“I can’t hear you!”: Improving audience-to-performer communication using electronic devices

by

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Abstract

Musicians and their fans are connecting on an unprecedented level today using the Internet; however, the communication channel is still very one-sided during a live performance. This thesis aimed to develop a new method for audience-to-performer communication. A literature review and survey of related projects were first conducted. Primary research was then carried out, including interviews with both concertgoers and performers. Multiple prototypes were developed and tested with users, and, after analyzing the results, a refined device was created and implemented at a live music performance. The paper concludes with a discussion on the significance of the device and possible future directions.

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Chapter 1

Introduction

A performance is a relationship between performer and audience. Whether it is a music concert, a theatre piece, or a magic show, the performer's goal is to communicate a message. Their message could serve as a diversion from day-to-day life, or it could be a thought-provoking commentary on reality. It is always favourable, in any case, that it gets delivered as clearly as possible. Consequently, there have continually been new tools and techniques developed in order to increase the fidelity of the message. Modern sound systems can amplify a signal so it is heard for miles. Huge screens are installed to ensure all spectators have an up-close view of the performer. Venues are precisely designed to maximize audience comfort and acoustic quality. In some cases, however, it is the audience members that wish to be heard more clearly; it is the audience members that uses tools and techniques to make their messages heard. At rock and pop concerts, in addition to the customary applause and cheers, it is common to see concertgoers waving illuminated lighters and mobile phones or even holding homemade signs in the air. In a performance, the audience is as important as the performer. It is useful, then, to put more consideration into how we might deliver clearer messages from audience to performer.

1.1 Motivation

Today, musicians are more connected to their fans than ever. By leveraging services like Facebook, Twitter, and Topspin, artists can keep their followers up to date on new releases, tour dates, and other special events. Perhaps more significant is the unprecedented level of access that fans have to the musicians. Fans are talking directly to the artists, voicing their opinions on their work, providing travel tips during tours, and sharing original content inspired by them. If it is now so easy to communicate with performers via the Internet, why, then, is the communication channel at a concert still so one sided? Waving a lighter does not convey much information, and it is rare that homemade signs are actually read by the performer. Some artists have tried to develop solutions, but these have their flaws as well. Giving audience members wristbands embedded with blinking LEDs, for example, is an impressive way to expand the light show into the crowd, but it is not actually interactive, as the devices do not transmit any information from the users. Displaying audience members' Twitter posts during a show may cause some excitement, but it is also inviting them to look down at their phones, and it is not a coherent output in the context of a music performance. I believe that modern music performances can benefit from a new, reliable method of audience-to-performer communication.

1.2 Research Question

The goal of this thesis project is to find the most effective communication system that will enhance a live music performance for concertgoers. This requires considering some important research questions. First of all, how might we obtain meaningful information from the audience without being a distraction to them? What information do concertgoers find meaningful? On the other hand, I am interested in what data performers might find useful. What sort of feedback could they provide that would enhance the performance for the audience? This project has a strong focus on interacting with technology. Thus, my theoretical framework will be greatly based in human-computer interaction research, ensuring that the final product is intuitive to use. With the project centred around traditional rock and pop music concerts, I am also interested in how the mind interprets this sort of music and environment. Referencing work in music psychology will help me understand why people attend these concerts and what characteristics make one performance more captivating than another. This work brings up some other topics that, while interesting, will not be addressed here. For example, while inspiration will surely be taken from other genres of music and experimental performances, the final product will be created for a standard western pop music concert. The commercial viability of the final product – matters of distribution, pricing, etc. – will generally not be considered. These sorts of issues are outside the scope of this project.

1.3 Overview

To begin, I will examine related academic and professional work. Next, the methods and results of my primary research will be discussed. My prototyping process will then be explained, followed by an analysis of the results from the user testing. Last is a discussion on the outcome of the project and possible future directions.

Chapter 2

Background

This chapter examines related research and projects. Past work includes studies on collaborative control, interactive dance clubs, and commercial products used in large-scale concert settings.

