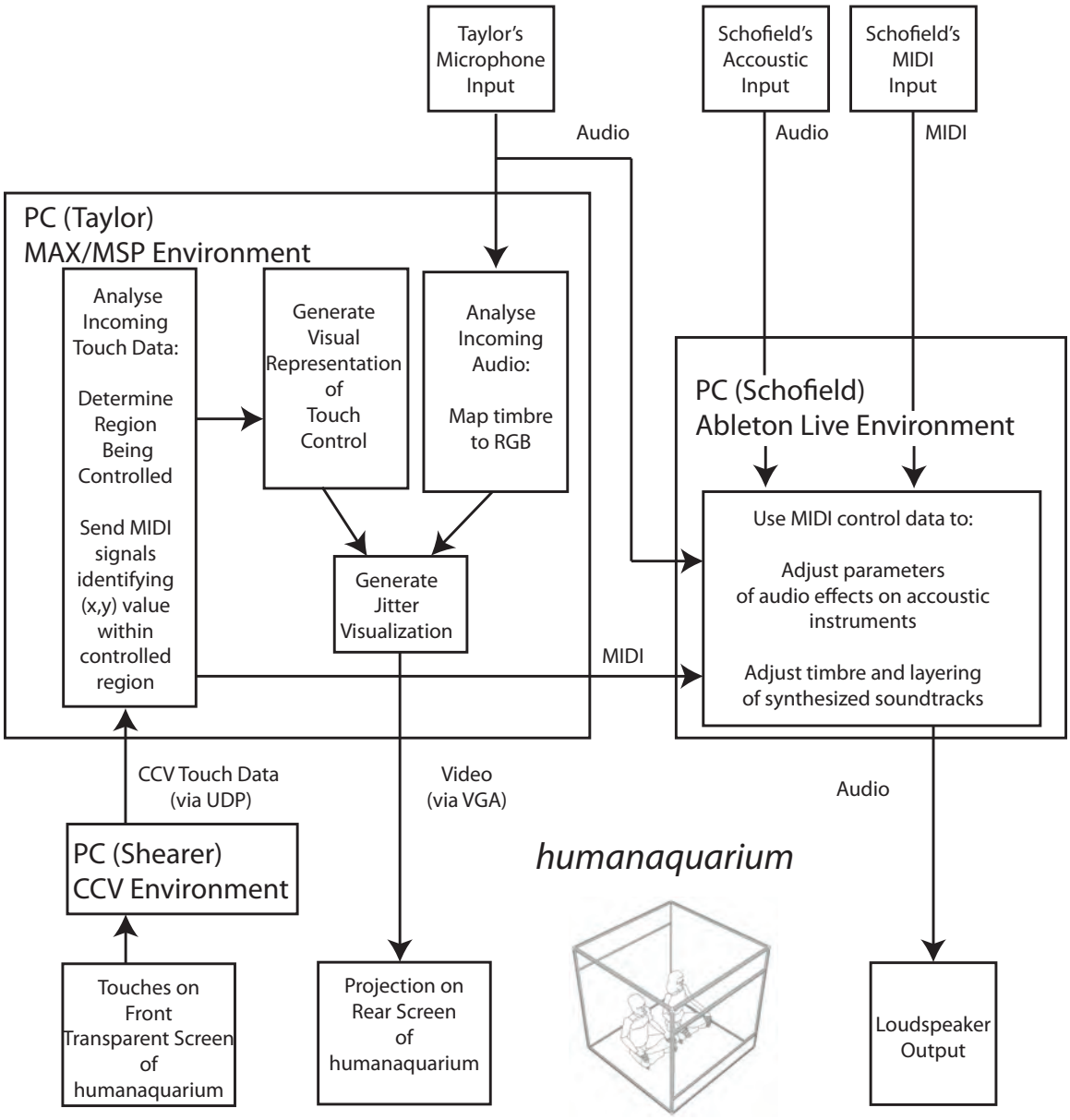

Figure 6.5: The hardware/software setup.

Audio Control

Responsive audio was controlled in real-time by mapping touches on the screen to control parameters in Ableton Live. Using Max/MSP, we converted touch positions on the screen to MIDI values between 0-127. Using a MIDI interface, we sent this MIDI data from the Max/MSP system to Schofield's Ableton Live interface. This enabled the front screen of *humanaquarium* to function as a large MIDI controller that could be used to interact with the Ableton Live engine. *humanaquarium* compositions consisted of multiple Ableton tracks, each of which had parameters (timbral control, amplitude, frequency) that were controlled at runtime by the MIDI data generated by participant touches, allowing participants to control the playback of the composition. Participant touches were also used to control the parameterization of audio effects applied to my voice as well as Schofield's accoustic instruments.

Please refer to Appendix B for an overview of the Max/MSP patches, visualizations of the Ableton Live sound environment, and a description of the audio/visual mappings used in the *humanaquarium* compositions.

6.2.3 Compositional Practice

As previously discussed in Chapter 2, the participatory nature of a project such as humanquarium necessitates designers, composers, and performers to extend their creative practice to reflect the challenges of an art form which relinquishes a degree of authorial control, sharing the performance frame with members of the audience. When composing the audiovisual content for *humanaquarium*, we developed a strategy of creative development that highlighted the interdisciplinary nature of the project. While all three of us (Schofield, Shearer, and myself) have an academic background in Computing Science, we also all have extensive experience and training in music and composition. Schofield and I primarily specialize in electronic

music and multimedia art, while Shearer is an interaction designer with a strong background in developing creative, playful interfaces for non-traditional, hands-on environments. By adopting a hybrid approach to content development incorporating the methodical evaluation of interaction science and the aesthetics of the arts, our method of composition leveraged the skillsets of both the practices of multimedia art creation and human-centered interaction design. We designed *humanaquarium* to essentially be an opportunity to define each performance experience as a set of participant-driven choices made within predefined aesthetic constraints.

As performers, Schofield and I led the performance by playing and singing live through our MIDI instruments and microphones. Input from participant touches affected the parameters controlling the orchestration and individual behaviors of our instruments and audio manipulation tools, essentially allowing the participants to conduct and orchestrate the audiovisual experience in real time. Each *humanaquarium* 'composition' was determined by the configuration of these controls and the ways by which user input could manipulate them, allowing participants to influence and determine the realization of the composition as it was enacted during live performance.

Together, we strategized a method of making the *humanaquarium* interface easier to learn, deciding to implement the ability to gradually develop the complexity of the touch screens behavior at run-time. We then could segment the screen into more discrete control regions as users became more capable with the interface, and as well increase the complexity of the associated audio-visual response by layering more controllable soundtracks as the performance progressed. Interestingly, this progression towards increased control and feedback complexity satisfied not only the necessity for a legible and learnable interface, but also our desire as musicians to make an aesthetically pleasing music composition as the introduction of musical motifs and orchestral complexity are basic constructs commonly found in contem-

porary music culture [18].

During the compositional process, while Schofield and I focused on establishing aesthetically pleasing collections of sonic and visual content, Shearer would apply his analytical skills to the evaluative process, experimentally mapping and remapping touch input from the screen to audible and visible parameters controlled by Ableton Live and Max/MSP/Jitter. He would explore the interactive screen, methodically testing boundary cases, and suggesting ways to make the mappings between input and output feel more satisfying and legible for novice participants. The unpredictability of these interactions from session to session led us to develop structures and themes within the music which could be reconfigured and re-ordered at will during the performance. By leaving opportunity within the composition design for us to contribute live musical content and dynamically reconfigure the audiovisual content in response to participant behavior, we were able to guide the aesthetic development of the experience using our skills as performing artists, framing open spaces for participant interaction while still maintaining a measure of creative control.

6.3 Investigation and Refinement Methodology

Once the *humanaquarium* was built, the third phase of our design process involved launching the performance into the public sphere, continually refining the design based on our ongoing understanding of the performance experience. Living with *humanaquarium* over a period of time allowed us to make sense of it in new ways as it became integrated into our existing creative practices. Our experiences suggest that investigating public interaction with technology through the medium of performance demands a long-term approach, as changes in context across performance repetitions affected not only the participants who encountered *humanaquarium*, but also our own engagement and perception of the interactive experience. By deciding

to place ourselves within the work as performers as well as designers, we gained the advantage not only of a co-temporal and co-spatial proximity to both the users and the artefact – in this case the *humanaquarium* performance – but also of being able to examine the shared experience through the filter of our own creative practice over an extended period of time.

6.3.1 Performance Practice and Documentation Strategy

From the outset, we intended to evaluate the *humanaquarium* performance from an immersed, self-reflective perspective, acknowledging that we as designer/performers were an inherent component of the use context under investigation – the participatory performance – and that we wanted to conduct the investigation from within.

Our planned methodology for documenting and evaluating our experiences with *humanaquarium* required us to deal with the constraints necessarily placed upon us, as active participants in an experience who had the dual responsibility of also maintaining a document record of our perceptions of the experience. By conceiving of *humanaquarium* as a 'show' - a performance in the theatrical sense with a beginning, an end and a musical trajectory between the two - we had committed to a form of practice where we would necessarily be occupied and immersed in the work during performances. During a performance of *humanaquarium*, Schofield and I (within the box) had to consciously engage the audience, play and sing around each other, monitor the changing state of the interface for faults in the computer vision system or audio/visual processing software and react to both the participants' physical actions outside the box and the consequent effect on our own musical output. Shearer (outside the box) watched for faults and performed the duty of sound engineer by listening and watching the musicians intently and gesturing for changes in volume etc. As well, in some cases Shearer acted as a ringer by demonstrating the interaction potential to particularly shy audiences.

Alongside our performance of these tasks, it was crucial to the development of the research trajectory for us to assign conscious focus to an ongoing process of observation and reflection during each unfolding performance. We had to find practical ways to document our experiences that could be done in situ. As we were performing in legitimate performance contexts we often had to contend with administrative or social responsibilities, such as conducting interviews, managing stage crew requests, etc., so our on-site note-taking had to be done with efficiency. Schofield and I would often pause briefly to jot several notes before exiting the box, as it was most effective to capture our recollections while their immediacy was still fresh. After mingling with the audience, we could then take the opportunity to augment our notes with any new information that had been revealed to us via the feedback from the public.

In addition, performances were videotaped so that we could review our performance from an external vantage point after the conclusion of the event. After each performance, the three of us reviewed our notes and videos, paying special attention to identify any critical incidents, such as unusual audience actions that could be used as inspiration to revise and improve our interaction design. We then filed the notes and videotapes with the intention that we would revisit them at a later date in order to explore how our design decisions and perceptions evolved over time (refer to Appendix F to see excerpts from our documentation record.)

It became rapidly apparent that the design of *humanaquarium* enabled the research team to observe the experience from perspectives that were both literally and figuratively diverse. As performers inside the box, Schofield and I had a very different visual perspective on the performance than did Shearer and the audience, who remained external to the box enclosure. Schofield and I could see the faces of the participants through the acrylic window and were able to recount experiences and communications that were shared between ourselves and the participants as

they watched one another through the glass. We were also uniquely positioned to observe smaller, more subtle communications and interactions between participants who had a perception of relative privacy when standing in front of the box with their backs to the observing audience.

In addition to the observations afforded to us due to our physical vantage point inside the installation, our roles as creative practitioners immersed in the execution of the piece allowed us to reflect upon the experience from a perspective of enriched investment. Our observations of the experience were fundamentally filtered by the instinctive audience evaluation and self-monitoring practiced by seasoned performers when engaged in their craft. Schofield and I documented our self-evaluation of our own musical performances, evaluating how well the show had been received from our perspective as the performers of the work. We were, however, aware that these very personal, reflective observations would inevitably be influenced and coloured by their inherently self-conscious nature.

Shearer, observing from the outside of the performance space, was able to provide a different accounting of the work. Observing from an external vantage point, he could see a much larger area of the room. He could watch how audience members approached *humanaquarium* and how they behaved before, during, and after interacting with the performance. Shearer had opportunity to interact with participants directly by collaborating with them on the multi-touch interface surface, and so could relate these shared experiences. Shearer could also evaluate the aesthetics of the performance from a removed, arguably more objective standpoint, as he was monitoring the performance from the audience's vantage point, rather than actively performing as a musician.

Using these collected observations to identify and inspire usability and design improvements, we were able to propose revisions and refinements to the *humanaquarium* that could be implemented as the year of scheduled performances

went on.

6.3.2 Iterative Revision Process

A fundamental component of the *humanaquarium* design process was our awareness of how growing familiar with our own performance platform over a period of time increased our ability to use the art piece as an opportunity for exploration. In contrast to *dream.Medusa* where the performance content was fixed and remained relatively constant over the year in which it was performed, we had specifically designed *humanaquarium* to be easily adaptable and changeable. We knew that over the course of numerous performances (at the time of writing we have performed *humanaquarium* over fifty times) we would want to adjust the audio-visual content and the interaction strategies in order to respond to participant feedback and our own experiences and perceptions of *humanaquarium*'s strengths and weaknesses.

As previously described, we had deliberately made technical decisions which would allow us to rapidly reconfigure *humanaquarium*'s creative content and interaction mappings. By defining the relationships between participant touches and system reactions in the visual programming environment of Max/MSP, we were able to make changes to the way participants' actions affected system output without recompiling code - enabling us to make strategic revisions on-site during the intervals between runs of the show in response to issues or ideas that arose in performance.

We very consciously decided to present *humanaquarium* in a form which was simultaneously finished and unfinished. In our earliest performances, we were acutely aware that our performance was essentially being tested 'in-the-wild', and we accepted that we were going to be unable to truly predict how our audience would choose to interact with the performance. From an artistic standpoint, this presented Schofield and me with a performance opportunity that was at once both

exhilarating and anxiety-provoking – we were aware that we would have to experience each participant-driven performance in a public context (for better or for worse!) and use our artistry and professional skill to react to participant behaviour truly on-the-fly in order to maintain the aesthetic integrity of the public performance.

We deliberately scheduled an initial run of small-scale performances scheduled two weeks apart, in order to maximize the opportunity to review, revise, and remount different versions of the performance. The rapid turnaround time between iterations allowed us to immerse and focus ourselves in a very immediate and intense process of creative design development. Many of these revisions centered upon improving system legibility by adjusting the mapping between participant touch and audio-visual response.

As the design stabilized and we began presenting the piece in more prestigious contexts (international festivals and exhibitions) we were able to take more time between revisions, permitting more labor-intensive changes such as the addition of an entirely new selection of new audio-visual content and motifs.

The Performances

Over the course of the year in which we worked with the project we created and refined three distinct audio-visual *humanaquarium* performances. The compositions were all highly improvisational, with their duration determined by Schofield and I as we judged the responsivity, engagement and enthusiasm of the audience. In practice, each performance usually lasted 10-25 minutes, depending upon the mood of the crowd, as well as any time constraints imposed by the venue.

- *Mariana*: Our initial composition, *Mariana*'s structure was very loose and free-formed. Using abstract imagery of jellyfish floating against colourful backgrounds (see Figure 6.6) no narrative structure was imposed on this per-

formance. The musical soundtrack consisted of simple, repetitive melodic structures that could be combined in any temporal order, and played on a multitude selected MIDI instruments ranging from drones to crystalline synthesizers. Participants' touches selected the instrumentation of the MIDI tracks, controlling the timbre of the parameterized musical playback and adjusting the repetition rate of the MIDI arpeggiators Schofield was playing. Participants were also allowed to control a wide range of vocal effects on my voice (including several very dramatic filters which rendered my voice practically unrecognizable – and very difficult for me to control.) Early *Mariana* performances varied widely across enactments, due to the performance being heavily determined by the contributions of participant interactions. In response to the difficulty we experienced, presenting such an improvisational, participant-dependent work, Schofield and I 'tamed' several of the more extreme voice and arpeggiator interaction mappings, making our own task as performers easier, but consequently removing a very dramatic control mechanism we had previously placed in the hands of participants.

- *Darkshines*: *Darkshines* used the same set of visualizations as *Mariana* (see Figure 6.6) but layered them in a slightly more structured fashion. The performance began very simply, with an image of a single jellyfish floating on a black background, and a basic instrumentation featuring a layer of drones which thrummed under a synthesizer line which faded into and out of the foreground in response to user touches. This piece was intended to explicitly illustrate the mechanisms of touch-and-response in the initial stages, in order to help partcipants navigate the learning curve in the hopes of mastering the interface. As the performance progressed it increased in audiovisual complexity, however, Schofield and I could jump back to the simpler, 'learning' phases of the performance in order to give new participants the opportunity to

Figure 6.6: The fluid, jellyfish imagery used in *Mariana* and *Darkshines*.

Figure 6.7: The theatrical backdrop imagery used in *Phantasmagoria.*

gradually explore the system's interaction space. *Darkshines*' soundtrack was less 'heavy' than *Mariana*'s, making it a contrasting piece of work. These two pieces were often exhibited together, often beginning with *Darkshines*. Its composition focussed more highly on legibility and dramatic build, whereas *Mariana*'s free-form and unpredictable structure offered greater challenge, flexibility and freedom – both for the audience as well as for ourselves, the performers.

- *Phantasmagoria*: *Phantasmagoria* was the most narrative of the three compositions. Using a new set of visual imagery constructed from public domain silent footage from the 1925 film *The Phantom of the Opera* and photography taken on-site at the Opera Garnier in Paris, *Phantasmagoria* highlighted the theatrical nature of the *humanaquarium* interface, enclosing each set of visuals inside projected proscenia, making the background of the *humanaquarium*

reminiscent of a theatre set of flats and backdrops (see Figure 6.7.) The performance made reference to the film's storyline, with the characters of *The Phantom* and *Christine* projected behind Schofield and myself respectively, and the film's famous chandelier swinging around the scene in response to participants' touches. *Phantasmagoria* featured a complex soundtrack, with Schofield providing accoustic instrumentation on a mandolin. Aesthetically, this was the most polished and dramatic of the compositions, and the one that best highlighted the theatrical qualities of the *humanaquarium* enclosure.

6.3.3 After-the-fact reflection

At the end of the year, our core production team scheduled a dedicated review session in order to discuss the project in terms of the progressions and insights we felt had been achieved over the course of the year. We assembled a recollected narrative of the project's trajectory, constructed out of the on-site notes that were associated with each performance. We discussed the key issues which had emerged during each performance repetition, and identified how these issues had inspired us to modify or adapt *humanaquarium*s design in response. With this retrospective created, we then reviewed the video documentation, exploring from this more temporally removed perspective how our intended modifications had actually impacted subsequent iterations of the performance (refer to Appendix F for examples of the notes we collected.)

This after-the-fact exercise afforded us the opportunity to make a holistic assessment of how *humanaquarium*'s evolving design trajectory addressed the issues and challenges originally targeted in the project brief. We also found that a retrospective look at the year's progression raised some previously undiscovered discussion points about the emerging tensions evident in this experience-centered design approach. Reviewing the entirety of the video documentation made it evident to us

that our motivations were simultaneously being influenced by concerns regarding aesthetics and usability, and that these concerns occasionally were in conflict, as we discuss later.

6.4 Impact of Our Design Decisions

By conducting ongoing evaluation and monitoring over the course of the year as well as retrospectively assessing the progression of *humanaquarium*s design, we were able to examine how we had addressed the design concerns we had originally intended to explore.

6.4.1 Stage Fright

The setup of *humanaquarium* was intended, as much as possible to overcome the intimidating nature of traditional stage performances. As previously discussed in Section 6.1.1, the spatio-temporal and emotional aspects of the performance were calculated to minimize stage fright and facilitate fearless engagement with the work. Seating the musicians at ground level, physically separating the performers from the participants, and enclosing the performance environment within a small space were all expected to reduce the sense of invasion of personal space and ease the emotional aspects of transition [93] between the roles of passive audience member and active participant in the performance. By placing the performance space in non-theatrical venues, we hoped to dispel the sense that *humanaquarium* was a traditional theatrical experience which required the audience to arrange themselves in a particular way as passive observers of the performance. We hoped that this would minimize the anxiety inherent in audience members consciously identifying themselves as part of a formal performance, with all of the concomitant social factors associated with such a high stress situation. Certain factors were retained in order to facilitate the audience's understanding of the situation - the window could still be read as a

Figure 6.8: Observers watch participants interact.

proscenium, encouraging viewing from the front, and the musicians were costumed and played conventional instruments. However, casting the scenario as a busking performance meant that participants were free to join or leave at any point, reducing the level of commitment required to take part.

The chief source of discomfort for participants, unsurprisingly, still seemed to be the presence of other audience members. While many audience members came forward to explore and interact with the box, some were still reluctant to relinquish the anonymity of the crowd and would form a horseshoe (see Figure 6.8), observing the action from several metres away.

6.4.2 Collaboration

When designing *humanaquarium* we were interested in developing a set of affordances that would facilitate collaboration between performers/designers and audience/participants. The FTIR technology which formed the basis of *humanaquarium*s interactive screen allows for multiple touches to be tracked and used in the performance. In designing compositions for *humanaquarium*, we attempted to build in

Figure 6.9: Children situated in the centre of the interaction pane.

responses which took into account multiple participants interacting with the entire area of the screen. In one particular paradigm, we divided the screen horizontally into three areas, allowing separate control of three separate instruments. In practice, however, we very quickly found that in nearly every case, adult participants were very reluctant to use the central portion of the screen.

In every performance, audience members approached the glass and seemed able to cope with their extreme proximity to the performers, suggesting that the ameliorating effect of the transparent barrier had been successful in reducing social anxiety in that regard. However, we noticed that many audience members chose to hover at the edges of the frame rather than placing themselves directly in front of the screen, enabling themselves to stay out of the performers' field of vision. Nearly everyone was extremely careful about blocking the view from audience members behind them. Participants would usually restrict themselves to one side of the screen, and stake out an area of the glass with which to play. The exception to this otherwise consistent phenomenon was small children (see Figure 6.9), who rarely seemed to have any anxieties about either their extreme closeness to the performers or the

effect of their presence on other audience members, often standing directly in the middle of the screen.

