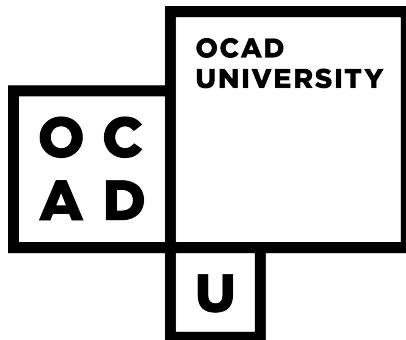


Enabling participatory interactions at
live music performances using digital technology

by

Ryan Maksymic



A thesis submitted to OCAD University in partial fulfillment of the
requirements for the degree of Master of Design in Digital Futures

Toronto, Ontario, Canada, April 2014

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Master of Design in Digital Futures

OCAD University, 2014

Abstract

Technology has long been used to improve the presentational aspects of a live music performance, but less often is it employed to encourage participation from audience members. This thesis investigates how digital technologies might be used to make traditional pop and rock concerts more participatory. A literature review and survey of related projects were first conducted. Preliminary 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

At the 2011 Coachella Valley Music and Arts Festival, Montreal-based indie rock group Arcade Fire are about to play one of the final songs of their headlining set. The guitar riff from the band's hit song "Wake Up" is instantly recognized by the audience, who cheer loudly with excitement. The song reaches the first chorus, and, suddenly, one thousand white beach balls begin tumbling over the top of the stage and gently falling onto the crowd below. The cheers swell into a roar as the balls disperse over the mass of people. When the band hits the song's final chorus, to the spectators' surprise, the balls begin to light up – flashing different colours to the beat of the music. Arcade Fire finish their set, grins on the band members' faces, as they watch the glowing orbs bounce across the crowd. After the show, festivalgoers grab on to the beach balls; cars leaving the festival grounds are seen glowing with the light from what have now become souvenirs from an unforgettable live music experience.

This project was made possible by several teams that managed the logistics, developed the wireless LED devices, fabricated and tested hundreds of beach balls, and ultimately executed the launch¹. The result was an awe-inspiring, albeit momentary, event that extended a live music performance into the audience. Large rock concerts seem to be growing more technically complex and spectacular all the time. Powerful equipment makes shows

¹http://www.momentfactory.com/en/project/stage/Arcade_Fire

louder, larger, and flashier. Only recently, however, have many mainstream artists begun investigating how technology can benefit not just the performance on stage, but the interactions within the audience as well. This thesis examines these sorts of technologies, asking how they might be used to make conventional rock concerts more participatory.

1.1 Motivation

In his 2008 book *Music As Social Life*, musicologist and anthropologist Thomas Turino divides live music performances into two categories – presentational and participatory. In presentational performances, the artist prepares music and presents it to a separate group, the audience. An example of a presentational performance would be a typical rock concert; a band rehearses and plans a set list and then performs it for a generally attentive audience. Participatory performances, on the other hand, deal only with participants and potential participants, and there is no artist-audience distinction. Peruvian communities, for example, perform in large groups with each participant either dancing or playing a panpipe or flute. Contra dances in the midwestern United States can also be considered participatory performances, featuring musicians, pairs of dancers, and a “caller” that provides the dancers with instructions – each an integral part of the event.

Many technologies exist for creating enhanced presentational performances. In general, they are implemented to aid the artist in presenting their music to the audience. When The Beatles did their first tour in North America, for example, they had 100-watt amplifiers custom made to ensure their music could be heard over the incredibly loud cheers of the fans; ultimately, the equipment was not nearly loud enough to overpower the audience (citation). Today, a large arena rock show might implement sound systems demanding tens or hundreds of thousands of watts (citation), enough power to send strong vibrations through concertgoers’ bodies or even, after enough exposure, cause hearing damage. Performers may take advantage of enormous screens that provide far-away fans with close-up views of the show. Complex lighting rigs, laser arrays, and flashy visualizations are also common methods of turning a regular performance into an awe-inspiring spectacle. Recently,

improved webcasting technologies have allowed for the live streaming of concerts over the Internet; a U2 concert streaming on YouTube in 2009 generated ten million pageviews, vastly increasing the reach of their performance².