2.1 Group Behaviour

2.1.1 Kershaw

This article examines how the behaviour of London theatre audiences changed over the twentieth century. Kershaw begins by citing a newspaper article claiming that theatre audiences are much more prone to giving standing ovations than they once were. He asserts that investigating this particular trend could tell us more about modern theatre as a whole. It is pointed out that little research has been done on applause as a phenomenon, and Kershaw surmises that this is due to it being taken for granted as a straightforward element of a performance. So, just what is applause? The author proposes that it could be an attempt to extend a performance that one does not want to end, or perhaps it is more “a giving up of individual judgement” and an attempt at forming a momentary community (p. 135). Regardless, Kershaw maintains that this increasing acquiescence in audiences indicates disempowerment and the fall of the theatre as a political environment. The potential power of an audience is emphasized via a case study: in 1926, an Irish audience rioted during a performance of a controversial play, thereby ending its run and making known the audience's opinion on the play's political issue. This sort of defiant reaction empowers the audience, Kershaw claims, whereas applause seems to actively muffle dissent.

Kershaw proposes that, over the twentieth century, the role of the audience member changed from patron to customer. Pre-World War II spectators had no inhibitions about booing or yelling their approval. In the 50s, however, theatres were becoming increasingly regarded as indicators of status; they were decorated lavishly, and the audience was managed such that certain groups sat in predetermined places. Since the 80s and 90s, most theatres have been filled with advertisements, indulgent services, and merchandise sales. Thus, states Kershaw, "the standing ovation [became] an orgasm of self-congratulation for money so brilliantly spent," and"political significance, democratic exchange, and the power of community all but evaporated" (p. 144).

The paper closes by recommending that theatres look for ways to encourage conflicting viewpoints in their audiences. The author proposes some admittedly "desperate" strategies, such as booking audiences with contrasting interests in the show or placing opinionated "plants" in the crowd to inspire irregular reactions. Kershaw believes that the political potential of the theatre is in danger of being lost and, thus, that "[it] now, perhaps more than anything else, needs unruly audiences" (p. 151).

2.2 Designing for Performances

2.2.1 Maynes-Aminzade, Pausch, and Seitz

In their 2002 paper, Maynes-Aminzade et al. describe three different computer vision systems that allow an audience to control an on-screen game; they also outline the lessons they learned about designing such systems. The first method tracks the audience as they lean to the left and right. The control mechanism was intuitive, but the system required frequent calibration. The second method tracked the shadow of a beach ball which acted as a cursor on the screen. This was also intuitive, but it only involved a few people in the audience at a time. The third method tracked multiple laser pointer dots on the screen, giving each audience member a cursor; this was a more chaotic system once the number of dots got overwhelming. Lastly, the authors presented some guidelines for designing systems for interactive audience participation. They recommend focusing on creating a compelling activity rather than an impressive technology; they state that every audience member does not necessarily need to be sensed as long as they feel like they are contributing; and they suggest that the control mechanism should be obvious or audience members will quickly lose interest. The authors also note that making the activity emotionally engaging and emphasizing cooperation between players will increase the audience's enjoyment.

These conclusions provide both guidance and new questions to consider for my own research. While I hope to work with some relatively advanced technologies, it will be important to remember that it is the actual interaction that will determine how engaging the experience is. User-centered design will need to be a major part of my development process. While this paper dealt with accurate control of a video game, my work will address interactions that are more passive and abstract. The authors stress the importance of an obvious control mechanism; considering how much their environment (a movie theatre) will likely differ from mine (a loud, dark music venue), I believe this will be especially crucial for my project. Audience members whose senses are already being overloaded will have even less patience for figuring out how something works. I will have to consider how this and other factors apply to my unique environment. How can I best tap into the emotional sensibilities of an audience at a concert? How might I create a cooperative environment in a situation that is not goal oriented? These are questions I will have to address in my primary research.

2.2.2 Ulyate and Bianciardi

In their paper, the authors describe their "Interactive Dance Club" – a venue that delivers audio and video feedback to inputs from multiple participants – and they present the "10 Commandments of Interactivity" that guided its creation. The goals of the project were to create coherent musical and visual feedback for individual and group interactions and to allow non-artistic people to feel artistic. Inputs included light sensors, infrared cameras, pressure-sensitive tiles, proximity sensors, and simple mechanical switches. By interacting with them, users could make notes sound out, manipulate projected video and computer graphics, modulate music loops, and control the position of cameras in the space.

This project's "10 Commandments of Interactivity" contain the following points:

- Movement is encouraged and rewarded.
- Feedback from interactions is immediate, obvious, and meaningful in the context of the space.
- No instructions, expertise, or thinking is required.
- A more responsive system is better than a more aesthetically pleasing system.
- Modularity is key.