As previously discussed, the audience was provided with few cues as to how to interact with *humanaquarium*. The screen was apparently an ordinary piece of acrylic and bore little resemblance to any kind of traditional musical instrument or electronic interface. In order to explore whether audience members would be able to determine its functionality from each other's efforts or whether approaching the glass would be a natural response to the performance we avoided using explicit graphical or signposted instructions of any kind. We occasionally met with a certain amount of trepidation concerning the interface: on several occasions audience members caused an abrupt effect on the audio when they touched the screen, and instantly gestured an apology for their perceived mistake.

Due to the culture and nature of the types events at which *humanaquarium* has frequently been shown (many "interactive", hands-on exhibitions which were billed as such) most audiences had a basic awareness that the performance likely involved some kind of interaction on their part. However, we occasionally encountered situations where audience members would initially install themselves in front of the box and wait to be entertained. We decided to intervene with gestures from inside the box if necessary to begin the collaboration, surmising that placing an outstretched hand on the glass would elicit a mirrored gesture from participants. This was borne out consistently. Participants were in general very willing to interact directly with us, the performers, making eye contact and watching our actions closely. We noticed a willingness to take cues in the form of gestures which helped us clarify some of the interactions in otherwise complex parts of performances.

6.4.3 Legibility

In *humanaquarium*, legibility was from the beginning an important factor. As we found in *dream.Medusa* that participants wanted to know how their actions affected the performance development, and to understand the domain space of what actions they could take, we consciously strove to make *humanaquarium* as legible as possible in terms of the connection between the actions of the performers, the participants and the system itself, without resorting to actual graphical instructions.

After the initial hurdle of beginning to engage participants, we quickly found that there was some variation in how well different audiences were reading the interaction. By scheduling multiple performances of *humanaquarium* at each venue, we were able to experiment with strategies to engage audience members at different levels, structuring the same shows slightly differently across repetitions. One particular approach which we adopted in the *Darkshines* composition was a gradual increase in musical complexity – using 'tutorial' passages in the composition so that solo instruments or voices could be clearly heard and the control paradigm discovered. As discussed, if necessary, we would intervene with gestures, if for instance, participants were attempting actions that the FTIR system did not support well, such as very rapid or light touches which could be difficult for the tracking system to properly detect.

We came to realize that certain controls were easy to discern, for example, the vertical axis of the screen mapped easily to balance between high and low synthesizer timbres. Other, more subtle controls were sometimes missed, such as variations in the tempo of arpeggiators or vocal panning effects. We realized quite quickly, to our surprise, that although legibility was important to some participants, it was quite possible to engage many audiences with the most basic forms of participation. Some audience members were apparently content to experiment with the first controls they discovered. Children in particular, would often watch the per-

formers, enthralled, while keeping one hand motionless on the glass for the duration of the performance. They appeared aware that their participation was required but otherwise had no desire to collaborate actively with the performers, choosing simply to register their presence and participation in the experience. For participants, knowing that their actions were in some way necessary to the outcome of the performance seemed to increase their investment in the experience, whether or not they chose to experiment with the full range of controls.

6.5 Reflections on a Year of Practice

Approaches such as Gaver's [32] cultural commentators or Hook *et al's* [49] use of externally created documentaries as investigatory stimulus use an outsider's account of a design and then communicate it back to the designer. Due to their external vantage point, unaffiliated creative practitioners can offer an intriguing set of perspectives from outside the design space. The voice that is missing from that mode of conversation is that of the creator him/herself. Cultural commentators or external documentarians take on the role of interpreter, conveying their own understanding of the artist's intentions at one remove, necessarily filtering the work through their own experience of it. In the design of *humanaquarium* we deliberately decided to attempt the inverse of this approach, seeking a more central perspective by designing from within, engaging in a direct dialogue with the user. Situating ourselves within the design and taking the role of performer during the *humanaquarium* performance we were able to add the voice of the designer directly to a phase of the design process from which it would normally be absent. While this manner of investigation is necessarily self-reflective in nature, placing ourselves inside the design provided us with a combination of first-hand experience and simultaneous dialogical exchange with users, leading us to a number of insights that may have been overlooked in a traditional design process.

Crucially, while Gaver's and Hook's approaches involve the creation of what could be termed secondary artefacts to explore the design space (e.g. documentaries and cultural commentaries), our practice-based investigation allowed our design process to focus entirely on the artefact under consideration: the *humanaquarium* performance. This approach was advantageous in that it allowed super-rapid prototyping of new design revisions and periods of simultaneous design proposition and response. A particular challenge of this approach, however, was that we had to adapt the complexity of our design interventions to account for the real-world time frame of the performance schedule.

Living with the piece for a year and integrating it fully with our creative practice led to a gradual reframing of the design space. Simultaneous with the evolution of *humanaquarium*'s design, we experienced a deepening understanding of our instincts as performers. In reviewing a year of performing and developing for *humanaquarium*, we realized certain factors were being constantly re-negotiated, sometimes unconsciously shifting the priority focus during the design process.

Schofield and I came to the project with nearly 20 years of experience in traditional stage performance and playing with other performers, either in jazz and improvisational contexts or in the performance of rehearsed pieces, Shearer as well having many years of experience as a composer and musician. However, the unique setup of *humanaquarium* necessitated careful consideration of our roles as performers and composers. We had begun preparing performances for *humanaquarium* with the initial hypothesis that allowing users the creative agency to structure and control the sensual components of the experience would increase user engagement. As time progressed, however, and we gained confidence with the interface, we began to introduce more complex structures, musical motifs and visual narratives and began to interact more with each other musically. A tension emerged between our instincts and desires as musicians to make more complex and (to us) more satis-

fying musical pieces (such as the complexly structured *Phantasmagoria*) and the necessity to retain a simplicity and transparency in our compositions which would allow passing viewers to instantly collaborate with us. Upon reviewing footage of early performances, such as the early presentations of the free-form *Mariana*, we realized that in creating more intricate, polished productions like *Phantasmagoria*, we had inadvertently sacrificed some of the unpredictability of the medium: something which we had always thought important. The combination of being able to look back on a large number of design iterations coupled with a deeply personal experience of each performance allowed us to identify and learn from experiences such as these.

In *humanaquarium*, we drew upon experience gained from working both in the arts and in HCI. When asked whether we had considered particular elements of the design 'as artists' or 'as HCI designers' we realized that in most cases the answer was both - the concerns of the one inseparable from the other due to the interdisciplinary nature of our creative process. We were able to learn not only from participants' accounts of the experience but also from multiple readings of our own, informed by alternative perspectives of our dually-faceted practice.

6.5.1 Contributions

In this discussion we have:

- Described our process of *designing from within* using the development and performance history of *humanaquarium* to illustrate our longitudinal, self-situated practice of reflectively interrogating shared experiences within their authentic performance/use context.

- Explained how, using McCarthy and Wright's pragmatic framework, we were able to draw design inspiration from our *threads of experience* investigation of *dream.Medusa*

- Provided a description of how issues of stage fright, collaboration, and legibility were explored and where possible, ameliorated, using the *humanaquarium* interface.

- Truly intertwined arts and HCI practice in the design and investigation of the playful *humanaquarium* interface.

Chapter 7

Nightingallery

In previous chapters, we described how our experiences with *dream.Medusa* and *humanaquarium* allowed us to refine our practice of 'designing from within' and establish a methdology of designing and participating in collaborative interactive performance to explore creative, playful, technologically mediated behaviour in public spaces. This chapter describes the third in our series of participatory works, *Nightingallery*.

Nightingallery was created in 2011 by Guy Schofield, John Shearer and myself, again in collaboration with Patrick Olivier, Peter Wright, and Pierre Boulanger. It is an interactive, performance-based installation in which participants converse and interact with a talking, singing animatronic bird (Figure 7.1.) Each time a participant speaks or sings to the bird, the bird replies with a synthesized birdsong. The birdsong responses mimic and transform participants' vocalizations, allowing installation visitors to engage in a cryptic, fantastical dialogue with the animatronic character.

Nightingallery continues the research trajectory begun in our two previous works, whereby self-situated, pragmatic investigation and evaluation is used to identify and explore issues of participant engagement within legitimate performance/use contexts. In developing *Nightingallery*, we have used our practice of designing from within to create an interactive art piece devised specifically as a platform from

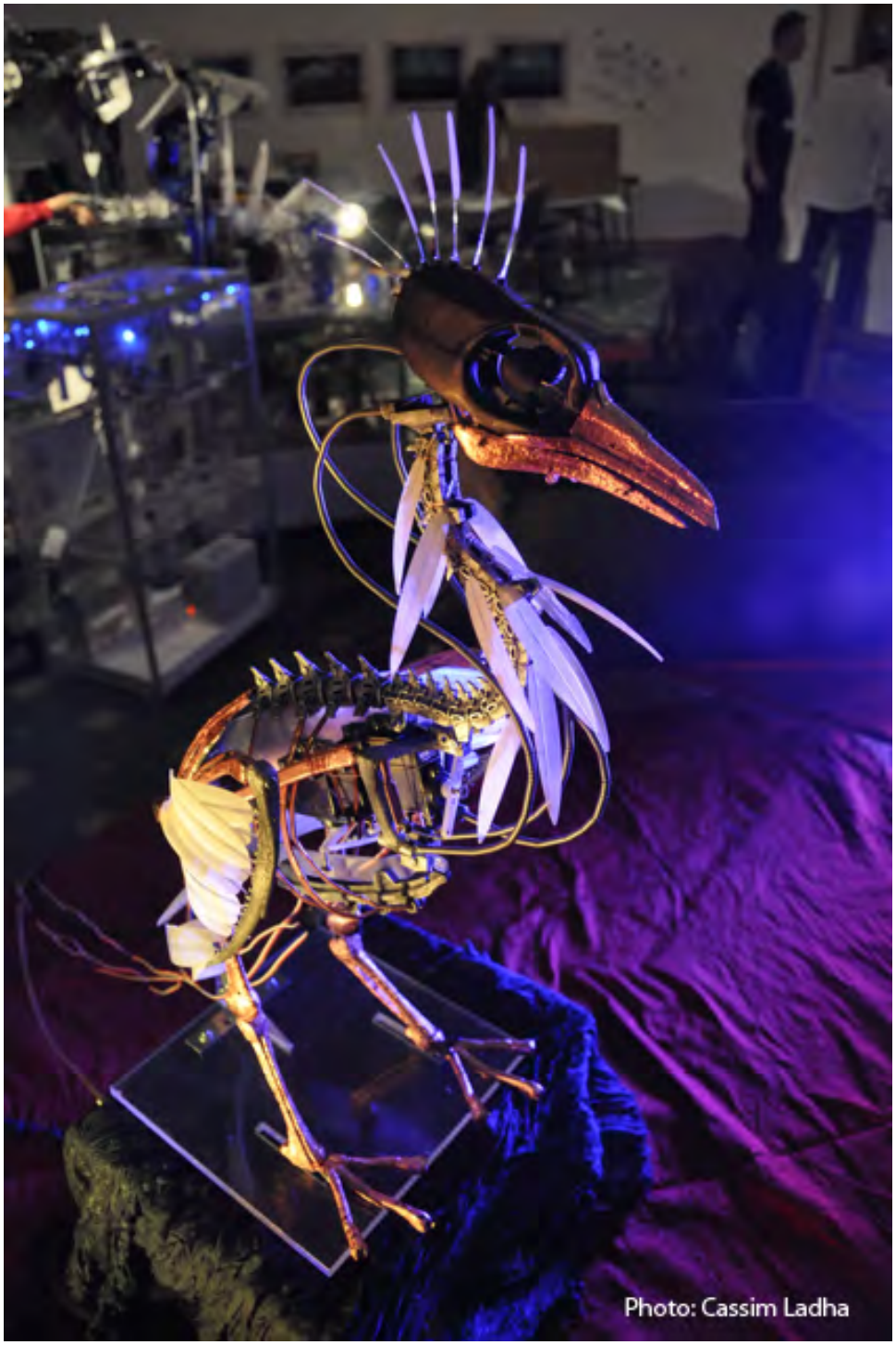

Figure 7.1: *Nightingallery*'s animatronic bird character.

which to pursue avenues of investigation which emerged during our study of participant experience in *humanaquarium*. We developed and refined two interaction paradigms for *Nightingallery* in order to explore two targeted research goals:

- to observe how groups of participants communicate amongst themselves when exploring playful technologies
- to encourage participants to engage in the unusual behaviour of spontaneous performance in public spaces

This project illustrates a feature point of our methodology, as by staging and examining collaborative performances in legitimate public settings we offer a way of interrogating the interactive scenario within its genuine use context, and suggest the use of performance as a platform for experimental design.

Casting *Nightingallery*'s animatronic bird interface as the central performer in the installation allowed us to explore how manipulating the placement of the designer/performer within the performance/use context allowed us new vantage points from which to engage in the practice of 'designing from within.' In this chapter we will describe how the *Nightingallery* project evolved based upon our experiences with *humanaquarium*, and how we specifically designed and refined *Nightingallery* in order to investigate social issues surrounding how groups of participants encounter and engage with playful installations. Throughout the discussion, we reflect upon how our experience as designer/performers positioned within the performance frame [4] allows us to explore the scenario from within its legitimate use context.

7.1 Exploring the Role of 'Designers/Performers' Within the Use Context

We began the design process for *Nightingallery* as an extension of the final stages of our evaluation of the *humanaquarium* project (see Chapter 6, Section 6.3.3.) During the course of three intensive days, Schofield, Shearer and I reviewed the video documentation of each of the *humanaquarium* performances, and generated a new series of notes and observations from this perspective of temporally removed external observation. In contrasting these new notes with the notes gathered on-site after each performance, we were able to benefit both from the on-the-ground observations which would have been lost had we only evaluated the experience from the post-experiential perspective (where we were removed both temporally and physically from our situated vantage point) as well as from a higher-level retrospective afforded by our year of performance. During this review process, we were able to benefit from both of these observational perspectives in order to identify several areas of investigatory focus that led to the creation of the *Nightingallery* project.

7.1.1 Designers as Performers in *humanaquarium*

After watching the videos and assembling the notes we had taken over the course of the year, we reflected upon how our presence as designers/performers literally within the use context under evaluation (the *humanaquarium* performances) shaped the nature of the performance's experience and enactment.

During the course of examining the *humanaquarium* footage and discussing our collective experience with the project we realised that many of the observations we made about *humanaquarium* related to the interpersonal relationships described in McCarthy and Wright's 'emotional' thread of experience [71].

We observed that the featured presence of myself and Schofield as live performers inside the *humanaquarium* installation had had significant influence upon

the behaviour of participants. While one of *humanaquarium*'s goals was to encourage participants to develop a sense of creative agency in the enactment of the *humanaquarium* performance, the sociocultural factors surrounding the inclusion of live performers in the installation environment had been simultaneously both encouraging and inhibitive of the nature of the participants' co-creative role.

humanaquarium was designed to mimic a busking scenario in which participants were explicitly welcomed, beckoned, and invited to join the interaction, however, upon examination of our video footage, we did observe that participants were often reluctant to interject their contributions into the ongoing performance of two live human musicians. In participant interviews conducted during the *dream.Medusa* investigation, participants had indicated they felt it was somewhat socially taboo to interfere with a performer's craft (see Appendix E, table E.2). Chapter 6, Section 6.1.1 describes how we had attempted to mitigate these social barriers to participation through the use of the window interface both as a definition of personal space and as a locus of desired interaction, a design idea which had directly emerged from our analysis of the interpersonal issues which had arisen during the *dream.Medusa* performance. While *humanaquarium*'s window interface did reduce participants' stage fright and increase their comprehension of the allowable interaction space they were free to explore, we still felt that the intimacy of positioning the site of live music-making in close proximity to the site of participant interaction made Schofield and I very much a dominant focal point of the installation. Our physical presence inside the installation allowed us to recruit and stimulate participants to interact (via eye contact, gesture, and visible responsivity to participant overtures – see Chapter 6, Section 6.4.2) however, our very integral role as featured performers reinforced traditional expectations inhibiting audience members from overstepping cultural boundaries preventing them from 'disrupting' the directional flow of the performance medium.

Not only was the physical presence of live performers a design component which strongly affected participant engagement with the *humanaquarium* installation, but in addition, the nature of *humanaquarium's* interaction strategy itself reinforced a performer-audience power differential which was heavily weighted in favour of the performers. While the participants could manipulate the audio-visual parameters of Schofield and my musical performances, they could not contribute any new content to the performance experience. This limited their co-creational contribution to that of moderators acting upon our live performance situated participants in a responsive, secondary role.

Due to the performance's design, many interactions involved participants mediated communications with us, the featured performers within the *humanaquarium* enclosure. The *humanaquarium* installation could readily be evaluated in terms of its mediatory capabilities, however, the investigation was very dominantly characterized by the interpersonal issues inherent in collaborative music-making with live human performers.

7.1.2 Shifting the Role of the Designer/Performer in *Nightingallery*

humanaquarium had allowed us the unique experience we termed 'designing from within': experiencing the performance/use context firsthand during live exhibition. In the *Nightingallery* project, however, we wanted to maintain this authentic immersion in the experience while playing a less prominent role in the enactment of the performance. We hoped to reduce our presence at the forefront of the experience while still availing ourselves of the research benefits afforded by remaining within the performance frame [4].

Nightingallery sought to explore a new subject position for the designer within the performance/use context. While heavily featuring live musicianship had framed the *humanaquarium* artifact as a mediating technology between performers and

participants, in *Nightingallery* we took the opposite stance, leveraging the anthropomorphic qualities of an animatronic bird character (see Figure 7.1) to give the technology under investigation (the bird itself) its own agency and the most prominent role in the performance.

Nightingallery's concept framed us, the designer/performers, in supporting roles. The focus of the participatory performance was upon the behaviours of a responsive animatronic bird who sang and moved in response to participant vocalization. We participated in the performance by assisting and mediating participants' interactions with the bird. This still allowed us to experience the piece through a role of a supporting 'performer', while distancing ourselves from being the primary focus of the installation. We hoped that this design strategy would allow the performance scenario to focus more directly upon the artefact under investigation (the animatronic bird character) rather than upon our own performances. Additionally, we hoped that communicating with the bird automaton would be less intimate than interacting with a human performer, decreasing the perceived risk in participation.

7.2 The *Nightingallery* Installation

Nightingallery's custom control mechanisms were programmed in the visual Max/MSP environment (see Figure 7.2.) We worked collaboratively to develop the software, and, as described in previous chapters, our methodology of designing from within required us to create a flexible, adaptable system structure which we were able to progressively refine as our understanding of the task domain evolved over the course of repeated performances with the project.

There are three main components to the system structure:

- Incoming audio from participant vocalization is processed in MSP, where it is analyzed and stored to be used as source material for the responsive birdsongs

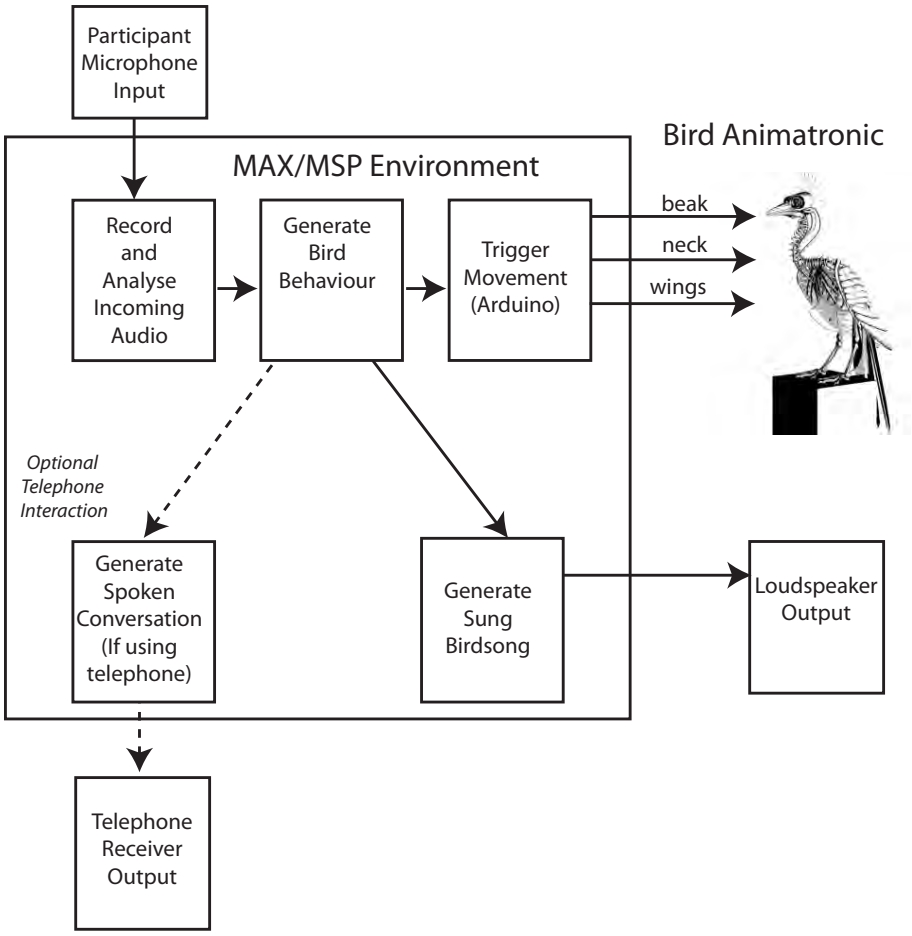

Figure 7.2: The *Nightingallery* system structure.

- The bird's vocal response behaviours are generated (based upon the two interaction paradigms discussed in upcoming sections of this chapter)
- The bird's physical movements are generated using the Max environment to send MIDI control data to the Arduino board which drives the three servo motors responsible for the movement of the bird's beak, neck and wings.

For more detail about the code and implementation, please refer to Appendix C.

7.2.1 Designing the Bird Artefact

In our discussions where we had identified the previously mentioned issues surrounding the social impact of human performers in *humanaquarium*, we suggested that it would be interesting to replace the human performers with animatronic counterparts in order to see how the social aspects of the performance would be affected.