Lastly, the authors share the lessons that they learned while running the Interactive Dance Club. They observed that interactions involving full-body movements were most satisfying. The form of an object, they found, determined how users first attempted to interact with it. They emphasize the practicality of a system that is both distributed and scalable. Designing the interactions required finding a balance between freedom and constraint. They found that, no matter how elegant the system, some users would still find a way to create unpleasant noise. Lastly, they observed that instant gratification is important; feedback that is too delayed or interactions that require too much concentration are ineffective.

2.2.3 Bongers

In his 1999 paper, Bongers provides a theoretical HCI framework for physical interaction between performers, audience members, and electronic systems in a musical performance. He defines three types of interaction – "performer-system", "system-audience", and "performer-system-audience." Bongers models the interactions as control systems wherein actions are either a *control* or *feedback* process. Electronic sensors and actuators are discussed, followed by human senses and motor systems. Bongers states that a more convincing interaction is one that provides "multimodal" feedback – influencing more than one of the users' senses. Lastly, a few prototypes of novel interaction systems are described. Especially notable is the "Interaction Chair", which most easily fits in the performer-system-audience category. Here, the performer has the ability to send vibrations through each audience member's seat back, while the chairs contain sensors that allow audience members to influence visuals projected behind the performer. Other projects like this one can benefit from Bongers' theoretical framework; thinking in terms of control and feedback processes may provide new perspectives on a system's design.

2.2.4 Barkhuus and Jorgensen

Barkhuus and Jorgensen's paper investigated interactions between audiences and performers at a concert. The authors used observations from traditional rock and rap shows to inform the design of a simple "interaction-facilitation technology" – a cheering meter. By tracking the applause patterns at several concerts, it was determined that the two most common reasons for cheering were to express anticipation and to reward the performers. This led to the creation of a cheering meter, an instrument for measuring the volume of an audience – in this case, to determine the winner of a rap battle. Microphones captured samples of the crowd's cheering, the signal was filtered, the peak volume was measured, and the rating on an arbitrary scale was displayed on large screens onstage.

The researchers reported no major issues while testing the system, and they express confidence that their technology helped to enhance the concert for the audience members. In their paper, they outline the main reasons for the cheering meter's success. First, the authors state that the usability of the system is due to the fact that it is based on an already-present behaviour; they recommend "designing technology that fits the situation and which utilize present activities rather than aiming to employ the latest cutting edge technology" (p. 2929). Next, they suggest that an event should not rely on the success of the technology; the rap battle, for example, could have easily continued if the cheering meter malfunctioned. Lastly, the authors emphasized the importance of immediate visual and/or aural feedback; seeing direct consequences of their actions gives the audience confidence in using the system. This research focused on a very specific type of event using an almost-gimmicky system, but the design principles it yielded are valuable.

2.2.5 Tseng et al.

This paper described the motivation and creative process behind a Taiwanese interactive theatre experience that let audience members connect with a dance performance. The project was realized using projection mapping, a Kinect, a local area network, and a custom iPhone app. Audience members downloaded the app before the show and entered a code corresponding to their seat number to connect to the local network. During the first part of the performance, each user was given control over one "light dot" projected onto the stage. The dot could be moved by moving the iPhone; users could also point their phone's camera at different light sources to influence the brightness of their dot. Later in the performance, audience members could use their phones to trigger sounds and projected images onstage. The dancer, tracked by the Kinect, interacted with the projections, improvising a dance with the light.

The authors approached this project by asking, "How can the audience become an essential element in a performance?" (p. 561). They claim that, while new media has been incorporated into theatre for decades, mobile phones have not been used to their full potential. Feedback collected after the performance revealed overall positive reactions. Some users, however, were uncomfortable having their personal devices connected to an unfamiliar network. Another negative was that not every audience member owned an iPhone; one of these spectators, though, maintained that she enjoyed the show even while being excluded from the interaction.

2.2.6 Reeves, Sherwood, and Brown

This paper investigates the design of technology for crowds by observing and analyzing the behaviour of a group of football fans gathered at a pub. The authors note that most related work has focused on spectators at a performance or on exceptional circumstances like riots. This work instead looks at everyday crowd-based settings where there is no attention-grabbing “spectacle.” To accomplish this, the researchers video recorded a crowd gathered at a pub during a football match and examined the group’s behaviour for recurring themes. People were seen singing, jumping, and pumping their fists in the air in sync with each other. In general, these instances of collective participation were all visible or hearable from far away. Once a small group of people began the actions, they would quickly “snowball” and overtake the crowd. Researchers also noticed the importance of “shared objects;” an inflatable object bouncing between people, for example, connected individuals at a distance. It was also observed, of course, that not every person in the crowd cared to participate in these group activities.

After outlining these observations, the authors present a list of design lessons that they extrapolated. First, they suggest treating a crowd as a unit rather than a collection of individuals – for example, exploiting already-present crowd behaviours or allowing for only partial participation. The importance of “intra-crowd interaction” is also emphasized: allow for shared objects and space-dependent interactions, and take advantage of snowballing by encouraging highly visible/audible actions. Additionally, one should allow for interaction with people on the fringes of the crowd but be aware of problems that could be caused by latency. Lastly, the researchers note that every crowd is different and that each design should reflect the nature of the environment.

2.3 Notable Precedents

2.3.1 Wham City Lights

Wham City Lights is a smartphone application that allows multiple devices to display light shows in sync during a concert. Audience members with an iOS or Android device can download the app before the show. Once the show has begun, an operator activates lighting cues by playing encoded, ultrasonic tones; devices with the app open "hear" these tones and perform the corresponding cues. This can be done at nearly any scale as long as every device is able to hear the tones. Users generally hold their devices up or wave them above their heads during the show. Light shows can be created live or programmed in advance using an online editor; cues include flashing colours, camera flashes, GIFs, text, and sound.

The concept was originally developed by US musician Dan Deacon. His intention was to prevent concertgoers from using their personal devices and disengaging during live performances. Deacon tested the app at his own shows and received a positive response. Today, Wham City Lights licenses their general-purpose app for different kinds of events; they also develop custom apps to include branding, tour dates, etc. Musicians and organizations like Brad Paisley, the Billboard Music Awards, and Intel have made use of this technology at their events.

2.3.2 Xylobands

Xylobands are controllable LED wristbands designed to be worn by potentially thousands of users at entertainment events. They are controlled using a proprietary piece of software downloaded to a laptop; the laptop must then be connected to a radio transmitter. With the software, an operator can turn the Xylobands on or off, select which colours are illuminated, and control the speed of the LEDs' flashing. The transmitter has a range of around 300 meters. Each wristband contains a small printed circuit board that holds, among other components, an RF receiver and an 8-bit microcontroller. The electronics are powered by three 3 V coin cell batteries.

The technology was originally developed for the band Coldplay, and wristbands were handed out to all concertgoers during their 2012 world tour. Giving the wristbands to each audience member at every performance reportedly cost the band €490

000 (around $680 000 CAD) per night. UK-based toy development company RB Concepts Ltd. are the creators of the Xyloband. Their website advertises that Xylobands can be customized and used at concerts, festivals, sports stadiums, or corporate events.

2.3.3 PixMob

PixMob is a patented wireless technology that enables the control of multiple LED-embedded objects. By giving PixMob objects to spectators, concert producers can create a controllable LED light show within the audience. The objects are activated with signals from infrared transmitters. Like normal lighting fixtures, the transmitters' beams can be shaped with lenses and controlled via the DMX512 protocol. The objects light up when they are hit by a beam, so patterns of moving light can, in essence, be painted across the audience. Light shows are programmed, simulated, and controlled through a software package called LAVA; they can also be controlled in real time using a MIDI controller or the LAVA iPad app. Previous PixMob objects include balls, wristbands, pendants, and beads, and custom object creation is available as well. PixMob also offers "second life" customization: objects can be programmed to react to sounds, play an mp3 track, or communicate with the user's personal computer after the show is over. Past clients include Microsoft, Arcade Fire, Eurovision, and Heineken.

Chapter 3

Research Question

Chapter 4

Primary Research

4.1 Audiences

4.2 Performers

Chapter 5

Development

5.1 First Phase

5.1.1 Objectives

The goal of the first prototype was to simply demonstrate how multiple users might interact with a performance using handheld devices. To realize this, I used Wii video game controllers and the Max visual programming software. The final product was to be a VJ system where one user (the "performer") could manipulate looping video clips using a Wii controller and multiple "audience members" could contribute to this manipulation to a lesser degree with their own individual controllers.