The bird character was first suggested in jest, as a potential replacement for myself. We discussed how I, in particular, had played a socially prominent role in initiating and maintaining participant engagement with the *humanaquarium* installation. While much of Schofield's attentions (and gaze orientation) had necessarily been focussed on the musical instruments which he controlled during performances, I had not played an instrument, so had been able to look directly through the screen at the participants and devote my efforts to communicating and engaging with them through eye contact, gesture, and visual encouragement. I had attempted to make my vocalizations as audibly enticing as possible, and had devised elaborate costumes and makeup in order to attract and maintain visual attention from passersby. We speculated upon how an artificial character could similarly attract and maintain participant attention, functioning as a sort of autopedagogic interface [77] that would initiate and guide participants through a gradually enriching human/avatar interactive dialogue.

While it had begun as a fanciful idea, we realised that due to the diverse skillset of our creative team and the variety of hardware and equipment accessible to us at Culture Lab Newcastle, we would realistically be able to create a mechanically simple, yet aesthetically compelling character. After discussing several ideas for the animatronic character persona, we felt that a visually appealing, mobile, animated singing bird could readily be anthropomorphized to portray a human-like role in an interactive scenario. This formed the basis for our proposed production, *Nightingallery*.

7.2.2 Constructing the Animatronic Bird

We recognized that a great deal of *humanaquarium*'s effectiveness as an interactive performance stemmed from its sensorial allure and emotive appeal. We specifically envisioned that the *Nightingallery* automaton could build upon the steampunk aesthetic and performance practice that we had cultivated in the *humanaquarium* project, so as to maintain continuity with what had been successful in our previous work.

Schofield, a trained sculptor and animator, created the bird's physical form using a combination of digital and traditional crafting techniques. Based on an examination of the skeletal structures of several bird species, Schofield designed a bird skeleton that bore visual resemblance to the type of birds often used in decorative taxidermy in the Victorian era. The bird's skeleton was modeled in 3D StudioMax, and was physically fabricated out of lightweight plastic (a plastic resin compound called *acrylic butadiene styrene*, commonly abbreviated ABS) on a rapid prototyping machine.

As we desired the bird artefact to have a steampunk aesthetic, the visual design combined the visible mechanics of the animation hardware with references to Victorian taxidermy and stylized clockwork automata. Schofield used a variety of techniques to manipulate the appearance of the fabricated skeleton. He simulated a metallic finish on portions of the skeleton, using photographic framing wax to produce a silvered texture for the bird's backbone, and gilded copper leaf onto the bird's beak, claws, and leg bones, which over time would develop an authentic patina. The surface of the crafted skeleton was distressed in various ways in order to emphasize the contrast between the (simulated) organic skeletal components, and the deliberately exposed mechanics of the animation hardware.

Three Arduino-controlled servos were used to drive the bird's movements, enabling it to open and close its beak, rotate its neck, and flap its wings. Exposed

Figure 7.3: Shearer, Taylor and Schofield, with *Algernon Barrington-Smythe*, the *Nightingallery* animatronic.

bicycle brake cables contained the wires used to manipulate the bird's joints. No attempt was made to mask the servos' movements, resulting in audible whirring and clicking. The joint movement was deliberately programmed to be jerky in nature, contributing to the desired clockwork-feel of the bird's behaviour. To complete the bird's aesthetic appeal, Schofield fashioned a set of wing and crest feathers out of laser-etched sheets of transparent acrylic and stems of thin fibre-optic cable. While we considered using real or synthetic feathers, we felt that this careful fabrication of each feather's delicate and organic shape out of artificial materials completed the juxtaposition we desired, marrying the technological (the servos and exposed cables) with the organic (the realistic skeleton and intricate feathers) in a way that also emphasized the modern influence of the digital in our creative process.

7.2.3 Supporting the Bird Persona

Schofield, Shearer and I exhibited *Nightingallery* numerous times during 2011, including appearances situated in locations as varied as the exhibition halls of *Maker Faire UK*, the concourse outside a series of lectures and concerts held during BBC

Radio 3's *Free Thinking Festival*, and a crowded and muddy tent pitched in the centre of one of the UK's largest alternative music festivals, *Bestival*.

Rather than the staged performance style of *dream.Medusa* or the busking tradition leveraged by *humanaquarium*, *Nightingallery* was very loosely structured in a way most closely resembling improvisational street theatre. While our presence as designer/performers remained a crucial component of the *Nightingallery* performance, we were mindful that a design goal of this installation was to explore the perspective afforded to us from the periphery of the experience, allowing the bird to hold the most significant agency in the interactive scenario.

We envisioned our role and presence in this exhibition scenario to be evocative of the vintage carnival barker, enticing visitors to approach the bird and encouraging them to talk or sing to him. As we had sometimes found that *humanaquarium* participants had been hesitant to initiate their interactions with the performance environment (Chapter 6, Section 6.4.2), our presence in the *Nightingallery* scenario allowed us to make direct interventions to facilitate participant engagement if required. As we wished to remain on the periphery of the interaction as much as possible, once participants engaged with the bird, we deliberately tried to minimize our interference so that the bird could then take over the agency in the scenario and engage the visitors in a dialogue. We remained available to mediate if the rapport between the bird and the participants was appearing to falter, and to reward participants' contributions through positive feedback and attentive encouragement. Occasionally we would sing or chat with the bird, exhibiting the range of its interactivity in order to attract attention to our installation or demonstrate the bird's vocal capabilities.

We incorporated elements of performance and stagecraft in our presentation and exhibition of the work. The bird was placed on a simply dressed set (using drapes and fabric to stylize the table on which he sits) and dramatically lit using

several floodlights. Our exhibition team (Schofield, Shearer and myself) attended to the bird while costumed in elements of steampunk Victoriana in order to further increase the spectacle of the production (see Figure 7.3).

Our team was careful to reinforce the bird's agency through chosen forms of speech. We deliberately cultivated the habit of referring to the bird as him rather than it, and when speaking to exhibition visitors were consistent in this choice of pronouns and in our anthropomorphic assignment of motivations to the bird ("Sing him a song – he really likes to be sung to" or "He can't hear you very well over the music – you'll have to speak more loudly.") We told participants that the bird's name was 'Algernon Barrington-Smythe' the name being a play on the prototyping material he is built of (the ABS plastic resin.) The overly aggrandized, 'double-barrelled' name reinforced our comical characterization of the bird as a decaying relic reminiscent of the type of trophy artwork owned by members of wealthy British society.

By referring to the bird as if it were real we encouraged participants to suspend disbelief and accept the bird as a player in the social setting. Our characterization as carnival barkers and animal minders gave our presence in the interactive scenario theatrical legitimacy, allowing us to observe interactions in close proximity to the participants while remaining true to the integrity of the aesthetic work.

7.3 The *Nightingallery* Interactions

In the remainder of this chapter we discuss how our performance-based research practice informed our conceptualization and development of two interactive behaviour paradigms for the *Nightingallery* bird character. Each interaction scheme was used to interrogate a different aspect of social behaviour in public spaces.

7.3.1 Designing *Nightingallery*'s Interaction Paradigms to Explore Research Goals

While reviewing our notes and videos and reflecting upon the *humanaquarium* performances, we noticed a particular topic emerging as a potential avenue for future research. From our situated vantage points in proximity to the installation (Schofield and I inside the humanaquarium structure and Shearer free to move amongst the participants clustered around the performance) we were able to observe interesting interactions going on within peer groups who either had arrived at the exhibition site together (in the case of families or friends) or who had encountered each other while exploring the installation.

While my attentions as a performer necessarily required me to attend to the functions of my craft (singing, making eye contact with audience members, and ensuring my posture and facial aspect was welcoming and engaging) as a researcher I found myself intrigued by observing how groups of people related to one another while interacting with the *humanaquarium* performance.

After performances concluded, Schofield, Shearer and I would discuss the experience, finding that we would often all have noted particular instances where the installation would stimulate groups of people to engage in shared interactions – side conversations, or gestural demonstrations, often of a retrospective, instructional or exhibitionistic nature. We observed people on-site immediately recounting their experiences to their friends, animatedly teaching each other how to interact with *humanaquarium's* interaction surface, or exaggeratedly showing off and courting the attentions of onlookers as they played with the interface.

Stimulating and Investigating Social Behaviour

We became interested in further exploring this social phenomemon of experience sharing. As previously discussed, we felt that *humanaquarium's* performer-centric

structure placed great prominance upon the contributions of Schofield and myself. We were unable to dedicatedly observe these social interactions due to the demands of our performative role. By removing ourselves from the focus of the installation and retreating somewhat to the sidelines, we hoped that we could have a better vantage point from which to observe these actions, consequently portraying less of a dominant social presence than we did when assuming the perceived mystique of trained musicians engaged in their craft.

Additionally, as we designed the *Nightingallery* installation, we explicitly sought to develop interaction strategies for the installation which were intended to trigger two social behaviours we sought to explore:

- **the transmission of personal experience from the participant to his/her peers:** we wanted to develop an interface that would stimulate participants to teach one another how to use the interface or recount their impressions of what had just transpired

- **the use of the creative interface as a playful form of exhibitionism and impromptu performance in front of others:** we wanted to see if we could encourage participants to intentionally 'play to the audience' of those around them

We implemented two interaction paradigms for the *Nightingallery* installation in order to cultivate and explore each of these phenomena.

7.3.2 Public/Private Communication and Experience Sharing

The first interaction strategy we devised was created to explore our first research question – how participants who interacted with playful technologies shared and communicated their experiences with those around them.

We had become interested in observing the phenomenon of experience sharing during our work with *humanaquarium.* As previously discussed, *humanaquarium*

participants spent a significant amount of time communicating and conversing with their peers, either during their participation in the *humanaquarium* performance, or after having completed their interactions and stepping away. Participants often instructed their peers in how to interact with the interface, through conversation and miming, or by exaggerated demonstration upon the interface itself. After performances concluded, participants were overheard relating their experiences to friends who had not chosen to take part. These communications were particularly common amongst family groups, since as often as not it was children who led the interaction, teaching and encouraging their parents to explore the interface.

With *Nightingallery* we were eager to explore these avenues of peer-to-peer communication. We looked for a way to create a significant distinction between the experience of the person participating and the experience of the onlookers who were observing, so that there was unique content and information known only to the participant which s/he could then choose to communicate to others. We hoped this would stimulate interpersonal discussion, as the participant would have a private experience that s/he knew was not evident to those who remained on the public, observational side of the experience until it was explicitly disclosed.

Asymmetric Telephone Interface

We chose to implement participant interaction via an interface styled as a vintage telephone receiver, using the affordances of the telephone receiver device to facilitate an asymmetrically structured interaction paradigm. When a participant lifted the telephone receiver, 'the bird's' phrases were transmitted as recognizable English through the earpiece of the phone. To the onlooking spectators, however, who were not privy to the communications heard only through the earpiece, the bird's voice sounded like unintelligible birdsong, which was played through a loudspeaker concealed in the base of the bird's platform.

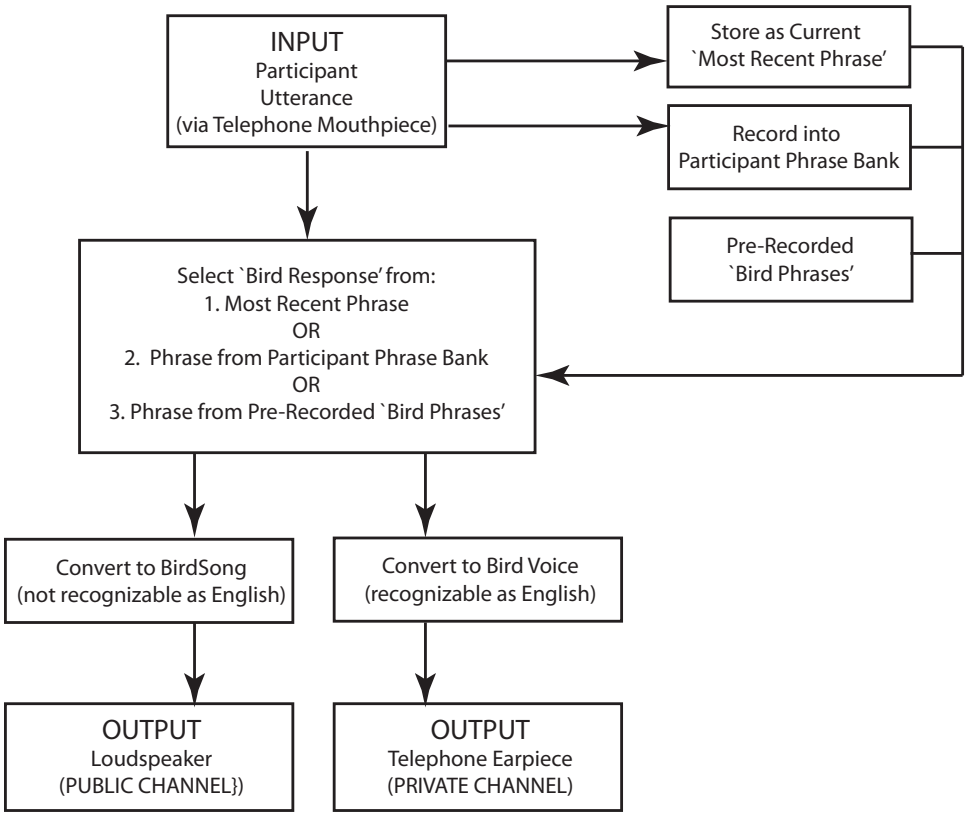

Figure 7.4: Participants hold 'conversations' with the bird via the telephone interface.

Participants spoke to the bird directly into the telephone mouthpiece, enabling them to speak quietly if they so wished, out of earshot of the crowd. This method of feedback provided entertainment for the viewing public (via the bird's melodic and dynamic birdsong responses) but enabled the existence of an additional, private channel of content available only to the participant who was directly interacting via the telephone (see Figure 7.4.)

The English narrative developing between the participant and the bird was known only to the participant holding the telephone receiver. The onlookers' perspective did not afford any knowledge of the content of the conversation. Therefore, a participant using the handset had the ability to either reveal or conceal the experience s/he was undergoing. The content of the conversation would only become known if the participant chose to tell people what was said, giving the participant the ability to share the details of what was heard through the phone interface, or to keep the information to him or herself.

By allowing participants to decide how much to reveal about their interaction, we allow them partial control over what Reeves *et al.* refer to as the 'spectator experience' [82], whereby public interaction is defined in terms of *manipulations* – the observable physical actions undertaken by the participant upon the interface (in the case of *Nightingallery*, speaking into the telephone receiver) and *effects* – the results of the manipulations (the bird's vocal responses.) Using the phone interface in *Nightingallery*, participants could choose to enact secretive interactions, by speaking quietly into the phone (the manipulation) and refraining from communicating what was said in response (the effect), or, instead, could choose to conduct more expressive interactions by speaking with the intent to be overheard and observed. In any case, the asymmetric design stimulated a sense of suspense for onlooking spectators, as one could only experience what was happening on the receiver portion of telephone interface through taking a turn at participating firsthand. Later in

this section, we will go on to discuss examples of how these interactions played out during live exhibitions of the work.

The Telephone Conversations

Conversations with the bird were initiated when a participant picked up the telephone. If the telephone remained hung up on the hook, it would intermittently ring, in the hopes of attracting the attentions of passersby. Observing from our position on-site nearby, we could remotely instigate telephone rings manually to lure nearby visitors to pick up the phone. When the telephone was eventually picked up, the bird's voice could be heard through the earpiece of the telephone, prompting the participant to speak to him. The participant would hear a bird-like voice repeating 'Hello?, Hello?' until s/he vocally replied, initiating a conversation which would terminate when the phone was replaced on its hook.

We were not prepared to equip the bird with sophisticated artificial intelligence or natural language parsing, so the conversations were necessarily rudimentary in content. While the scope of the bird's conversational ability was constrained by the logistics of our implementation, we felt that the conversation paradigm we devised effectively evoked an uncanny, slighly disconcerting conversation scenario, engaging human and bird in a dialogue which we envisioned could be entertaining and socially stimulating.

Modelling the Bird's Behaviour

We modelled the bird's behaviour after the popular culture representation of the type of pet bird known for vocal mimicry – a parrot or a mynah bird. We discussed how we would expect a 'typical' bird character to behave, and watched numerous examples of people playing with mimicking birds online. We were particularly inspired by a parrot on Youtube (see Figure 7.5 who sang a remarkable approximation of Mozart's 'Queen of the Night' coloratura aria [27].

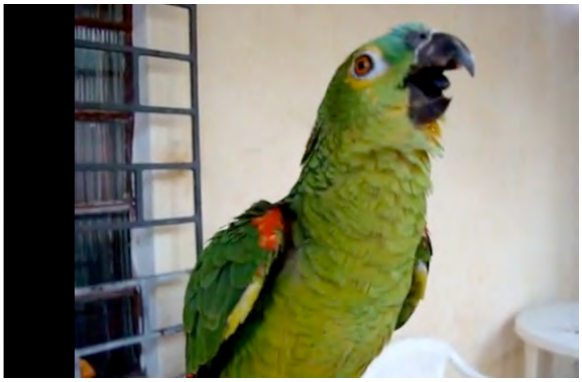

Figure 7.5: A parrot sings Mozart's *Queen of the Night's Vengeance Aria* (screencap).

The parrot's interpretation of the aria yielded great comedy when observed by an audience familiar with Mozart's score. The aria's most famous coloratura phrase contains a series of repeated staccato pitches which, of course, as written, are repeated a fixed and predictable number of times. The parrot in the video appeared incapable of remembering how many times the pitch was to be repeated before proceeding on to complete the phrase, often appearing to be 'stuck' on the repeated staccato pitch. After a random and unpredictable number of repetitions of this favoured pitch, the parrot would suddenly and smoothly go on to effortlessly execute the rest of the phrase. The anticipation this provoked in us, as observers, led to great humour as we watched the parrot sing the song a number of different times on the video.

We wanted to stimulate a similar sense of anticipation and humour in participants who engaged with the *Nightingallery* installation. We wanted our bird's vocal behaviours to be maddeningly repetitive, yet allow him to maintain participants' interest through unpredictability, surreality, and humour. In order to do this, we set up a simple schema, whereby each time a participant spoke to the bird, the bird would randomly respond in one of three manners:

- He would mimic what the participant had just said

- He would repeat something that the participant had said earlier in the conversation
- He would introduce a new phrase to the conversation

At the outset of the conversation, we weighted the random choice of response so that the bird most often chose to repeat the participant exactly. This allowed us to establish the bird's persona as a slightly irritating mimic - much like a natural parrot. However, as the conversation progressed we increased the bird's ability to say things independently, or repeat something heard previously, allowing him to introduce unpredictability into the interaction, as participants would often be surprised when his response was not what they expected.

Memory Bank of Phrases

To do this, as participants spoke into the telephone we recorded their verbal utterances into a memory bank for future playback. We had pre-loaded a memory bank of phrases that the bird 'knew', which had previously been recorded in studio. These phrases would provide novelty and also contribute to the development of an eerie, uncanny mood when interjected into the conversation. Choosing slightly disconcerting phrases was keeping with the enjoyably dark aesthetic we had created via the bird's dishevelled, steampunk appearance. We deliberately chose phrases which were either interrogative (in the hopes that they would further the conversation through participant response) or ominously evocative within our cultural context, often referencing famous literary quotes.

Example interrogative phrases:

- "Tell me a story?"
- "Why are you doing this?"
- "Who are you?"

- “Who’s a pretty boy then?”
- “Polly want a cracker?”

Example literary quotes:

- “Beware the jubjub bird”
- “Nevermore”
- “Fair is foul and foul is fair”
- “There’s daggers in men’s smiles”
- “Something wicked this way comes”

When a participant engaged with the bird and replied to any of these questions or comments, his/her phrases could then be added to the bird’s memory bank, allowing the bird’s library of responses to become more varied. Bizarre conversations would be allowed to evolve if participants played along and responded to a conversational entity whose cultural familiarity as a mimicking, parrot-type of creature allowed them to excuse his fundamental insensibility. The dialogue, while absurd, could be interpreted as acceptably believable when considered within the context of a human/bird narrative.

The Bird’s Speaking Voice on the Telephone

The bird’s speaking voice was integral to the suspension of disbelief required to engage participants in the installation narrative. As the bird’s voice was synthesized in Max/MSP, we had access to a number of VST (virtual studio technology) audio plugins which we used to process the phrases the bird would speak. For the sake of ascribing the bird a consistent character voice and persona, we needed him to have a believably consistent voice whether he was speaking a pre-recorded phrase

or a participant generated phrase. We achieved this by transposing all phrases into a similar octave and layering a number of vocal effects, managing to establish a characterized speaking voice for the bird which remained relatively constant regardless of the gender or pitch of the seed phrase. The end result was satisfyingly reminisent of the croaky, cawing, harsh tonality of parrot or mynah bird speech. Please refer to Appendix C, section C.3.1 for further implementation details.

The Bird's Singing Voice on the Loudspeaker

The audio feed played over the loudspeaker whenever the bird participated in the conversation, however, it contained only a heavily filtered representation of the phrases the bird was saying. We used a second bank of layered VST sound processing objects to translate the English phrases into melodic, unintelligible birdsong. We programmed the movements of the bird's beak to reflect the amplitude of the phrase, so that the bird appeared to widen its mouth when singing loudly. This simple mechanical implementation approximated lip-synching, giving the impression that the automaton was actually singing the phrase.

The observing audience could see the bird's beak moving and hear the cadences of the birdsong, but no intelligible words could be discerned. The asymmetric interaction paradigm meant that a participant was solely responsible for deciding how much or how little of his/her interaction s/he wanted to share with us or his/her peers. By isolating part of the interaction we created a platform for exploring how people chose to share this private information with the people around them.

Sharing Experience in Public Spaces

We launched the *Nightingallery* installation at *Maker Faire UK* in 2011. The telephone interface was placed on a table next to the bird automaton, and was set to ring at regular intervals to attract participants' attention. During the *Maker Faire* exhibition, and subsequent exhibitions in the UK, we were able to use *Nightingallery's*

Figure 7.6: Participants have conversations with the bird via the telephone interface.

asymmetrical interface to observe how participants chose to share an individual experience with friends, family, or peers (see Figure 7.6). We remained nearby the installation to assist participants with the interface if required, otherwise simply remaining present as part of the social dynamic of the public exhibition's performance frame.