5.1.2 Prototyping

My first milestone in this prototype was having a single Wii controller communicate with my computer. Using a program called OSCulator, I was able to read movement and button-push data sent via Bluetooth (see Figure 5.1). From here, the data is sent to a simple Max program (called a "patcher") that I created. The patcher reads various movement data from the controller and visualizes them as different motions

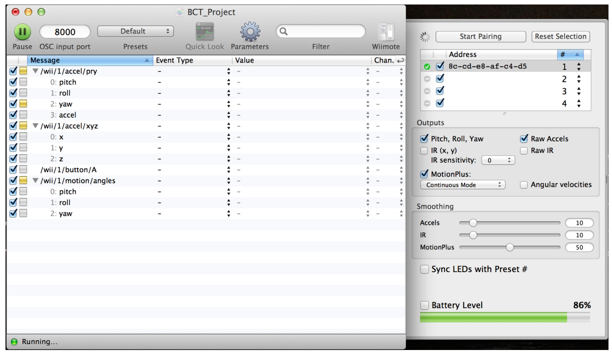


Figure 5.1: OSCulator software receiving data from one Wii controller

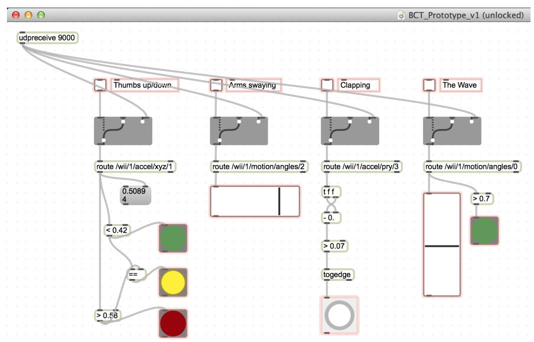
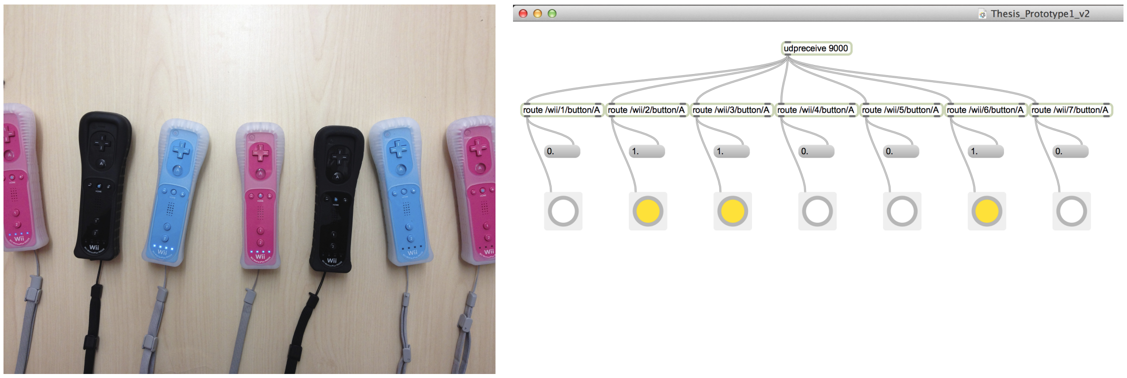


Figure 5.2: First Max patcher

that a typical concertgoer might perform. The motions are: giving a “thumbs up” or “thumbs down”, swaying arms from side to side, clapping, or doing “the wave,” as shown in Figure 5.2. Visual feedback is provided in the form of illuminated LED objects and moving sliders.

My second notable achievement was testing the limit of how many Wii controllers would be able to connect to my computer using the current setup. Since my thesis aims to give every member of an audience a new way to communicate, this number would ideally be limitless. The OSCulator software, unfortunately, could only connect to a maximum of seven controllers. However, for the purposes of this prototype, this number is acceptable. To test this, I created a Max patcher to display data from seven Wii controllers. I synced all seven controllers with OSCulator with no issues,