While some participants interacted individually with the installation, focusing only on the bird character throughout the interaction and not talking or communicating about their experience in our presence, many participants did share their experience with other people in the space (friends, family, strangers, or members of our exhibition team.) We specifically watched for these types of interactions and were able to identify several common methods of experience sharing [1]:

[1] Participant quotes included in this text were transcribed verbatim from video footage and on-site notes made during public performances

Directly recounting the contents of the phonecall. Some participants chose to tell those around them about the content of the phonecall. This could either happen during the phonecall (a participant might echo a phrase the bird said to them on the phone, allowing onlookers to understand the conversation as it was happening) or after they had terminated the phonecall and finished interacting with the bird.

- The level of detail included in participants' recounting of the conversation would vary. Some participants would echo or paraphrase the specifics of dialogue (ex: "It said 'hello' back!") while others would provide more high-level commentary about the call (ex: "It kind of repeats what I say, but in a 'birdy' way." or "It's completely bonkers!")

- Occasionally we observed participants inventing and recounting behaviours that could not possibly have occurred given the constraints of the interface. On one occasion a child repeatedly insisted to her parents that when she asked the bird specific questions (like favourite colour, or name) the bird responded with content that we, as programmers, knew was not contained in the bird's phrase bank. The child's parents left the installation quite impressed with the "intelligence" of the talking bird – due to a complete fabrication believably conveyed by their child's recounting.

Teaching, assisting, or coaxing others to use the phone interface. After talking to the bird, many participants encouraged their friends and family to have a conversation of their own.

- Enthusiastic participants would often physically pass the phone receiver to others, encouraging them to talk into the phone. Some participants deliberately refused to recount their experience on the telephone as a form of motivation, insisting that to find out what happened on the phone, their friends and family must try the interface for themselves.

- Additionally, we observed numerous occurrences of groups good naturedly teasing one another other, insisting that one of their party must sing or talk to the bird. While sometimes this peer pressure was successful, sometimes it resulted in a targeted individual leaving the vicinity. One woman announced in mock frustration, "I'm *not* singing to it! You sing to it yourself!" while making her hasty retreat.

- Occasionally, small children had to be instructed by their parents how to speak and listen to the vintage telephone interface (a parent remarked that her child had never seen a traditional wired telephone before.)

Conveying the content of the dialogue by 'performing' the audible end of the conversation While the participant in possession of the telephone receiver was able to hear the English content spoken by the bird, observers nearby could only hear the voice of the participant speaking into the phone receiver. Participants could choose to exaggerate their end of the conversation for the purpose of conveying the content of the phonecall to others.

- Participants could intentionally include a repetition of the bird's phrases into their end of the conversation, allowing others nearby to work out what they were hearing on the phone ("No, I won't tell you a story. Stop asking me that.")

- Participants could convey an interesting narrative solely through the phrases they contributed to the dialogue. By following the contextual clues contained in each comment the participant spoke into the telephone mouthpiece, on-lookers could approximately infer the other end of the conversation. One particularly memorable 'performance' had a participant animatedly ordering a pizza over the telephone, expressing pretend frustration as if the mimicking

bird was a particularly incompetent pizza shop staff member who was not cooperating in taking the order.

- Conversely, we also observed participants who deliberately obfuscated their conversations by wrapping their hands over the phone mouthpiece so that what they said was completely private, intentionally minimizing these performance based aspects of interaction.

Our placement situated on-site in this scenario enabled us to demonstrate the use of the phone interface if needed, or engage participants through dialogue ("Ooh, what is he saying?") The theatrical nature of our attire and manner (referencing the bird as a 'he' rather than an 'it') helped facilitate the playfulness and suspension of disbelief required in order for a participant to engage an animatronic bird in a purported conversation.

7.3.3 Singing and Performing

The second research question we had sought to explore with the *Nightingallery* installation was to investigate how we could reduce participant inhibitions, and motivate them to perform more creative, musical interactions with the bird character.

Even during our initial *Nightingallery* exhibitions using the asymmetric telephone interface, we had observed a number of participants who, by providing dynamic phrases and sounds for the bird to sing and repeat, chose to perform for the public through the medium of the bird. The cadence of the birdsong that was broadcast over the loudspeaker followed the cadence of the spoken phrases, meaning that if the bird repeated a participants particularly emphatic phrase, the observing audience would be able to recognize the vocal pattern in the repetition. Several participants were seen to exploit this feature, saying or singing things in exaggeratedly pitched voices to make their friends laugh.

We were very encouraged to see such a thing occurring as it reinforced to us that

the bird animatronic would tempt some participants to use it for creative means. The asymmetric telephone interface was not the ideal mechanism for stimulating performance, however, as participants were required to subvert the phone-call interaction strategy and conversation semantic when they used the telephone mouthpiece to make the bird sing to their friends. For the next iteration of our design, we chose to design an interaction scheme that would more readily and intentionally facilitate impromptu performance.

The Performance Interface

In this interaction strategy, we replaced the telephone interface with a conventional microphone (either hand-held or on a stand depending on the constraints of the exhibition space.) The microphone was positioned so that the participant could easily see the bird at eye level. In this interaction paradigm, the private channel of communication was removed and all efforts focused upon encouraging participants to perform with the bird by making him respond and mimic their voices.

We removed the element of randomness from the bird's responses, making him purely a mimic. We did this for two reasons:

- We wanted the repetitive nature of the bird's behaviour to focus participants on testing the range and extent of the bird's vocal mechanism, rather than being entertained by the surprising verbal content of his replies.

- We wanted participants to understand that their vocal utterances would directly control the audible content of the bird's subsequent reply, so that they could feel confident that they could predict what was going to happen after they sung. As described later in this document, exploitation of this knoweldge led to participants' ability to develop more sophisticated musical constructs in collaboration with the bird character.

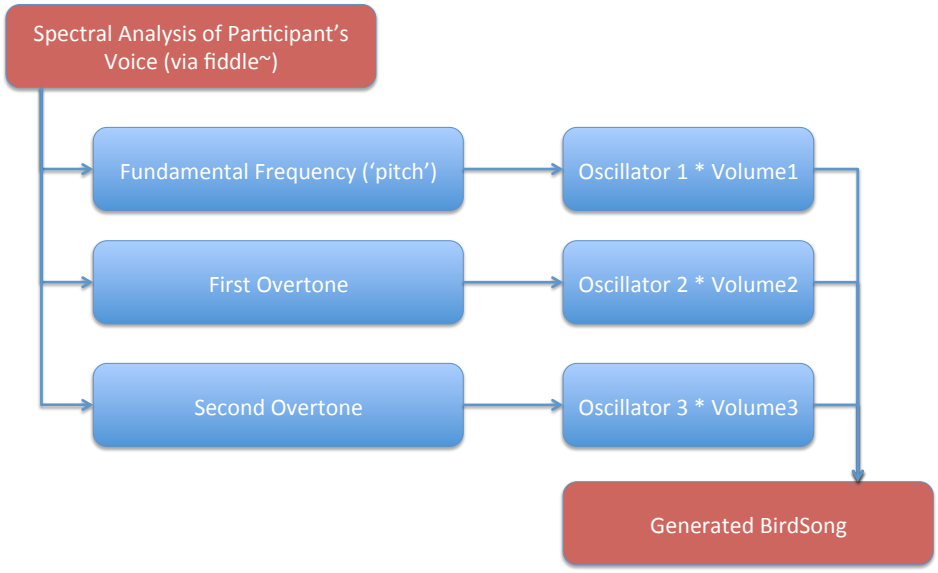

Figure 7.7: The bird's voice was synthesized based on participants' vocal input.

Synthesizing Birdsong

In this implementation we did away with the pre-recorded bird phrases as well as the simple VST manipulation we had previously used to generated the 'bird voice'. We desired the bird to have a more complex and compelling vocal mechanism in this implementation. Instead, we used Max/MSP to equip the bird with a fully synthesized voice, generating the bird's vocal content based on the frequency components present in the participant's voiced sound. To do this, we used Puckette *et al.*'s Max/MSP object `fiddle~` [79] to implement a fast fourier transform (FFT) on the incoming audio stream from the participant's microphone. This allowed us to examine the rich spectrum of sound produced by the human voice (refer back to Chapter 5, section 5.1.2 for detail on how examining the output of an FFT can allow us to extract perceptual characteristics of the human voice.)

The Synthesized Voice

We used the harmonic spectrum of the participants' vocalizations output by the `fiddle~` object to generate the bird's voice, resulting in a 'birdsong' that shared an approximation of the same perceptual qualities as the input vocalization, and creating an instrument that was highly responsive to participant nuance.

For the purposes of synthesizing the bird's mimicked response, we isolated the fundamental frequency of the user's vocalization (what we would perceive as the 'pitch' of the sound) as well as the first and second overtones present in the sound spectrum. Using these three partials, we drove three oscillators (part of the MSP sound synthesis toolkit) to generate the bird's singing voice (see Figure 7.7.) While the voice was generated based on the qualities of the input vocalization, as the sound was synthesized from applying the extracted data to oscillators, the character of the sound had an eerie, robotic quality that we felt suited the aesthetic of the bird character. Please refer to Appendix C, section C.3.2 for further implementation details.

Using this method to generate the birdsong response meant that the bird's vocalizations were most dramatically tuneful when presented with harmonic, sung input. Harshness and choppiness found in spoken utterances (due the presence of plosives and glottal stops found in speech) was reflected in the synthesized sound, making the bird chatter and chirp. If the input vocalization was steady and strong, however, as occurs when someone makes a prolonged and smooth sung vocal utterance, the bird would emit a rich, steady spectrum of musical sound, enabling it to pleasantly sing.

Stimulating Participants to Sing

In 2011, we launched this configuration of *Nightingallery* during a four-day series of performances at *Bestival*. *Bestival* is a popular annual music festival held on the

Figure 7.8: Participants sing using the microphone interface.

Isle of Wight which receives over 50,000 visitors each year.

The lively, raucous nature of the festival environment was an ideal place to engage participants in creative, uninhibited play (see Figure 7.8.) We found that the bird's vocal mechanism responded richly to participants' vocal experimentations, and groups of participants encouraged and rewarded each other's efforts with enthusiasm and praise. Participants could show off for their friends, or encourage their less confident peers to sing or hum into the microphone. Groups of participants often shared the microphone to sing together (Figure 3.)

Situating *Nightingallery* in creative, musically oriented contexts such as *Bestival* or the subsequent exhibition we mounted at BBC Radio Three's *Free Thinking Festival* allowed us to engage with participants who were already immersed in the aesthetic, artistic atmospheres of their surroundings. We observed participants exploring the installation in a variety of imaginative ways:

Experimenting and building confidence in their abilities Participants were often initially hesitant to sing audibly in public. Social norms do not often reward inexperienced singers for attracting attention by singing in public spaces. Several aspects of the installation were designed to encourage participants to overcome the perceived cultural barrier which made the act of singing in public somewhat intimidating.

- Participants discovered that they need not speak or sing loudly into the microphone to make the bird sing. This reduced the risk of participating in the installation, as they could sing quite quietly and remain relatively unheard by those around them. The bird would then respond with an audible birdsong corresponding to what they had sung. Shy participants could thereby allow the bird to do the performing rather than risk being heard singing themselves.

- Sung input produced a highly harmonic and rich musical result, making the reward for risk-taking behavior (singing) desirable, and tempting participants to experiment with musical sounds in order to discover how the system would react.

- Enthusiasm and praise from others in the space would encourage a participant to continue playing with the installation. Observers and bystanders would often react positively to the participant-generated birdsongs, and if no supportive bystanders were nearby, our performance team was careful to remain engaged and attentive to the installation in order to offer social feedback and reinforcement.

- The input mechanism was sensitive enough to detect the efforts of groups of singers sharing the microphone. When groups attempted to take part, often the more confident singers would gravitate closer to the microphone, while

their more hesitant peers could sing from a distance. In this way, the entire group could share in the appropriation of the experience.

- Numerous participants who were unwilling to sing themselves held their mobile phones up to the microphone, playing MP3s for the bird to translate into birdsong. This subversion of the installation allowed participants to take part in the experience in a creative way that we had not envisioned.

Interacting with external music sources Presenting *Nightingallery* within the contexts of cultural events like the *Bestival* festival, or the *Free Thinking* festival illustrated how the spatiotemporal aspects of the environment played a large role in facilitating how participants would choose to interact with creative technologies in social, shared spaces.

- If external music sources were present in the environment, participants would attempt to use the bird to sing along or jam with the music playing in the space. A particularly memorable incident happened at *Bestival* when a dedicated group of participants determined how to manipulate the timing and duration of their vocalizations in order to allow the bird to sing along with remarkable accuracy to a Bob Marley track playing over a nearby loudspeaker.

- On any festival site, it is not uncommon to overhear people singing snippets of music by upcoming or recently heard artists. When interacting with *Nightingallery* at festivals, participants often chose to sing excerpts from artists featured on the concert lineup. It was interesting to see participants using the bird in this manner, relating to their peers by referencing artists and songs which were currently relevant within the festival context.

Increasing the complexity of the musical interaction As participants grew more confident that they understood the parameters of the interaction they began to de-

vise more sophisticated ways of interacting with the bird responses, building more interesting musical structures.

- Participants often explored the possibility of creating feedback loops by aiming the microphone at the speaker playback source, so that the bird could hear it's own birdsong. This resulted in a series of increasingly distorted responses generated from the original seed phrase.

- After becoming familiar with the behaviour of *Nightingallery's* interaction system, in particular becoming attuned to the timing of the delay between participant input and system response, participants could incorporate rhythmic aspects to their interactions. Call-and-response was a popular style for these type of interactions, whereby participants would perform simple songs with the bird, timing the rhythm of their phrasing to the rhythm of the bird's replies.

- More sophisticated still was the attempt to use the bird to sing cyclical 'rounds'. An experienced singer in attendance at the *Free Thinking Festival* managed to overlay her live vocals over the bird's vocal playback in order to build up a multi-voiced song sung in the manner of a traditional round.

On-site, we helped facilitate the interactions, assuring participants it was permissable to explore, interact, and photograph the exhibition. We socialized with visitors, encouraged them to sing and play with the bird and cheered them on when they vocalized into the microphone interface. We found it rewarding to see how many participants used their mobile phones to document their interactions with the installation.

7.4 Summary

While much HCI research surrounding interactive performance media focuses on the relationship between performers, participants and audience from a perspective which positions the designer as an external observer, our method of practice places the designer inside the performance frame under investigation. Using the *Nightingallery* performance, we have explored the possibilities afforded by manipulating this placement of the designer/performer, repositioning him/her to a supporting role so as to focus attention on the interface artifact (the bird) and engage participants in social behavior.

In both interaction paradigms we have described, we use our role as mediators to stimulate and explore peer-to-peer communications amongst participants. Our situation within the performance frame allows us to co-experience these interactions within a shared social space, and affords us the ability to experience and refine our design from within its authentic context.

We designed this interaction to examine participant communication. Using an asymmetric interface, we were able to explore how participants shared their personal experiences with those around them. The mimicking, musical interaction paradigm allowed us to stimulate participants to perform for their peers. While on its surface, *Nightingallery*'s primary function is to entertain visitors with a playful, aesthetically pleasing responsive artefact, the process we have described detailing the conceptualization of this project also illustrates how interactive art pieces can be intentionally developed to interrogate specific behaviours within authentic sociocultural contexts for the purposes of further study and research.

7.4.1 Contributions

In this discussion we have:

- Illustrated how participatory performance can be used as a form of experi-

mental design, allowing us to use a creative platform to elicit and investigate social behaviours such as experience sharing and spontaneous performance.

- Introduced an artificial agent to draw social focus away from the designer/performer, so that the designer/performer could remain present within the performance/use context without dominating the investigation.

- Provided a description of social behaviours that were stimulated and observed during our experiences with the *Nightingallery* installation.

Chapter 8

Compositional Tensions

During the process of designing the interfaces and audiovisual content of the performances, we were able to observe various tensions arising as a result of our need to function as composers both of aesthetic content and of interaction design[1]. Creative choices which would have seemed valid in more traditional uni-directional performance contexts often had to be re-evaluated when consideration was given to the needs of composing art intended to be realised as a dialogue between performers and participants.

These tensions tended to surface when we considered the composition from the perspective of the novice participant's encounter of the installation. Often, matters of composition were influenced by the concerns of interaction design as well as by matters of aesthetics. We identified three main areas where usability concerns were inextricably intertwined with the aesthetics of our compositional practices, influencing our creative choices: discoverability, expressivity, and location of creative agency. The negotiations we made in order to balance our creative choices so as to satisfy both aesthetic and interactive concerns reinforced our conceptualization of the role of composer as both artist and facilitator. We were able to experiment with addressing these concerns using different strategies. Rather than considering

[1]A version of this chapter has been published. Taylor, R., Schofield, G., Shearer, J., Boulanger, P., Wallace, J., Wright, P., Olivier, P. Composing for the Interactive Medium. International Journal of Design and Innovation Research Vol.6:1, 2011.

interaction design as a limiting factor in our creative process, we suggest that in fact, it stimulated our creativity in novel ways.

By framing performances as dialogues between performers and participants, and composing the aesthetic content as a structured environment to encourage playful exploration and co-creation, we have practiced a method of composition which simultaneously considers artistic and functional concerns. Designing creative content by defining spaces within which users can interact, and considering the role of composer as s/he who determines the parameters of what can be undertaken within the boundaries of an aesthetic, creative system allowed us to develop a practice whereby we crafted a sketch of the anticipated performance experience, leaving room for its specifics to be realized by the dialogue between artist and audience at the time of performance. In this chapter, we explore how various tensions surrounding the issues of discoverability, legibility versus expressivity, and location of creative agency emerged during the process of developing the performance projects, and how those tensions informed our compositional process when authoring content for the interactive medium.

8.1 Initiating Discovery

In each performance, we had to make design decisions that would allow participants to discover the ways in which they could engage with the performance interface. Each of our performances addressed the issue of discoverability in different ways. When staging each performance, we had to ensure that people would know that there was something they were able do with the interactive interface, and that it was socially acceptable for them to enter the performance frame to join in the collaborative performance. We knew we could easily explain interaction parameters explicitly (through signage or direct conversation.) However, as our creative focus began to shift to place more emphasis on the value of ambiguity in ludic, playful

experience design, we experienced a tension in the design process as we attempted to balance the need for clarity with our desire to allow the interaction space to be discovered and explored through more natural means of intuition.

In *dream.Medusa*, initiating participants into their engagement with the performance was handled quite explicitly and straightforwardly, as the four participants were chosen before the performance began, and could be briefed about what their role would entail. I was able to speak with participants and secure their agreement that they were willing to join me on the stage to take part. Similarly, in *Nightingallery*, Shearer, Schofield and I were able to engage directly with participants if required, coaxing and encouraging them to speak to the bird. In addition, *Nightingallery's* input mechanisms also provided social cues as to how participants could engage with the installation: a conventional microphone interface invitingly positioned at mouth height, or a telephone ringing to be answered allowed participants to intuit how their interaction was being solicited.

humanaquarium, however, posed a unique set of challenges. Schofield and I were positioned inside the aquarium box, with no way of speaking with participants outside. While Shearer was outside the aquarium, able to communicate directly with participants if required, often his attentions were focussed on other staging and technical tasks. In any case, one of our investigatory questions we wanted to explore with *humanaquarium* was to see how we could incite interaction without resorting to direct instruction.

The *humanaquarium* installation's deliberate ambiguity (the featureless box with the transparent window) featured an interface bearing little relation to other interaction mechanisms found in the familiar world. People do not generally go around poking at transparent windows. And if they did, they would not expect the windows to generate sounds and images in response! As the *humanaquarium's* front screen could be viewed as some form of traditional proscenium, we expected

that the natural instinct of audience members would be to watch the performance inside from a respectfully distant vantage point. Initially we considered explicit methods of indicating to participants that the interface was touch-sensitive, but resorting to such blunt forms of instruction such as signage seemed unacceptably stilted and mechanical.

As discussed in Chapter 6, Section 6.4.2, we quickly realised, however, that we, the performers inside the box could readily establish eye contact and gestural communication with the observing audience. Beckoning participants closer, reinforcing their actions with encouraging motions and facial expressions, and modelling for them the interaction of placing hands upon the glass resulted in them rapidly gaining an understanding of their role in the performance. Children in particular were highly responsive to our coaxing, responding almost universally to the placement of my hand upon the glass by mirroring my gesture, making contact that would have been physical had it not been for the separating barrier of the interactive screen.

Our presence performing inside the *humanaquarium* structure appeared to inhibit participants from freely instigating interaction, likely due to the fact that they had to get very close to us to interact, and were wary to do so without social reassurance (in the form of eye contact, welcoming posture, or gesture.) This was not observed during *Nightingallery* performances, as during *Nightingallery*, visitors would often initiate conversation with the bird animatronic without requiring any stimulation or prompting from our performance team.

8.2 Legibility versus Expressivity

In addition to surmounting the initial obstacles of encouraging participants to enter the performance frames and take part in the performances, we faced a second challenge when designing each composition. We found there was a distinct tension between our desires to create complex, nuanced, and rich performances, and

the practical need to make the results of participant interactions legible enough that participants could understand how to engage with the systems.

We intentionally designed performances so that participants were not required to fully understand their agency in order to appreciate it. Although we did not need each participant to be able to directly identify each distinct parameter their actions controlled, the degree of legibility needed to be such that they knew they were doing something, and that would stimulate their curiosity to discover further what that something was and how it could be controlled. Throughout the development process of each project we had to revisit the balance between complexity and legibility in order to produce compositions and interaction mappings that resulted in participant satisfaction. As participants began to develop an understanding of how their actions influenced the performance, we could see them repeating motions and testing the system responses, clarifying their understanding of what they could make the system do. In *dream.Medusa*, participants repeated various motions of the controllers and analyzed their effects. In *humanaquarium*, participants repeated sequences of actions across the screen, exploring their consequences, and in *Nightingallery* participants tested the boundaries of the bird's responsivity by exploiting their own vocal range. In each performance, we had to consider the degree of expressivity we should allow participants to control, and define the boundaries of the interaction space they would explore.

We particularly struggled with this balance during the composition of our earliest work, *dream.Medusa*. In *dream.Medusa* each participant controlled a unique aspect of the visualization (two people manipulating the colour intensity of independent video streams, one controlling the blending mechanism which combined the videos into a composite image, and one more controlling an edge detection effect which manipulated the final video feed.) While allowing participants to manipulate these effects simultaneously produced the most visually stimulating and complex

effects, we had to take care that each participant had enough of a chance to interact independently so that s/he would not become frustrated, unable to understand how his/her actions affected the shared visualization. If we allowed each participant to interact independently, the effects of their contributions were much more legible and easy to understand, however, participants soon became bored, as they rapidly exhausted the limits of their effect's expressivity.

As each person could control only one aspect of *dream.Medusa's* visualization, they had only the boundaries of the visual parameter's predefined limits to explore. We wanted to create a more expressive interaction space for the *humanaquarium* performance, but recognized that we had to be mindful of legibility issues. Additionally, while we wanted to allow the interactions to be sufficiently nuanced as to permit a skilled and patient participant to experience increasing degrees of mastery over their contribution to the performance, we were cautious about allowing them to make "mistakes", concerned that this could scare them away from further investigation. This presented a compositional challenge: in order to enable virtuosity, the degree of expressiveness and flexibility provided by the interface could likely also allow users' experimental and inexperienced contributions to be unpleasant or inaccurate due to inexperience. How could we avoid this, while still allowing participants a wide expressive range? This became a major focus of the design investigation surrouding *humanaquarium.*

In laboratory experimentation we initially implemented *humanaquarium's* window interface as a large synthesizer, allowing the location of each touch to trigger the onset of specific notes. This very direct mapping between action and response was both satisfying and unsatisfying - essentially modelling the interactive screen as a large vertically arrayed keyboard allowed participants very direct control and expressive variability, but diminished for us the experimental, ludic nature of participant exploration and discovery that more subtle forms of interaction allowed us

to achieve. While allowing participants to literally play note for note across the *humanaquarium's* surface could allow patient and determined users to play the interface quite expressively, it could also permit elements of cacophony and discord to be introduced by unskilled or malicious players, something which was not desirable for our design. We wanted participants to be intrigued by the richness of *humanaquarium's* responses - we didn't want them to become bored by a system which was too simple - but we were aware that by making the mappings overly intricate we would only succeed in making the interface too confusing and discordant to be harmoniously controlled.

We settled upon a primary method of mapping *humanaquarium's* touch to audio, allowing the location of participant touches to affect the tracking multiple Ableton Live synthesizers, and the parameterization of real-time audio filters applied to the performance of the musicians inside the box. This meant that participants were able to intentionally modulate dynamic shifts in the timbre of the audio soundscape and bring various instrumentations and melodies to the foreground of the orchestration. This strategy prevented participants from making any undesirable contributions (as their contributions were bounded by the pre-defined compositional space) but allowed multiple touches to affect multiple aspects of the soundscape simultaneously, allowing one or more users to build up a rich layer of control over the resulting sound simulation. To promote legibility while permitting expressivity, *humanaquarium* performances encompassed both straightforward mappings (eg. spotlights would change colour when participation was initiated, and touches on the screen would manipulate a superimposed graphic that followed the user's fingers) in addition to the more subtle, nuanced interactions involving layers of synthesized audio and sound.

When we developed the *Nightingallery* interface, we attempted to create an interaction paradigm that was similarly reassuring to that of *humanaquarium* –

no matter what kinds of sounds participants made into the microphone, *Nightingallery's* bird animatronic always emitted a melodious, harmonic stream of song. We understood, however, that the more we made the performances robustly safe with restrictive boundaries upon what participants could do, we reduced the potential for creative participants to approach virtuosity with the performance interface. We continually struggled with determining how best to enable expressivity while ensuring adequate control over the aesthetics of the performance.

8.3 Location of Creative Agency

The tension we felt when addressing issues of interface expressivity essentially related to our need to determine how best to share creative agency amongst the composed content, the live performers, and the interacting participants. As composers, our efforts to manipulate the locus of creative agency within the performance were implemented by defining the boundaries of the interaction space and the transaction mechanisms by which participants could influence the parameterised audio-visual content as well as the improvised responses of the performers within the installation.

dream.Medusa was structured with the agency very much centralized on me (the performer) and our the predefined, prerecorded elements of the composition. Participants' agency only extended to the limits of an interaction space which was controlled both temporally (participants controllers were only activated during specified points during the performance) and dimensionally (participants had only one axis of control over which they could affect the visualization.) While allowing "our" contributions (performances and audio-visual material) a significant amount of agency in the determination of the performance outcome had aesthetic benefits, since we were able to use our skills as performers to contribute complex and sophisticated musical content to our productions, it limited the manner in which

participants could engage with the performance experience, as their co-creational power was restricted by the relatively small way in which they could control the shaping of the performance.

In contrast to this, when conceptualizing *humanaquarium*, we initially envisioned *humanaquarium's* creative agency to be placed nearly wholly on the participant interaction, with the live performers inside functioning in a reactive role, improvising in response to the participant-driven manipulations of audio-visual parameters. This was reflected in the initial format of our first composition, Mariana, which, as described in Chapter 6 section 6.3.2, was extremely open in form. Choosing to explore with a highly indeterministic form of composition, Mariana's soundscape contained only sparsely detailed pre-composed content, highly reliant on participant manipulation of a widely varying audio-visual parameterization. This resulted in a performance that was extremely responsive to participant intervention. To further place the location of creative agency upon the participants and away from the live performers, we experimented with participant-driven audio filters that were intentionally difficult for the performers to control (eg: arpeggiators whose repetition rate fluctuated wildly based on participant intervention, vocal filters applying high levels of distortion.) This forced the performers to sacrifice control in favour of allowing participants to shape the development of the performance.

Not surprisingly, this resulted in a mixed response: while we were stimulated as performers and composers by the creative challenge of improvising within such a variable soundscape, our instincts (honed from years of traditional performance) tended to resist this strategy due to our desire to perform interesting musical lines and improvisations. In our next performances, *Darkshines* and *Phantasmagoria*, we featured a distinctly more rigid structure and complex pre-composed content even attempting to introduce rudimentary narratives into the production, and more explicitly casting the humanaquarium as a virtual theatre set.

Upon review of our documentation of a year's worth of *humanaquarium* performances, however, we were interested to re-evaluate this compositional choice. While we concurred that a more structured form of performance allowed us to execute more polished and theatrical-style productions (and granted us personal satisfaction as performers and musicians) revisiting the early performances from the perspective of a temporally displaced and external observer allowed us to more greatly appreciate the compelling nature of the participant-driven performance enactment that was afforded by our initial treatment of the humanaquarium as a largely blank canvas for participant improvisation. We admitted that our return to more traditionally structured and performer-driven compositions was in some ways a step backwards towards the highly structured nature of *dream.Medusa*, partially influenced by our own personal desires to acquit ourselves well as musicians - and losing, in some ways, the focus of sharing agency with the audience by placing too much value upon the technical merit and aesthetic quality of our own musical contributions.

In *Nightingallery* we experimented with relinquishing primary agency as performers within the performance frame, instead functioning only in a peripheral capacity assisting an animatronic character who interacts with participants. The two interaction paradigms we defined for *Nightingallery* each shared agency between the bird characer and the participants in different ways. Under the telephone-based interaction schema, the bird character initiated and engaged the participants in convoluted conversation. While the bird character initially held agency in this scenario, participants gained increasing control of the conversational narrative due to the fact that the bird character's conversation consisted heavily of mimickry, making it possible for participants to manipulate his behaviour. In the microphone-based setup, the bird functioned solely as a mimic, allowing participants to control the encounter from the outset, leading the bird in repetitive speech and song.

In both cases, participants had much more freedom to define the terms of the interaction through the narratives they created with the bird than they did during *dream.Medusa* or *humanaquarium* productions, in which we as composers and performers presented participants with a much more constrained interaction space within which to explore. Our experiences with the project illustrated both positive and negative aspects of this manner of configurtion. Admittedly, the unstructured nature of the work meant that often, encounters between the participants and the bird character could develop in a rather mundane fashion. If participants' contributions were boring or unenthusiastic, the bird's responses would be relatively uninteresting in reply. A participant had to choose to exploit their agency and engage creatively with the bird automaton in order for the full potential of the installation to be realised. When participants did commit fully to the interaction, however, such as in the examples discussed in Chapter 7, Section 7.3.3 where participants chose to sing rounds with the bird animatronic, engage in call-and-response, or manipulate the speaker and microphone setup so as to set the bird executing complex feedback loops, the potential power of their agency within the performance scenario was revealed. While keeping relatively tight hold of the agency within the *dream.Medusa* and *humanaquarium* allowed us to maintain a greater degree of control over each performance's development, allowing participants greater freedom in their encounters with *Nightingallery* allowed greater opportunity for spontaneous, creative, participant-led engagement with the work.

8.4 Discussion

Our experience in developing the participatory performances led us to reflect upon the role of the composer when creating for the medium of interactive aesthetic experience. We approached the composition of participatory art as the definition of boundaries, transaction mechanisms and exploration spaces, allowing us as com-

posers, to structure and facilitate dialogues with participants that formed the emergent enactment of each creative experience. As discussed, while developing the works, we identified various centres of value which sometimes came into conflict, causing creative tension in the design process. Recognising these tensions and exploring how they could be resolved through different aesthetic or technical design interventions has provided creative stimulus for us in our work.

In our practice, the concerns of the interaction designer are inextricably intertwined with those of the content composer, as we approach them holistically during the design and implementation phases of development. While practicality designates that it is sometimes necessary to alternately prioritize the concerns of one aspect over the other in order to address specific aspects of implementation or creative desire, recognizing the inherent interdependence between interactivity and aesthetics has fundamentally shaped our approach to compositional development. We have attempted to ameliorate issues relating to interaction design by adjusting the aesthetics of the content, and conversely, have found inspiration through experimentation with creative content in response to issues that emerged during the refinement of interaction strategies.

By performing alongside participants, and literally experiencing the effects of our design interventions 'from within', we have been able to examine the performance/use scenario not only from the removed vantage point of composer and evaluator, but also firsthand, from the immediate perspective of improvisational, interactive performers. This has allowed us to form a personal, somatic connection to the works under investigation, accessing experiential acuity acquired through the long-term practice of our craft in order to engage and understand the nuances of the shared experience. As described by Schiphorst [86], accessing personal *connoisseurship* over body-based, somatic activity such as that which occurs during collaborative, shared performance allows the creative practitioner to leverage

performance-honed skills in order to better interpret the shared experience. As improvisational performers, our firsthand experience sharing the performance frame with participants let us use the intuitive methods of ongoing observation and enhanced discernment (available as part of the skillset of our performance-based craft) as tools with which to examine and develop understanding of the interactive performance experience. Through our personal, visceral connection to the composition and enactment of the performance works, the areas of tension described in this chapter were naturally identified and explored as we reflected upon the conflicting centres of value which tugged for our attentions during the course our ongoing creative practice.

We suggest that the identified areas of tension (discoverability, legibility versus expressivity, and location of creative agency) are not exclusive to the realm of participatory performance. By exploring these issues through the medium of interactive public art we can investigate creative engagement with playful public systems, resulting in increased understanding of social interaction with technology that could be applied to a broad range of domains.

Chapter 9

Conclusion

This thesis presents the results of longitudinal, autobiographical, practice-based research in which myself and a team of collaborators have explored social interactions with publicly situated technologies by firsthandedly taking part in a series of professionally exhibited participatory performances. We have presented a methodology of design whereby the creation and refinement of interactive performance scenarios has allowed us to conduct a trajectory of development, investigating experience 'from within' by using our skills as creative practitioners positioned as designer/performers within the authentic use context of public exhibition.

We have characterized our manner of practice as *self-situated*, as we ourselves experience our design interventions firsthand alongside participants, and *longitudinal* so as to leverage the potentials for understanding revealed through an extended time period over which *sense-making* of experience takes place. Our manner of exploration allows us to engage and reflect upon the *dialogues* we experience alongside participants, both through direct contact during the performances as well as through a long-term practice of *refining and evolving our performance designs* in response to participant contribution, which we facilitate by ensuring our designs *remain open to participant-driven interactions* which we look to as inspiration for design refinement. We are also mindful of the influence of *place* upon experience, staging the performances in a variety of venues so as to explore the socio-cultural

impact presentation context has upon the enactment of the works.

Our investigatory approach draws upon existing literature examining interactive media from an experience-centred perspective, notably McCarthy and Wright's pragmatic framework for considering encounters with technology as consisting of an interplay between *sensual*, *emotional*, *spatio-temporal*, and *compositional* factors [71]. As well, we leverage Sheridan *et al.*'s characterization of the tripartite interactors (performers, participants and audience) who comprise the performance frame of interactive performance media [92][93], providing us with a contextual foundation from which to discuss the encounters and relationships observed when exploring the interactive performance in a pragmatic, experience-centered way.

Our particular method of practice, however, builds upon Sheridan's tripartite framework, adding another interaction role into the performance scenario: the role we have fulfilled when taking active roles within the developing performance, functioning simulataneously as designer/performers. By deliberately taking active roles within the performance scenario in order to allow our experience to shape and evolve an ever-developing design, we allow ourselves to explore firsthand the relationship between composer and composition, mindfully engaging in dialogue in multiple ways during the refinement of an interactive work. We can propose and respond to improvisational, collaborative content during performance enactment, we can directly engage with participants, media and critique before and after the presentation of the works, and, most broadly, we can re-shape design and content in response to ideas which emerge from these dialogues encountered over the course of repeated performance experience.

By extending the interaction model to include and address the relationship of the designer to the performance design we have identifed and explored an additional relationship which is critical to McCarthy and Wright's interpersonal, emotional thread when considered within the context of the interactive performance

experience. Exploring our practice of 'designing from within', we have examined how this thread encompasses the relationship between a creator and his/her work, as well as the relationship beween the creator of a work, and those who experience and encounter it during public exhibitions.

9.1 Contributions Summary

This thesis makes several contributions to the growing body of research which looks to art practice to inspire HCI investigation.

- We have described our practice of *designing from within*, contextualizing it with relation to other experience-centered HCI approaches, considering experience from a holistic, pragmatic perspective which accounts for the socio-cultural factors that impact an encounter with technology

- Using the *dream.Medusa* performance to frame the discussion, we have applied McCarthy and Wright's pragmatic framework theory to analyze the interactive performance medium. We explore the medium's sensual, emotional, spatio-temporal, and compositional *threads of experience*, its potential for stimulating dialogical interaction, and the stages of sense-making that are experienced when engaging with an interactive performance work

- Evaluating our experiences with *dream.Medusa* via participant interviews and our own self-reflection, we use McCarthy and Wright's threads of experience framework to structure the design process of the *humanaquarium* performance interface. Using *humanaquarium* we investigate engagement with creative media via a long-term process of performance, autobiographical evaluation, and iterative refinement of an evolving design.

- Through the *humanquarium* performance, we explore *stage fright*, *legibility* and *collaboration* in participatory performance, and suggest how participant

engagement with ludic technologies situated in public spaces may be improved by addressing issues related to these concepts.

- By developing a third performance, *Nightingallery* we illustrate how interactive performance can be structured to examine specific research questions. In *Nightingallery* we create a platform from which to specifically explore two investigatory goals: how participants share experience amongst their peers, and how we can best stimulate participants to overcome stage fright or shyness to engage in playful, creative behaviour in public spaces. We provide examples of how *Nightingallery's* interaction paradigms allow us to elicit and observe these social behaviours.

- We identify and discuss several creative tensions which emerged through our experiences with the works: *discoverability*, *legibility versus expressivity*, and *location of creative agency*. By reflecting upon our performance practice, we examine how each of these centres of value can be manipulated in creative interaction design.

9.2 Application to Future Work

The authentically 'public' nature of our performance-based explorations imbues participation with motivating factors obviously different than those which would occur were physically similar interactions undertaken and studied in traditional laboratory settings. People who take part in our performances know they are being watched. They know that their experimental explorations with our intentionally ambiguous systems are being observed by the viewing public, providing them with incentive to appear competent, skilled, or even if possible, masterful in their visible interactions with the performance interface.

We liken these incentives to those experienced by individuals within more gen-

eralized public scenarios, returning to Goffman's interpretation of the presentation of self, whereby he asserts that in the presence of others, a person will instinctively try to shape the impressions others form about him/her through his/her own chosen actions – making public life a performance, of sorts, in which participants attempt to control the presentation of themselves, simultaneously observing the performances of others in order to make sense of the social order [40]. Considered in this manner, any action taken in public view can be considered to share some experiential qualities with more formalized interpretations of performance. The authenticity of public experience can only be approximated in the laboratory, making our method of evaluating experience within the legitimate use context particularly appropriate when pragmatically assessing social interactions with technology.

While we have explicitly conducted our investigations using literal performances to stimulate and explore social interactions with technologically mediated playful applications, we suggest that the understandings we have gained via the shared performance medium could be used to inform the future design of more generalized applications to which similar sociotechnical considerations apply. In particular, recent rapid advancements in gesture-recognition and motion tracking systems (such as the popular Kinect interface) faciliate unencumbered, embodied interactions whereby participants must do no more than come into range of the motion-tracking sensors in order to interact with responsive systems. As such systems present appealing possibilities to commercial entities ever-searching for ways to capture public attention and draw the interest of passersby, much current research deals with the installation of gesture-based control systems that enable pedestrians to interact with eye-catching responsive applications situated in public venues such as shopfront windows, exhibition halls, and other gathering spaces [54] [95].

Additionally, open-ended methods of soliciting participant-driven interaction with ludic, playful systems such as the ambiguous interfaces implemented in our

performance environments provides an interesting vantage from which to explore how participants would choose to approach an unfamiliar, mysterious technology. By being open to participant-led, exploratory interaction with systems which do not conform to conventional control paradigms, we are provided with opportunity to observe a variety of spontaneous interactions triggered by participants' intuition of how a novel interface *could* or *should* work. If stimulating, these observations could be used to propose and refine design strategies for novel interaction schemes suitable for non-traditional interfaces.

Interacting with ambiguous, playful systems installed in high-traffic public spaces certainly requires participants to engage in exploration, experimentation, and accept the risk of possibly making errors or exhibiting a lack of interface mastery in conspicuous view of others. We propose that the issues we have identified surrounding engagement with our systems (issues of discoverability, legibility versus expressivity, and location of creative agency) would all still be applicable to such publicly situated, playful applications, regardless of whether or not they are literally 'performances'.

The next step planned for our research trajectory is to explore how the practice-based research described in this thesis could transfer to more generalized scenarios where technology is experienced in social, public spaces. As an intermediary stage of development, our design team plans to structure a series of performances exploring gesture-based interaction with motion-sensing systems. By evaluating our performance experiences and using our insights to inform design for the distinct yet closely related use context of unmanned installations which can remain active round-the-clock in public venues, we plan to use performance practice to propose an interaction design for an installation situated within a storefront window on a public street.

9.3 Concluding Remarks

As described at the outset of this work, the research described in this thesis was inspired by our interest and excitement upon observing how participants engaged in social, creative behaviour during our early experiences with the *dream.Medusa* project. After discussing the potential for using participatory performances such as *dream.Medusa* as a way to investigate how participants engage with technology in highly visible public spaces, we decided to take a more deliberate approach to exploring how users experienced their encounters with interactive performance systems, with the intention of using the results of our investigation to inspire further design.

The research has resulted in many positive outcomes, including the creation and refinement of the two subsequent works, *humanaquarium* and *Nightingallery* – both of which have been critically well received in a variety of esteemed performance and exhibition venues. In addition, we have produced numerous publications discussing the works and the methodology of our practice-based research, and contributed to the development of two internationally attended workshops examining the relationship of live performance to experience-centered design.

By using performance both as the method of presenting the results of our design research as well as the method of investigating the success of our proposed interventions, we have been able to intertwine dual expertise from the fields of creative art and interaction design. We have reduced the distance between investigatory action and evaluative reflection, allowing us to combine research with practice in order to further our understanding of complex, nuanced, shared human experience. Structuring performances as frames for investigation of social phenomena has allowed us a non-traditional manner of interrogating issues of creative agency, locus of creative control, the relationship between artist and artefact, and playful, participatory engagement with ludic systems.

It is my hope that this contribution to the growing field of interdisciplinary research which leverages creative practice as a means to stimulate and explore human experience conveys my firm belief that aesthetics and the arts allow us to unlock and encourage aspects of social behaviour which might otherwise remain difficult to untangle, hidden as they conventionally are behind cultural propriety and public restraint.

It is through my experiences as a performer that I am most readily able to intuitively express and identify how I relate myself to those around me. By allowing people space to play – to explore, experiment, and take chances – and by striving to understand how we interpret one another when we enter into a collaboration in order to engage in ludic, creative activities, I hope that the method of practice I have described enables us to evaluate our encounters in a manner which embraces the acuity of that which we can only fundamentally know through our own lived and shared experience.

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Appendix A

Technical Information for *dream.Medusa*

A.1 Max/MSP Software Overview

dream.Medusa is implemented in Max/MSP, using Jitter to generate the visualizations. There are two main functionalities in the software:

- The voice visualization system
- The mapping between Wiimote rotations and video manipulations

A.2 Voice Visualization System

As described in Chapter 5, Section 5.2, *dream.Medusa* reuses a system of voice visualization first created for a previous performance piece, *Deep Surrender*[104][103].

Using the `fiddle~` object developed for Max/MSP by Puckette *et al.*[78] we use a fast fourier transform to analyze and extract the harmonic spectrum of the vocal stream. To map the spectrum to a resulting colour value, we identify the fundamental frequency, plus the first two overtones. The amplitude of tone present in these three partials are mapped to the Red, Green, and Blue components of a Max colour selector object (see Figure A.1.) The values of the partial amplitudes are scaled so that the impact of the overtones has greater weight in the resulting output colour, as the amplitude present at each the overtones is substantially less than at the fundamental. Without the scaling factors, it can be difficult to see a measurable colour difference between tone qualities.