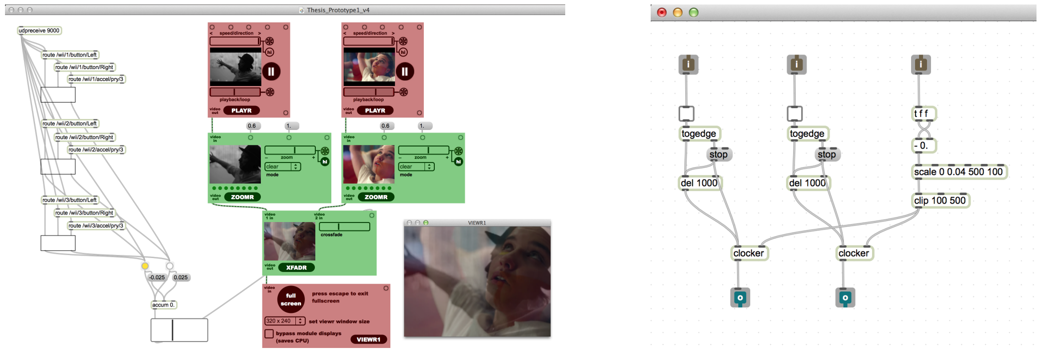
(a) Wii controllers (b) Max patcher

Figure 5.3: Testing simultaneous input from seven Wii controllers

and the program worked as expected (see Figure 5.3).

The next goal was to have multiple Wii controllers collaboratively manipulating a video in some way. I decided to create a patcher where users could “vote” for how to control the video. In this case, I fed two video loops – one monochrome clip of one person dancing and one colourful clip of multiple people dancing – into a crossfader object. By pressing and holding the Left or Right buttons on their controllers, users can vote on which clip dominates the screen. In an effort to experiment with multiple motion data, I also incorporated a mechanism that lets users make their votes count double by shaking their controllers. Lastly, I packaged all of these programming objects into a “sub-patcher,” making the program more modular and readable. Figure 5.4 shows the patcher running with three users.

My next task was to create the VJ program for the performer in my scenario. I spent a lot of time experimenting with video effects in Max. I selected four effects objects that would allow the performer to rotate the image, control pixelation, enable a motion blur effect, and crossfade between two video loops. These are controlled by rotating the Wii controller, increasing the incline of the controller, pressing and holding the A button, and pressing the Left and Right buttons, respectively. An



(a) Main patcher (b) Sub-patcher

Figure 5.4: Video effect voting system with three users

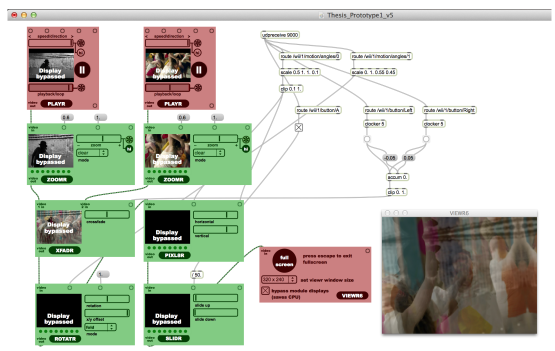


Figure 5.5: Wii controller VJ system

important part of programming this patcher was mapping the data from the controller to the effects controls. Values had to be carefully scaled and clipped in order for the user's movements to translate naturally to the effect they control. The patcher is pictured in Figure 5.5.

The results of the last two victories were finally combined to create my audience-performer interaction system (see Figure 5.6). Here, one user has the VJ controls described in the previous section. The audience voting system, however, is also implemented, allowing the other users to collaboratively control the crossfading of the two clips. Thus, as the performer simultaneously manipulates the two loops, the audience can decide which of them dominates the screen. Additionally, using the

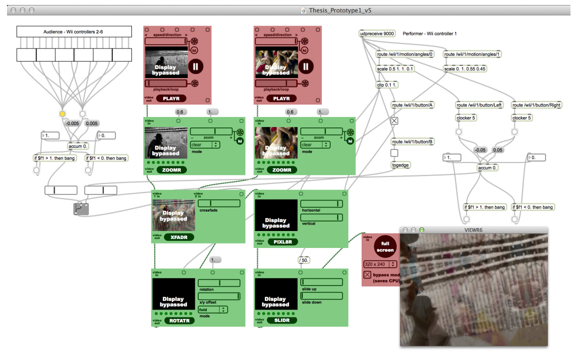


Figure 5.6: Audience-performer interaction system

controller's B button, the performer has the ability to "mute" the audience if their input is no longer desired. This stage required development of more sub-patchers to condense and modularize the program.

5.1.3 User Testing

5.2 Second Phase

5.2.1 Objectives

5.2.2 Prototyping

5.2.3 User Testing

Chapter 6

Implementation

6.1 Production

6.2 Event

6.3 Reflection

Chapter 7

Conclusion

7.1 Discussion

7.2 Future Directions

7.3 Conclusion

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