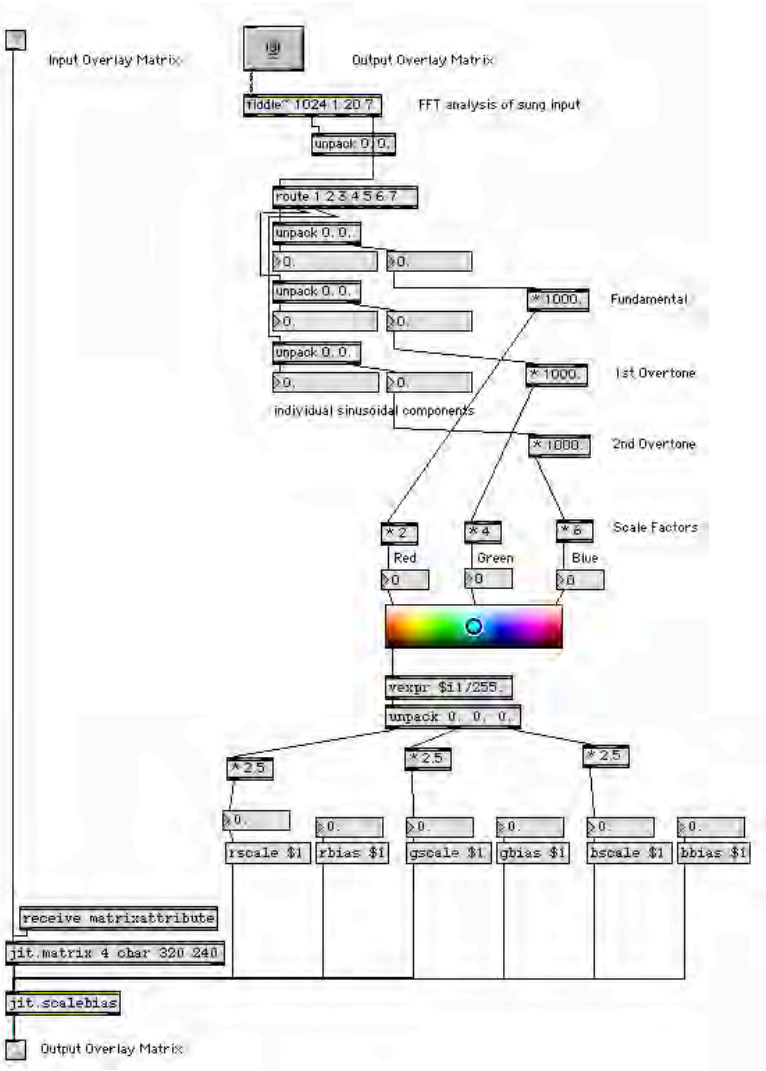

Figure A.1: Visualizing vocal timbre by mapping to RGB

As we explain in Chapter 5, Section 5.2, sharply focussed sounds (such as the closed vowels /i:/ as in 'free' or /u:/ as in 'fool') produce bright, reddish colour outputs, while broader sounds (such as the open vowel /a:/ as in 'car') produce cooler, green or blue colours (refer to Chapter 5, Section 5.2 for a discussion surrounding the acoustic basis for this phenomenon.)

The voice-mapped-to-colour RGB output is used to adjust the hue of a video overlay (containing a drifting jellyfish image) which appears when I sing. The coloured overlay is chromakeyed onto a background image, resulting in a composite video wherein a jellyfish drifts across the screen in response to my vocalization. By subtly manipulating the timbre of my vocal production, I can make dramatic, directly responsive adjustments to the colour of the overlaid image which foregrounds the composite projection displayed on the screen.

A.3 Wiimote Control Mappings

Using Akamatsu's `aka.wiimote` plugin for Max/MSP [66] (see the help file pictured in Figure A.2 illustrating the functionality of the `aka.wiimote` object), we can make a Bluetooth connection to Wiimote devices and obtain orientation data from the 3-axis accelerometers contained inside them. The `aka.wiimote` plugin also provides support for activating the vibration functionality of the Wiimote device, enabling us to provide tactile stimulation to participants.

During the course of the performance, we use the vibrating function to indicate to participants that their Wiimote has been activated and that they can interact with the visualizations. Each Wiimote is mapped to a different aspect of the visualization. Figure A.3 shows how we have mapped each Wiimote's Y axis orientation data to Jitter functionalities. This allows participants to control edge detection and image saturation on two videos, plus mix the videos into a composite video that is played back on the large projection screen.

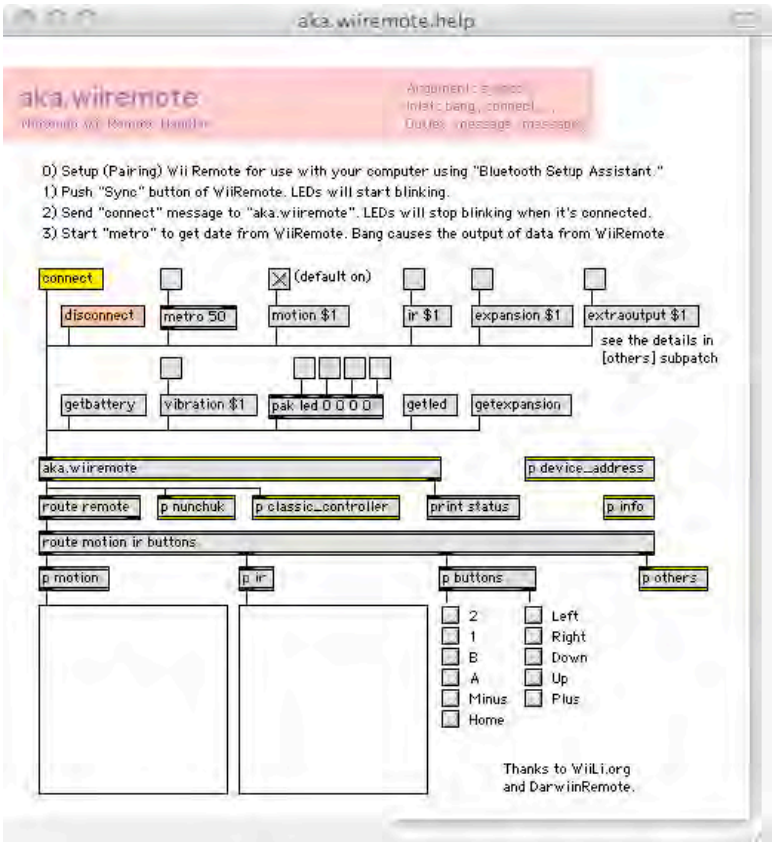

Figure A.2: *aka.wiiremote* object (help file)

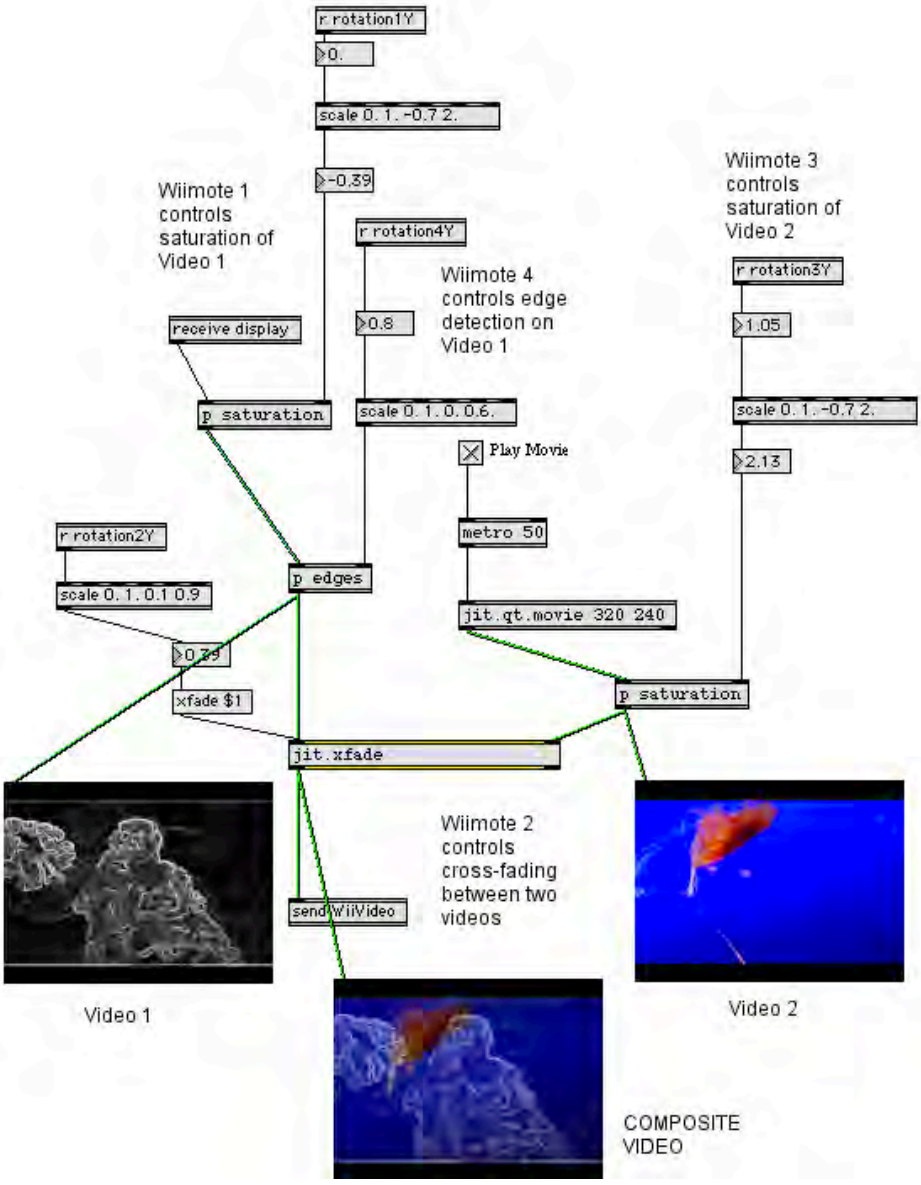

Figure A.3: Wiimotes control elements of the visualization

Appendix B

Technical Information for *humanaquarium*

B.1 Max/MSP Software Overview

humanaquarium is centrally controlled using a Max/MSP interface. The Max/MSP interface receives touch data from Community Core Vision, translating touches on the screen into controls that manipulate audio-visual content via Jitter and Ableton Live. There are three main aspects to the software:

- Functionality that translates touches into meaningful control data
- Video manipulation via Jitter
- Audio manipulation via Ableton Live

B.2 Translating touch into Control Data

Multitouch data from the Community Core Vision system is transmitted to Max/MSP via a UDP connection. While CCV supports multitouch, we have chosen to average the locations of touches on the screen to come up with an X,Y coordinate pair used to control the audio-visual manipulations. This mean X,Y location is represented visually on the backdrop of the screen. Participants can see how pressing on the screen drags the icon (associated with the control location) towards their hands. Averaging the touch inputs and working with one location as a control parameter allows us to avoid confusion that might arise from responding to the large amount

of multitouch data generated by multiple participants. Manipulating a single control location also ensures that we slide gracefully across the parameterizations, as the averaging function used to determine the mean location naturally results in the control location gliding from one point to the next, as new touch data pulls the mean value towards the new location on the screen.

We translate this averaged touch input value to MIDI control data under one of two schemas at various points during the performances:

- We could treat the window as one large control region, X and Y. In this case, we have two midi control values that are used to manipulate Jitter and Ableton Live effects: one corresponding to the mean X position, and one corresponding to the mean Y position (see Figure B.1). The values along the X and Y axes were translated into MIDI values from 0-127, allowing participants to play the window surface like a standard MIDI touch pad controller.

- Alternatively we could partition the screen into discrete control regions. For our purposes we found that two side-by-side control regions worked well, but that creating any more divisions was unproductive, as the middle regions of the screen were rarely used in any case. Under the two-region setup, information could be sent on four MIDI controls – and X and Y value from the left hand side of the screen, or an X and Y value from the right side of the screen (see Figure B.4 This setup allowed us to make more complex controls, such as mapping one half of the screen to manipulate synthesizers, while the other half could be mapped to control vocal effects.

See Figures B.3 and B.4 for the Max patches associated with the partitioning tasks.

B.2.1 Video Manipulation via Jitter

The video manipulations are handled in the same way as the visualizations described in Appendix A, as the voice visualization system is identical to that used in *dream.Medusa*.

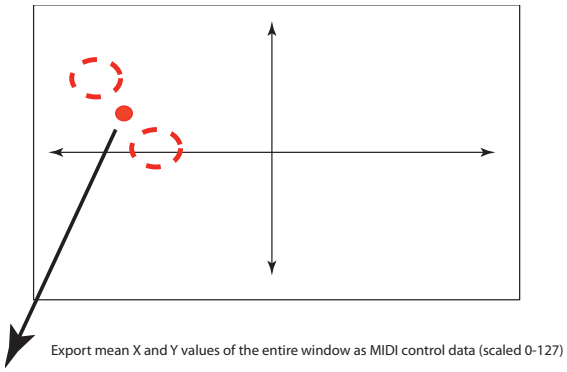

Figure B.1: Treating the pane as one control region

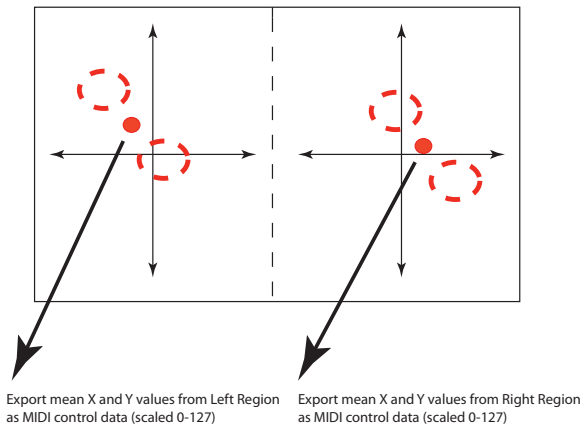

Figure B.2: Treating the pane as two control regions

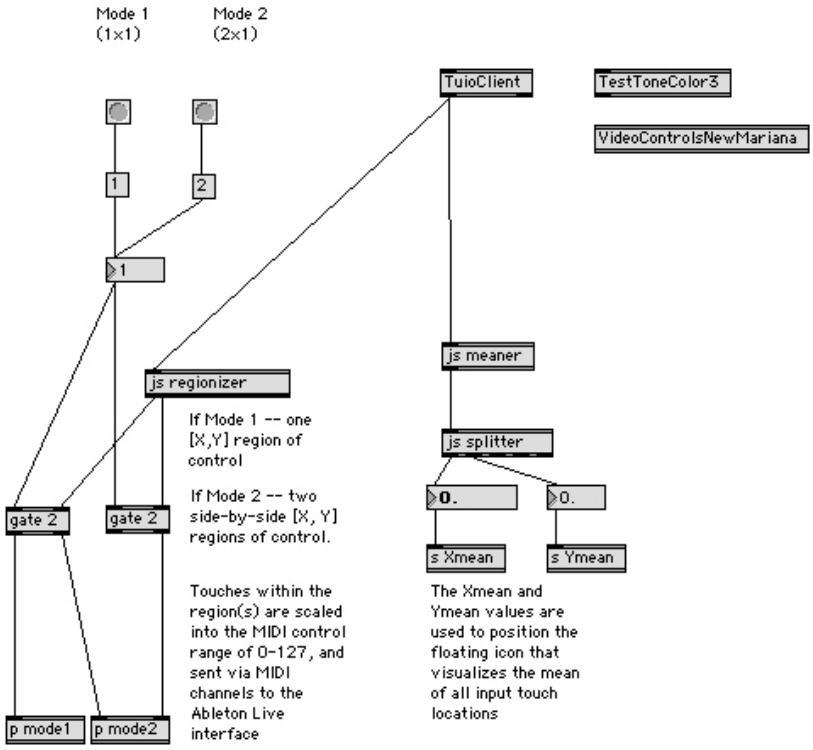

Figure B.3: The main control window

Figure B.4: Mapping the touches into two side-by-side [X,Y] control regions

In addition, a small video icon (a jellyfish, or a chandelier) is overlaid onto the video stream, mapped to the location of the mean X,Y value of all touches. As the mean value drifts towards a participant's hand, the icon glides across the visualization to reflect the new touch location. This helps increase legibility, as participants can see how their touches are affecting the control system.

B.3 The Ableton Live Audio Control System

Each *humanaquarium* composition is configured as an Ableton Live project. Figure B.5 shows an example configuration, used in the *Mariana* performance. The labelled components of the diagram illustrate how the flow of control is executed in Ableton Live to dynamically manipulate audio. We step through the flow of control to illustrate how it works:

Mapping *humanaquarium*'s MIDI output to Ableton MIDI control inputs (*Labels 1 and 2*)

- Output reflecting the position of touches on *humanaquarium's* vertical Y axis is sent as MIDI values on MIDI control number 1 (Label 1)
- Output reflecting the position of touches on *humanaquarium's* horizontal X axis is sent as MIDI values on MIDI control number 2 (Label 2)
- These MIDI controls can then be used to manipulate effects that are applied to tracks in the Ableton Live synthesizer, allowing the *humanaquarium* screen to function like any standard MIDI control device

Example: Controlling an arpeggiator (*Labels 3-7*)

- MIDI control 1 is mapped to control the repetition rate and volume EQ of an arpeggiator (see Label 3) applied to a track that takes input from a digital piano (shown at Label 4) played by Schofield during the performance.
- The lower portion of the Ableton screen displays the chain of effects which affect the arpeggiator.

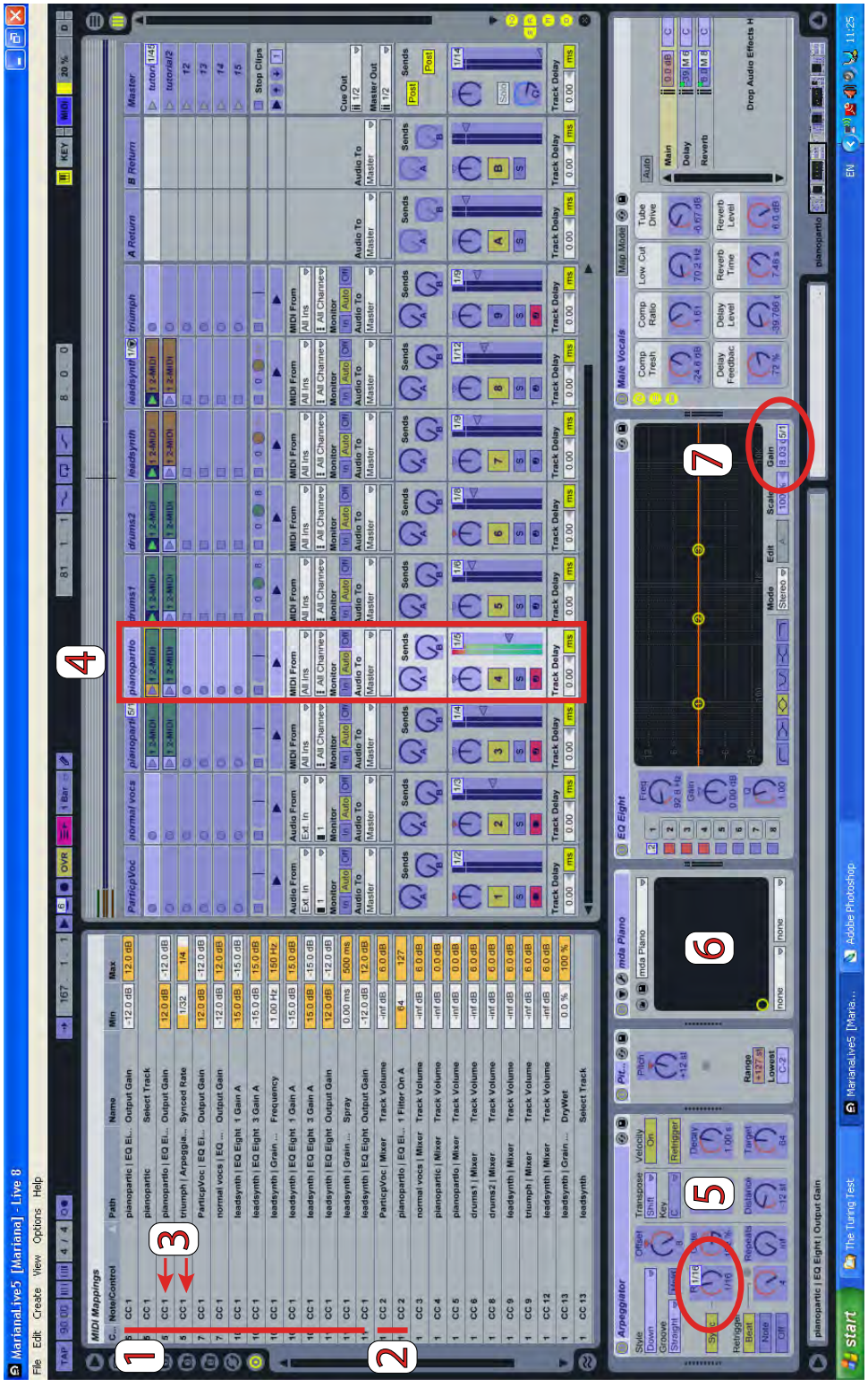

Figure B.5: Screenshot of Ableton Live, configured for *Mariana*

- Each note played by Schofield is used as a seed to the arpeggiator function. The arpeggiator generates sequences of MIDI note values that harmonize with and augment Schofield's playing. The repetition rate (meaning the speed at which the arpeggiator outputs a sequence of notes based on Schofield's seed note input) is controlled by the placement of touches across *humanaquarium's* Y axis. The higher the location of the input touch, the more rapidly the arpeggiator will generate the augmenting stream of MIDI notes (Label 5)

- Each item of MIDI note data output by the arpeggiator is sent to the `mda Piano` MIDI instrument (Label 6)

- Touches on the *humanaquarium's* Y axis then affect the volume level of the piano track's playback. The higher on the Y axis the touch data resides, the louder the arpeggiated piano track will be played back (Label 7)

This example illustrates how *humanaquarium* controls one track of the Ableton composition. The MIDI control values can be used to control any number of tracks (including vocal effects, synthesizer timbre, etc) simultaneously, allowing participants to manipulate multiple aspects of the composition.

B.4 Compositions and Mappings

In this section we describe the audio-visual mappings of each *humanaquarium* composition. Each composition consists of a number of phases, each of which maps participant input to a different set of audio-visual parameters and responsive imagery. During performances, Schofield and I decide when to transition between the phases of the performance depending upon the mood and energy level of the audience. We can dynamically move back and forth between phases, letting us easily vary the performance's length based on the requirements of the presentation format.

Table B.1: *Mariana* Control Mappings

Mariana
Phase 1 • Image of jellyfish swimming in a tank • Vertical axis, timbre ranges from low (bass, rumble) to high (sparkle, crystal) • Touch affects colour of overlay, jellyfish glides to centralize on location of touch *Phase 2* • Image of textured watery background • Vertical axis, timbre ranges from low (bass, rumble) to high (sparkle, crystal) • Touch affects colour of background, jellyfish glides to centralize on location of touch • Voice visualization overlay, large jellyfish appears/disappears with amplitude of voice, changes colour in response to timbre *Phase 3* • Imagery of jellyfish in tank partitioned in half so Taylor and Schofield each sit in front of a different colour Touch affects colour of background, jellyfish glides to centralize on location of touch • Touches in front of Schofield affect repetition rate of Schofield's MIDI controlled arpeggiator (vertical axis, higher touches result in faster repetition rate) • Touches in front of Taylor affect reverberation affect applied to voice (vertical axis, higher touches result in more reverberation) • Voice visualization overlay, foreground of image brightens to reflect amplitude of voice, changes colour in response to timbre

Table B.2: *Darkshines* Control Mappings

Darkshines
Phase 1 • Black screen, simple synthesized rhythm. • Touches on screen trigger a synthesized overlay of sound which disappears when touch is discontinued • Touches on screen trigger a jellyfish image that glides to centralize on location of touch *Phase 2* • Image of textured watery background • Vertical axis, timbre ranges from low (bass, rumble) to high (sparkle, crystal) • Touch affects colour of background, jellyfish glides to centralize on location of touch • Voice visualization overlay, large jellyfish appears/disappears with amplitude of voice, changes colour in response to timbre • Left-right position of touch pans Taylor's voice between two stereo speakers *Phase 3* • Imagery of jellyfish in a tank • Touch affects colour of background, jellyfish glides to centralize on location of touch • Vertical axis, timbre ranges from low (bass, rumble) to high (sparkle, crystal) • Voice visualization overlay, foreground of image brightens to reflect amplitude of voice, changes colour in response to timbre • Left-right position of touch pans Taylor's voice between two stereo speakers

Table B.3: *Phantasmagoria* Control Mappings

Phantasmagoria
Phase 1 • Black screen, simple synthesized rhythm. • Touches on screen trigger a synthesized overlay of sound which disappears when touch is discontinued • Touches on screen trigger a chandelier image that glides to centralize on location of touch *Phase 2* • Imagery shows two stylized frames behind Schofield and Taylor • Vertical axis, timbre ranges from low (bass, rumble) to high (sparkle, crystal) • Touches on the screen trigger images of the Phantom of the Opera and Christine Daae to appear in the projected frames behind Schofield and Taylor • Chandelier glides to centralize on location of touch *Phase 3* • Imagery of Opera Garnier staircase • Vertical axis, timbre ranges from low (bass, rumble) to high (sparkle, crystal) • Chandelier glides to centralize on location of touch • Voice visualization overlay, crowd of revelers appears/disappears on the staircase projection, brightening with amplitude, changing colour with timbre *Phase 4* • Imagery of stage proscenium at the Garnier • Voice visualization overlay, row of ballet dancers appears/disappears on the Garnier stage projection, brightening with amplitude of voice, changing colour in response to timbre • Touches in front of Schofield control effects on acoustic mandolin • Touches in front of Taylor affect reverberation affect applied to voice • Chandelier glides to centralize on location of touch • Vertical axis, synthesizer timbre ranges from low to high

Appendix C

Technical Information for *Nightingallery*

C.1 Max/MSP Software Overview

The *Nightingallery* application is implemented in Max/MSP. There are three main aspects to the software:

- Functionality to record user input (for use in later birdsong playback)
- Generation and output of birdsong
- Control of bird movements

See Figure C.1 to see the Max/MSP front end for the bird software application.

C.2 Recording User Input

In order to use participant vocalizations to generate and trigger responsive birdsongs, the participant's microphone feed is monitored. Sung or spoken phrases are recorded into a series of buffers.

In order to separate the stream of audio which constantly comes in from the participant's microphone, we monitor the amplitude of the incoming stream. When the amplitude rises over a certain threshold, a buffer is opened, which records the participant's vocalization until a pause speech is detected, or the buffer reaches its 10-second maximum length. The buffers of participant phrase input are stored in an array for future use.

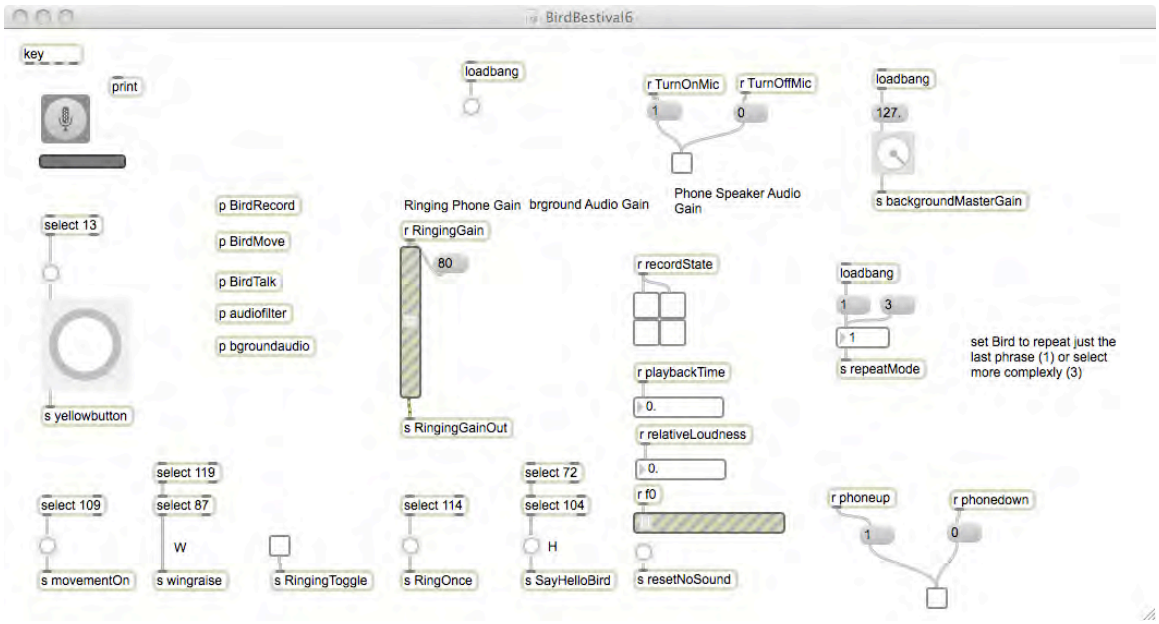

Figure C.1: The Max/MSP front-end to the *Nightingallery* control system

When the system has detected that the participant has uttered a phrase, it then triggers the bird to sing back a response. This response could be generated by manipulating content drawn from the array of participant-uttered phrases, or from pre-recorded content pre-loaded into the bird system.

After the bird has uttered his response, the participant's microphone is again monitored, so that the participant can reply to continue the "conversation."

C.3 Birdsong

We implemented the bird's singing voice in two ways: firstly, using audio VST effects, and secondly by generating a purely synthesized voice.

C.3.1 Birdsong – VST driven

In *Nightingallery's* telephone application, English phrases are translated into heavily distorted 'birdsong' before being played for the public via the loudspeaker. On the telephone earpiece, the spoken content of the phrases is still recognizable, however, distorting effects are still applied in order to give the 'bird voice' a croaky, unique character.

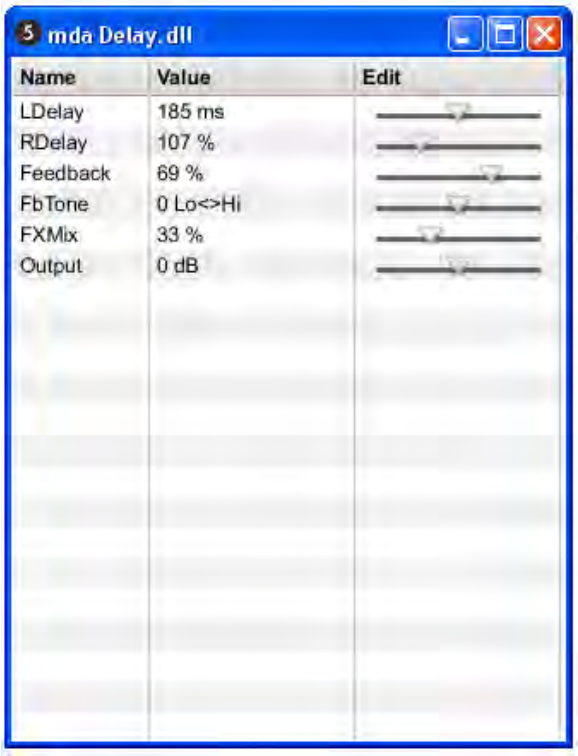

Figure C.2: The open-source mda Delay VST object

In both cases, we use a simple open source Virtual Studio Technology (VST) object to distort the phrases during playback. We configured the `mda Delay` VST (see Figure C.2), using delay effects to generate birdlike voices from human spoken phrase input. The more intense the delay, the more unintelligible the resulting phrase. We experimented with the parameterization of the VST until we were satisfied with the resulting 'bird voices' and 'bird songs' which could then be played back via the telephone earpiece and public loudspeaker.

C.3.2 Birdsong - Synthesized

In contrast to the VST implementation, which simply applied audio filter effects to recorded vocal streams, the second implementation of the birdsong used a fully synthesized bird voice.

See Figure C.3 for the Max/MSP patch.

Using Puckette *et al.*'s `fiddle~` object [78] to perform an FFT on real-time vocal input coming from the participant's microphone, we are able to analyse the

harmonic spectrum to extract the fundamental frequency of the voice (the pitch) as well as the overtones that characterize the participant's vocal timbre (see area 1 of the diagram)

Three oscillators (Max/MSP `cycle~` objects) were used to generate the voice `cycle~` objects use standard sine waves and take frequency values as arguments. Their amplitudes can be adjusted.

For the purposes of synthesis, we used the fundamental frequency (F) and the first two overtones (F_1 and F_2) as frequency inputs to the three `cycle~` objects (see areas 3-5 of the diagram.) We used the amplitude found at F, F_1 and F_2 in the participant's voice to adjust the amplitudes of the three `cycle~` oscillators, resulting in a multi-layered synthesized sound that, while mechanized and far from human, shares some perceptual similarities with the participant's vocalization.

To make the resulting sound stream more 'birdlike', we interjected small clicking sounds (pre-recorded 'ch' utterances) into the soundstream (see area 6 of the diagram). This had the result of breaking up the birdsong into clicks and chirps, adding to the avian character of the voice. We also built the option of increasing the octave of the birdsong responses if desired (see area 2 of the diagram).

The `mda Delay` VST was applied to the generated audio before output, improving the aesthetic of the synthesized voice (see area 7 of the diagram.)

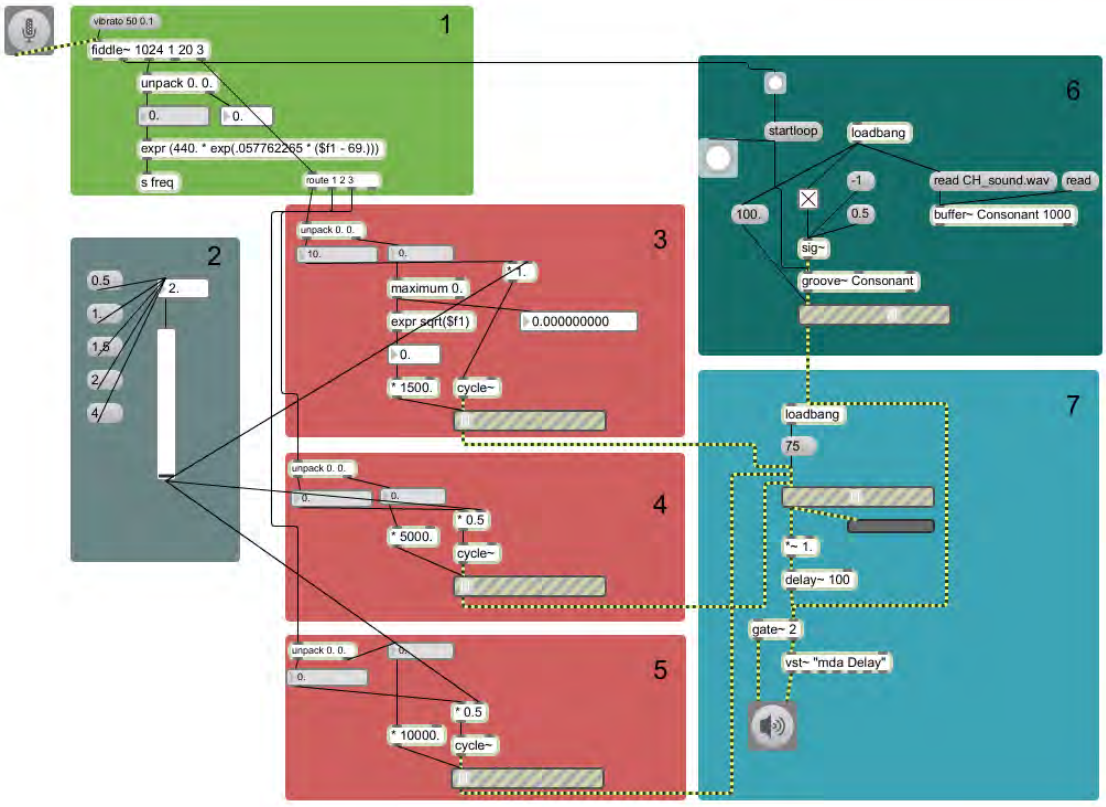

Figure C.3: The Max/MSP Voice Synthesis Patch

C.4 Arduino Control of Bird Movement

The bird automaton has a moveable neck, beak, and wings, controlled by a Teensyduino (an Arduino clone) [98]. Teensyduino controllers have onboard USB, and so enumerate to the PC as any kind of USB device, unlike standard Arduinos which always enumerate as serial devices. In order to control the bird's movements from the Max/MSP environment, we configured the Teensyduino controller to enumerate as a MIDI device, which allowing us to control the servos by sending standard MIDI from Max/MSP. MIDI control 2 was assigned to control the beak servo, 3 to the neck servo, and 4 to the wings servo (as the bird was only implemented using 3 servo motors, control 1 remained available for future expansion.) To move the bird's motors, a Max patch (see Figure C.4) was created to send MIDI values corresponding to the appropriate controls.

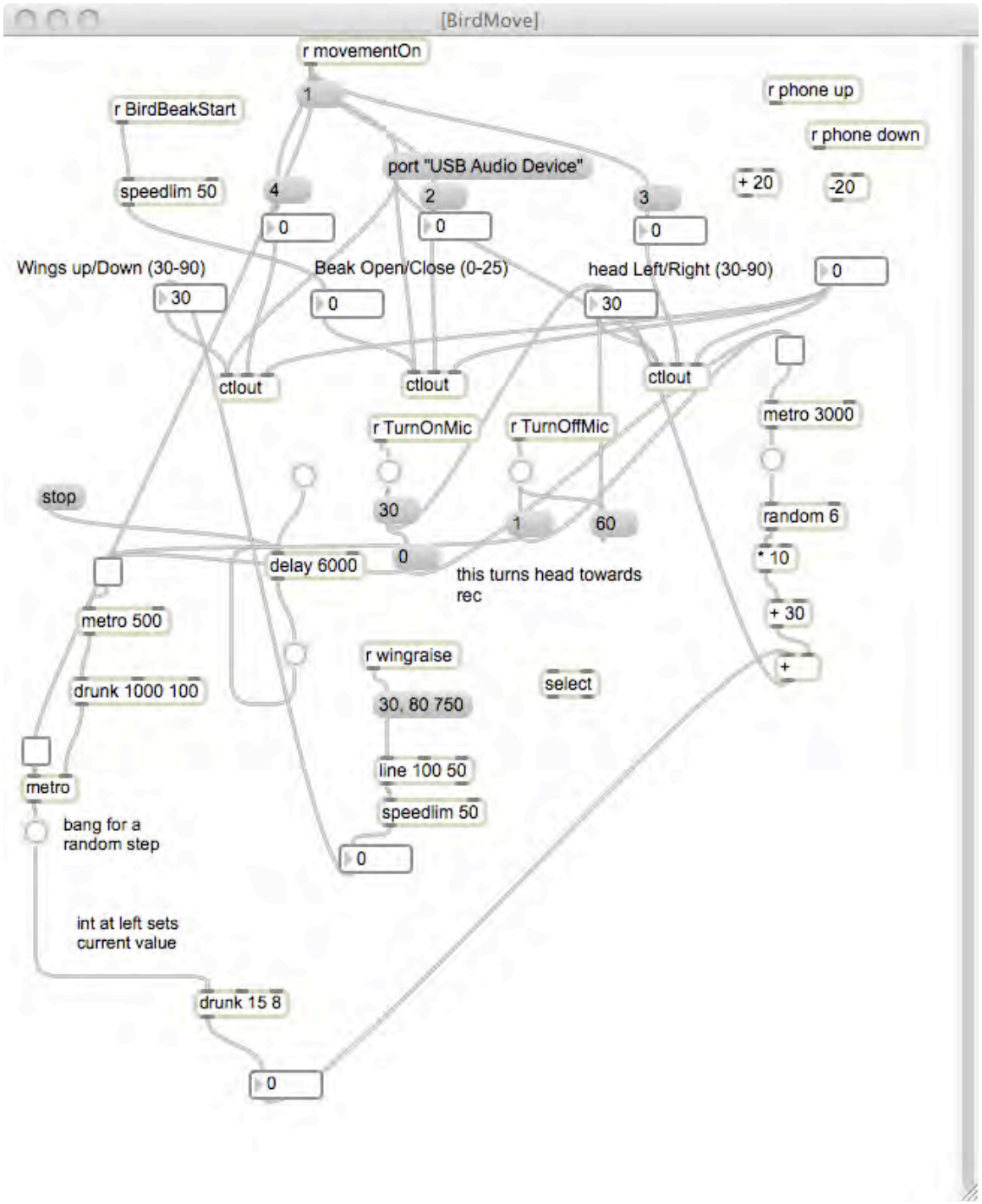

Figure C.4: The Max patch that controls the bird's movements.

C.4.1 Code Listing

The following code was loaded onto the Teensyduino to control the bird's servos:

```
#include <Servo.h>

int ledState = 0;
int ledPin = 6;
int looplimit = 2;
int step = 5;

int servo1Pin = 23;
int servo2Pin = 24;
int servo3Pin = 25;
int servo4Pin = 26;

Servo servo1;  // create servo object to control a servo
Servo servo2;  // create servo object to control a servo
Servo servo3;  // create servo object to control a servo
Servo servo4;  // create servo object to control a servo

int count = 0;
int pos = 0;    // variable to store the servo position
byte testbyte =1;

void setup()
{
  Serial.begin(115200);
  Serial.print("Setup: Starting.");
  pinMode(ledPin, OUTPUT);
  usbMIDI.setHandleControlChange(ControlChange);
  digitalWrite(ledPin, HIGH);
```

```
  servo1.attach(servo1Pin);  // attaches the servo
  servo2.attach(servo2Pin);  // attaches the servo
  servo3.attach(servo3Pin);  // attaches the servo
  servo4.attach(servo4Pin);  // attaches the servo

  Serial.print(".");
  delay(250);
  servo1.write(0);
  servo2.write(0);
  servo3.write(0);
  servo4.write(0);

  Serial.println("Complete.");
}



void loop()
{
  usbMIDI.read();          // All Channels
  delay(1);
}

void ControlChange(byte channel, byte control, byte value)
{
  if((int)control == 1)  //Spare servo in case needed
  {
    servo1.write(value);
    Serial.print("Servo 1 move to ");
    Serial.println((int)value);
    ledState = 1-ledState;
  }
```

```
  if(control == 2) //Beak Movement
  {
    servo2.write(value);
    Serial.print("Servo 2 move to ");
    Serial.println((int)value);
    ledState = 1-ledState;
  }
  if(control == 3)  //Neck Movement
  {
    servo3.write(value);
    Serial.print("Servo 3 move to ");
    Serial.println((int)value);
    ledState = 1-ledState;
  }
  if(control == 4)  //Wings Movement
  {
    servo4.write(value);
    Serial.print("Servo 4 move to ");
    Serial.println((int)value);
    ledState = 1-ledState;
  }
  digitalWrite(ledPin, ledState);
  ;
}
```

Appendix D

dream.Medusa interview questions

Several members of our research group, unaffiliated and previously unfamiliar with the *dream.Medusa* project agreed to take part in a public performance and take part in a short, informal, verbal interview afterwards in order to provide us us with feedback about their experience. The interviews were structured based upon McCarthy and Wright's four threads of experience [71].

Each of the four participants was interviewed separately by other members of our research group, so that I would not bias any of the participants by posing them the questions directly. The instructions in italics were given to the interviewers to frame the context of each discussion section.

Table D.1: Questions regarding the Sensual Thread

Sensual

These questions are meant to evaluate the sensual aspects of the performance (audio, visual, tactile) and the emotional qualities these aspects evoke for the participants. Please try to encourage the subject to use descriptive words when talking about the performance, and try to get them to elaborate on why they feel as they do.

- what were your first impressions when the performance began, when you saw the images on the screen and listened to the introductory music?
- what words would you use to describe the movements of the jellyfish in the videos?
- describe the music and singing in the live performance?
- describe the things you touched during the performance, the interactive objects and the bedding that was on the stage?
- what would you say was the mood of the music and imagery?
- can you think of other situations where you felt some of the same emotions and moods that this experience made you feel? what were they like?
- were you absorbed by the experience of watching and listening to the images and music?
- describe the 'world' you were creating during the performance
- did you ever forget that you were in a theatre?

Table D.2: Questions regarding the Emotional Thread

Emotional
In this section I am interested in finding out how they felt about their own role in the performance, and how they imagine that I and the other participants felt during the performance. I'm interested in their own self-reporting of their experience, as well as the projected attitudes, intentions and emotions they ascribe to me, the other participants and the audience. • how did you feel about, being on stage in front of an audience? • how did the other participants and the singer seem to feel? (how could you tell?) • did the performance go well? did the audience enjoy it? (how could you tell?) • how do you think the other participants and the singer felt about your contribution? • do you think your contribution was important? in what ways? • what do you think the audience thought about you and the other participants on stage? • do you think they would have wanted to switch places with you? • did you talk or communicate with any of the other participants during the performance? why?/how? • did you feel like you were collaborating with the other participants and the singer? • did you do anything in response to the others? • did you feel like anyone was doing anything in response to your actions?

Table D.3: Questions regarding the Spatio/Temporal Thread

Spatio/Temporal
Here I am interested in the spatio/temporal aspects of their experience I want to investigate how they perceived the event context and the atmosphere of the performance. I would like to know how they felt that the performance was influenced by the environment and the contributions of the individuals that collaborated in the creation of the performance (participants, singer, audience...) • did you feel under pressure to do well in this performance? • what ways? who from? • do you think the singer felt pressured to do well? • how large was the audience? • how different do you think this performance would be if it was performed again tomorrow

Table D.4: Questions regarding the Compositional Thread

Compositional
In this section of discussion, I would like to explore how they perceived the artistic aspects of the composition as I'd imagined them. My intention in this piece was that the participants would be experiencing aspects of a lucid dream that they would be immersed in the audiovisual environment, and drift in and out of control of a small aspect of the experience. I would like to know if they felt like this concept was conveyed by the experience, and if they felt that exploring the interface was rewarding or frustrating. I intentionally made the interface ambiguous, hoping that they would explore their interaction space and learn to get better at controlling the wiimote devices with practice during the course of the performance. • are you familiar with the concept of lucid dreaming? • have you ever had a lucid dream? can you describe it? • did you see a link between this performance experience and lucid dreaming? • did you feel like your actions had an effect on the performance? (what effect?) • as you practised did you feel like you had more control? • the way you controlled the experience was designed to be ambiguous and explorative did you find this interesting or frustrating? • did trying to 'control' the interface distract you from enjoying the experience?

Table D.5: Miscellaneous Questions

Miscellaneous
• how long was the actual performance? • have you performed on stage before? (how?) • are you familiar with multimedia technologies? • what did your actions do? do you know what the singer's actions did? the other participants?

Table D.6: Participant Quotes Regarding Stage Fright

Stage Fright

- "Well at first, when I first sat down at first I was quite conscious, I came in cold, I wasn't expecting to be up on the stage, I was going to be in the crowd. And, I was very much conscious of the fact that there was cameras on us when I first sat there, and, there was a lot of people in the crowd, more kept coming in, but the second it started, I mean, I completely lost track of what was going on - I would say it was almost 100 percent absorbing."
- "(Q: Did you ever forget, at any point, that you were in a theatre?) Um, yeah, definitely. After about ten minutes, I guess, ten minutes would be. I did forget there was lots of people sitting behind me. (Q: right) and I was being filmed by 2 cameras. (Q: Cool) which is good because it was really messing me up a little at the start, sort of sitting there when Robyn started singing, I was like (Q: So having your back to the audience was that a bit, or was it more just being on stage and whatnot, people doing something...) Kind of. Having my back to the audience was the best way of making me ignore the fact that I was involved with (Q: Oh right, yeah) Yeah."
- "I remember saying something about feeling nervous before the thing actually started, as if, you know, it was a little bit of stage fright, although I knew I wasnt really performing, but, and feeling more comfortable once, at the very beginning when she started singing and I saw the images that were situated."
- "Yesterday in [the new media summit] I felt really bad, only five people turned up and I was like: this will be great, going to do this performance tomorrow, we got five people, wave a wiimote, go home. And, uh, loads of people ... I'm sitting there on the stage going 'crap!' and, uh, Robyn was passing round all the wiimote things, and that made me think I wish I hadn't volunteered to be on stage! "
- "I mean I was actually aware that, cause one person I could see who was in my line of sight was Atau Tanaka, and you know, just thinking, this was actually part of my performance anxiety, and I was thinking 'Oh my God, I'm flailing this thing around in front of, you know, Mr Technology over there'. [...] Anyway, um, no, I just felt like 'Oh God' so I was aware there were people such as that out there that could have made all sorts of things happen, and it might have been frustrating to watch me doing it."
- "I held one of the pillows in my lap the entire time,a nd partly it was just a nice feeling object, and also, kind of protection up there on the stage, so, a pillow. Comfort."

Table D.7: Participant Quotes Regarding Collaboration

Collaboration
• "(Q: Did you talk to any of the other participants during the performance?) No. I wanted to, but I felt as though I probably shouldn't I wasn't sure if that was going to affect what we were trying to do here, you know, I was very keen to ask the guy next to us if he could work out what his remote was doing, and I also wanted them to stop at certain points, I wanted to tell them all to stop so I (laugh) could work out what I was doing, you know, but I felt that that might have been a little rude! (laugh)." • "I did wonder if we were allowed to talk, but seems kind of rude to talk if someone's sitting there singing." • (Q: Did you feel like you were in collaboration with the other participants and the singer?) No, I kind of felt in some ways, well maybe the singer yeah, but, like, the other participants they sort of - not collaboration, what's the opposite of that, maybe working against... (Q: Kind of working against each other? Oh really? That's interesting. [Given] that you'd started to work out some of the things that the others were seeming to be changing [...] did you do anything in response to the things that they were doing?) I tried to maintain the blue as much as possible, and then occasionally I got confused and didn't understand, and I did try to try and get into gray spikes when one of the other people was moving their thing, but, that didn't seem to happen. (Q: Did you feel like anyone was doing anything in response to your actions?) Um, no. Not as far as I could see, anyway." • "I felt like there might have been communication on the screen between what we were doing, I kind of looked at their I looked at them all occasionally and what they were doing with their controllers, but I didnt feel like except for that one point with the shrug there wasn't any eye contact at least between me and the others but I think probably, I'd like to think there was a communication about what there was, I mean we were doing on the screen." • "When I saw people doing certain things on the screen and I knew what they were doing, I tried to fit what I was doing in with that, so if one of them was switching from – [Other Participant] was switching from colour to black and white I would maybe try to time my movement with him. (Q: Yeah, that is the next question, if you felt like collaborating with the other participants?) Yeah. So, I did, I liked to, I wanted to try, and, I am quite a musical person so I wanted to add some more, I guess I wanted to add sound, but without musical training its not something you can add without destroying some of the timbre of the whole piece."

Table D.8: Participant Quotes about Legibility

Legibility
• "I pretty much spent the entire time trying to work out what my motions were causing on the screen and I was trying to work out what other people were doing. I was very much aware of the guy next to us, I could see the effect he was having, bizarrely, but not so much myself." • "It's not always possible to work out what they're doing in non-standard performance situations. So, if you come onto a stage and there's three people standing up with instruments you know, it's quite easy to work out what's going to happen but if you come along and you see four people sitting on a mat with cushions and one person singing that is a bit odd." • "Um, I mean it's nice to know that what you're doing is having an effect, but I'm not entirely sure that what I was doing did have an effect. You know? " • "Once I found out what I was doing in the first opportunity, I kind of got that, but then I wasnt quite sure how far I could take it, or what could be done with it so (Q: limits were) yeah, I did, and so I kind of got to, by the end of that little opportunity, I kind of had exhausted at least the first discovery of what I had done. And then the second time I used a completely different technique that may or may not have been doing anything, and so I think that the learning curve is longer than the opportunity I was given." • "Once I got the once I learned the limits of the device I was very aware of making sure that I didn't make the transition between the two extremes at that one point without wanting to." • (Q: The way you controlled the experience was designed to be ambiguous and explorative did you find this frustrating or interesting?) I found it interesting, but I felt that the degrees of freedom that I had to control was very limited which did lead to some frustration ." • "I think I cant escape that kind of feeling of not necessarily knowing what kind of control I was having and, so I wasnt always certain what my input was producing, and therefore it was hard to know how I fit in to the team, and this is probably has a lot to do with the fact that Im not familiar with the wii technology, I cant really see, this is a huge assumption but that sort of computer science-y men that I was sitting with would have actually encountered this technology." • "No matter how concealed that control was to me, it was still, you know it was a challenge, and a challenge is always fun and exciting and interesting."

Appendix E

Feedback from *dream.Medusa* used to inform *humanaquarium* design

The *dream.Medusa* interview transcripts were encoded based upon McCarthy and Wright's four threads of experience [71]. The datasets associated with each 'thread' were then examined in order to identify feedback that could help us design a more engaging user experience in *humanaquarium*.

Table E.1: The Sensual Thread

Feedback from *dream.Medusa*	**Proposed Design Improvements**
• Music and visuals characterized the atmosphere of the experience (1,3) • Music was cue to pace of actions (3,4,5) • Participants "felt" underwater/transported (1,3) • Singing/live performance held their interest (1) • Participants appreciated the aesthetics of artefacts – bedding, wiimote cases (6)	• Maintain the mood of dM via fluid imagery, sweeping/ethereal audio soundtrack • Introduce more variation in tempo, intensity, as some participants expressed desire to increase the dynamic range of their contribution • Increase participants rhythmic control via the touch interface • Important to maintain interesting aesthetic in design of box

Example quotes:

1. "But there were certainly, there were certainly an aspect of feeling underwater with the music and the visuals. The background music helped with that."
2. "The background music, yes, em, I mean, the singer was, she really set it all off. If it was just the music in the background I think it would become quite boring, but, the second she started singing it was, it was great."
3. "that wash of sound – to me that felt as though it had movement in and of itself"
4. "You have this interactive device so you feel like a child just shaking it around and seeing what happens but you're aware that you don't want to keep doing that because it won't fit with the music"
5. "I did something against the grain of the music to see how it would behave"
6. "Well, the silver tubes I thought were kind of funny in that they were very stagey, and they reminded me of magician's equipment, even like a magician's set that they had when I was little that actually had cardboard tubes with foil paper surrounding it, but I liked, even though they sort of seemed hokey in that sense, I also liked the idea of hiding the technology, and you know even just that, that idea of conjuring up the sense of magic."

Table E.2: The Emotional Thread

Feedback from *dream.Medusa*	**Proposed Design Improvements**
• Content distracted from 'stage fright (1) • Orientation (back to audience) was helpful (2) • Exploratory nature of actions made behaviours 'safer' (3) • Proximity to artist intriguing but a bit uncomfortable (5) • Participants were sometimes unsure what they were 'allowed' to do within the performance context (4,5)	• Increase opportunities for collaboration, communication • Bring participants into close proximity using shared collaborative surface • Use window to define boundary between performers and participants • Use window to define mode of interaction across this boundary

Example quotes:

1. "I remember saying something about feeling nervous before the thing actually started, as if, you know, it was a little bit of stage fright, although I knew I wasnt really performing, but, and feeling more comfortable once, at the very beginning when she started singing and I saw the images that were situated"
2. "After about ten minutes, I guess, ten minutes would be, I did forget there was lots of people sitting behind me. (Q: So having your back to the audience was that a bit, or was it more just being on stage and whatnot, people doing something...) Kind of. Having my back to the audience was the best way of making me ignore the fact that I was involved."
3. "I know some of the people on the stage are natural performers, I'm very much not, but I don't think I was in any sort of detrimental place because of that, I was doing mostly the same as them, and I felt free to do pretty much what I liked."
4. "I kind of wanted to watch her sing because you kind of don't get an opportunity to watch people sing really close and then I felt kind of embarassed so I was trying to look at her sing but not try to look at her sing and to pay attention to the screen at the same time."
5. "I did wonder if we were allowed to talk, but seems kind of rude to talk if someone's sitting there singing."

Table E.3: The Spatio-Temporal Thread

Feedback from *dream.Medusa*	**Proposed Design Improvements**
• Nature and size of crowd was significant (concert, workshop etc) (1) • Traditional performance medium was perceived as formal, stressful, important, etc. (1,2) • Participants expressed concern that they help the performer/artist present the piece well (2) • Participants appreciated the ephemerality and unique nature of each performance more readily when they could perceive the impact their contributions had on the performance development (3)	• Move out of 'theatre' and into less formal venues • Less choreographed progression of music/visuals, live remixing, library of content which can be responsively assembled on the fly • Improve legibility so that participants have a better sense of the uniqueness of each performance and their own role as a contributor

Example quotes:

1. "[At a previous session], only five people turned up and I was like: this will be great, going to do this performance tomorrow, we got five people, wave a wiimote, go home. And, [when the performance was scheduled to begin] uh, loads of people ... I'm sitting there on the stage going 'crap!"'
2. Oh, I think all the pressure is on [Robyn] in a way, in that this is her piece and so it, in some sense I mean, is identified with her so she has the identity problem, association, the responsibility, and this is all projecting from how I would feel in that situation, so certainly there's a lot of pressure on her, where we're just rubes from the audience you know (laughs) but that's not to say that we are without pressure."
3. "I was trying to figure this out actually, if she, how much she was reacting to the images and how much the images were reacting to what she did, and you know, what kind of dance was going on there and I couldn't quite figure that out. [...] Again, I really dont know what interactions were going on in there, but certainly if you got different people up there with the controllers I think different things would sort of be happening."

Table E.4: The Compositional Thread

Feedback from *dream.Medusa*	**Proposed Design Improvements**
• Compositional framework dictated when and how participation was allowed (2) • Ambiguity reduced legibility (1,2) • Simple interaction techniques (one control parameter per participant) could be frustrating (3) • Participants recognized the Wiimote device as a video game controller, reducing its effectiveness as an abstract interface (4)	• Make size, intensity of actions legibily consistent with response • Give each participant some obvious controls as well as more subtle ones • Allow participants to lead the pace of the interaction • Allow for 'virtuosity' via combinations of effects • Use a more abstract interaction mechanism (a window instead of a Wiimote)

Example quotes:

1. I think I cant escape that kind of feeling of not necessarily knowing what kind of control I was having and, so I wasnt always certain what my input was producing, and therefore it was hard to know how I fit in to the team"
2. I would've liked to've – I would much more have preferred to have seen a lot going off! You know, if I wiggled that little wii remote I'd have liked to have seen fireworks you know, everything, but (Q: Yeah, something definite) but it was so much... subtle, so much more subtle it was difficult to gauge what was going on"
3. "I find it quite easy to immerse myself in things so I think as soon as I was in the expressive mode I was entirely immersed in the situation, but when I found something limiting me I was very aware that the, that I was, that I was separate."
4. "I felt uncomfortable, mainly because, Ive been on stage a lot and thats not a real issue, but mainly because of the technology because Ive never used a Wii before and I know that people were supposed to do specific things with them, like to get certain effects, and I dont know what those are. I havent had that experience so I felt like certainly insecure about having to use the technology that I was going ot be asked to use."

Appendix F

Example Performance Documentation for *humanaquarium*

As described in Chapter 6, Section 6.3, our design process for *humanaquarium* saw us iteratively refine and evolve the design over the course of a year's worth of public performances.

For each performance, we conducted a number of evaluative activities:

- Each presentation of the performance implemented a number of new design interventions, goals and system revisions
- Immediately after each performance we would jot down notes relating our impressions of the experience. We would discuss the performance at the end of the evening, keeping a record of what had taken place. At the nearest opportunity we would sit down and watch the videotaped footage of the performance, noting any new observations obtained by watching the performance from this mediated perspective
- After a year of performances had taken place, Schofield, Shearer and I sat down to watch the entire series of videotaped footage. We compared our impressions of the performances to our initial understandings. Often we found that different ideas emerged when re-visiting the footage, as we were able to newly make sense of our experiences within the context of our extended exposure to the work.

In this Appendix we provide example data corresponding to the first three *humanaquarium* performances, each of which was scheduled roughly a week apart:

- *humanaquarium* was first presented to the public via an installation of media art that took place at *Dance City* – a well-respected dance studio and exhibition venue in Newcastle Upon Tyne. We had submitted the *humanaquarium* design concept, and had been selected for inclusion in the festival. The audience for the performance was made up of people who had pre-arranged to purchase tickets for the event. During each of two scheduled performances, the *humanaquarium* was situated in a cavernous, concrete lobby space outside the main auditorium doors. When the audience streamed out of the theatre, they immediately encountered the*humanaquarium* installation.

- The second performance took place in a small gathering space at *Dove Marine Laboratory*, accompanying the screening of an aquatic-themed local film. A number of the audience members in this experience were known to us, as the event was sponsored by our research facility. It was the first time our colleagues had seen and interacted with the work, as we had deliberately planned to unveil the performance to them at this scheduled exhibition.

- The third performance took place at a media event held at *Culture Lab Newcastle*, in which members of the public were specially invited to an evening of art and performance. Approximately 200 guests got to see and interact with the work. We performed three separate *humanaquarium* shows over the course of the evening.

The following three tables present the observations and reflections Schofield, Shearer and I made about our experiences on each of the performance evenings. For each performance we list the design goals we were exploring, our immediate impressions of the performance event, and the discussion points which emerged later as we re-watched the video footage at the end of the year.

Table F.1: Dance City – Performance Notes and Reflections

Dance City – October 2, 2009 (first public performance.)

Design Goals and Interventions:

- We implemented 2 control regions during this event, planning to increase to at least 3 vertical control regions later in the process
- We mapped placements of touch to layers of sound and sound effects
- We deliberately gave the participants extreme control over performers
- Taylor's voice – heavy reverb, uncontrollable 'dragon voice' generative voice synthesizer seeded by her singing voice, with parameterization controlled by participants
- Schofield's MIDI arpeggiator – repetition rate controlled by participants, and could vary wildly based on their input
- Touch was visualized by changing the colour and edge detection of the Jitter imagery

On-site reflections and immediate video viewing:

- the heavy voice effects made participants uncertain that Taylor was actually singing
- difficult for Taylor and Schofield to perform, given that significant control had been given to participants
- legibility issues participants told us they wanted a visual representation mapped to the location of their touches
- adult participants did NOT want to stand and interact in the centre of the screen adding a third vertical control region would be meaningless

Observing Video 1 year later:

- the performance was actually extremely dynamic in comparison to later implementations of the work
- giving control to the participants rather than performers was an interesting choice - we should have found a way to pursue this rather than abandoning it. Perhaps with better monitoring it would have made us more comfortable as performers.
- People snuck back to play and explore the box after we had exited and the 'performance' was over - then they were willing to use the entire screen as an interaction surface, presumably because they were no longer blocking the view of the performers inside

Table F.2: Dove Marine Laboratory – Performance Notes and Reflections

Dove Marine Laboratory – October 14, 2009.

Design Goals and Interventions:

- Introduced a visual representation of touch, in the form of a jellyfish that would fly to follow participants' hands
- Reduced the dynamic range of the participant-controlled effects applied to the arpeggiator and vocals - making it easier for us to perform

On-site reflections and immediate video viewing:

- Jellyfish needed fine-tuning in terms of size and responsivity rate
- Legibility issues were a concern needed to build a more steady, gradual learning curve into the performance content
- Wanted to add more silence and space into the composition in order to help make interactions more legible
- Basic interaction modalities seemed sufficiently expressive (one or two 2-axis continuous control regions allowed participants a large aesthetic space within which to experiment and explore), so interest should be added through the performance content, not by making the interaction more complex

Observing Video 1 year later:

- People kept very definitely hanging on the sides of the screen, more than we saw in subsequent performances. Retrospectively, we wondered if this was being caused by the social dynamic of the audience this was a group of socially stratified (and sober) work colleagues. Perhaps it was the presence of the 'bosses' that was inhibiting participation rather than flaws in the interface.
- After comparing the performance footage to later performances, socio-cultural dynamics were definitely visible in the video which we had not noticed in our first analysis of the situation. More outgoing and/or highly-ranked staff members were visibly dominating the interaction – this had not been immediately obvious to us until some time had elapsed, providing us with a more removed perspective from which to better understand the experience.

Table F.3: Culture Lab Relaunch – Performance Notes and Reflections

Culture Lab Relaunch – October 22, 2009.

Design Goals and Interventions:

- new performance, *Darkshines*. New score, similar visualisations
- we made the early phase of the performance audibly and visibly sparser. In addition to the floating jellyfish, a prominent layer of sound also faded away when touch was released, reappearing when touch was resumed
- we gradually added layers of sound and visuals, slowly building complexity in the performance rather than having everything happen at once (to assist in legibility)
- we solidified our composition practice, setting up in an empty performance hall for several days, physically mimicking a real performance scenario when composing
- we implemented left-right stereo panning effects, hoping to entice participants to physically explore the space surrounding the *humanaquarium's* front screen
- we introduced dynamically controlled uplighting which turned from blue to bright red when the screen was touched

On-site reflections and immediate video viewing:

- The gradual fading in and out of sound and imagery suited the aesthetic of the composition's slow, fluid rhythm... yet if participants wanted to make sharp, jerky movements, the fade-out rate interfered with the interface's responsivity.
- Lighting was very legible, allowing the interaction's learning curve to be started for people further away who could see how the touches controlled the lights. The lighting had massive aesthetic value, drawing attention to the *humanaquarium* structure and emphasizing how our installation dominated the environment

Observing Video 1 year later:

- We were very satisfied with the sparse introduction, but foresaw that it would be best suited for a scheduled audience who were willing to invest in a longer build-up phase. We later found that this presentation style was not particularly ideal for engaging walk-by traffic
- The importance of demographics and social context upon experience was very obvious when watching this video in contrast to other videos. We had been performing in front of a lively party in which alcohol flowed freely. Participants were very daring in such a lighthearted environment, resulting in many dynamic and interesting kinds of interactions that were rarely seen in other situations.