There is clearly a great deal invested in enhancing the presentational aspect of live music performances in Western culture. As Turino points out, when it comes to presentational performances, profit making is usually the primary goal. Louder speakers and bigger screens mean artists can play larger venues with more seats to sell to fans. On the other hand, Turino admits that participatory performance does not fit well within capitalist societies: “Participatory traditions tend to be relegated to special cultural cohorts that stand in opposition to the broader cultural formation” (p. 36). Why, then, might we want consider technologies that enhance the participatory aspect of performances? As stated by Turino, disregarding its potential financial value, it is music’s function as a social interaction that holds the most value for humans. Levitin (2008) agrees, stating that the social nature of music may have been an important evolutionary adaptation that helped early humans thrive in groups: “Singing around the ancient campfire might have been a way to stay awake, to ward off predators” (p. 258). Thus, while we may no longer depend on participatory performance to the degree that our ancestors did, it seems as though it is against human nature to continue widening the gap between audience and performer. Artists are placed on brightly lit stages with booming sound systems, allowing their voices to echo through stadiums; the voices of audience members, meanwhile, become meaningless noise as more and more people are packed into venues. How might technologies instead be used to embrace the social functions of music and let everyone – performer and audience – be a participant? This attitude is, fortunately, reflected in some of the ways we are using technology today.

The Internet has connected performer and audience in a new way. Social media allows for unique interactions between artists (big and small) and their fans. A small touring band, for example, might send out a message to their followers on Twitter asking for restaurant

²<http://www.wired.com/business/2009/11/4-ways-live-and-digital-music-are-teaming-up-to-rock-your-world/>

suggestions in a town they are passing through. More well-known artists may have difficulty connecting to their growing fan base, but events like “Ask Me Anything” question-and-answer sessions on Reddit allow them to directly answer questions from their supporters. Beyond these social media interactions, the Internet is also continually supplying new ways for musicians and fans to connect. Crowdfunding platforms like Kickstarter rewards fans for directly funding artists’ projects by giving them exclusive gifts; Feedbands³ lets users vote for their favourite musicians each month, and the winning artist gets their record pressed on vinyl in a limited-edition run; using Alive⁴, Japanese promoters can ensure shows get adequate turnouts by having concertgoers commit to buying tickets before artists are even booked to play. The Internet has afforded many new types of participatory experiences for musicians and fans. Recently, digital technologies are being used increasingly to enhance this connection during live performances themselves.

As the music industry continues attempting to find its footing in the digital age, ticket prices for concerts are steadily increasing – seeing a 40% increase from 2000 to 2008, for example⁵. It seems then that, in order to ensure patrons are getting their money’s worth, it is important for performers to deliver a truly unforgettable show. Stages, lighting, and visuals are certainly becoming more extravagant. Some artists, however, are looking to more innovative solutions to wow their audiences. Arcade Fire and Coachella, as described above, succeeded in creating a memorable live music experience using hundreds of wirelessly controlled LEDs. Wham City Lights created a similar experience by using a smartphone application to turn audience members’ personal devices into a synchronized light show⁶. Other instances allow for more direct interactions. At a special performance by R&B artist Usher, for example, fans could send tweets about the performance that would appear on the large screen onstage and then morph into abstract animations⁷. Plastikman, alter ego of Canadian DJ Richie Hawtin, released a smartphone app to accompany his 2010/2011

³<http://www.feedbands.com>

⁴<http://www.alive.mu>

⁵<http://www.musicthinktank.com/blog/the-beatles-tell-us-that-weve-hit-the-concert-price-ceiling.html>

⁶<http://whamcitylights.com/>

⁷http://www.momentfactory.com/en/project/stage/Amex_Unstaged:_Usher

world tour; fans with the app could view a live video stream of the performer’s perspective, reorganize audio samples that Hawtin would use in his performances, and participate in a live chat with other users during the show⁸.

There are countless types of performance exhibited by the world’s various cultures – some more presentational, some more participatory. In Western cultures, presentational performances draw the biggest crowds, and technologies are being developed to make them larger, louder, and more lucrative. We must remember, however, that music is an inherently social activity; by continuing to separate performer and audience, we are potentially reducing its impact as an event that brings people together. Thus, it is valuable to consider how we might use technology to enhance not the presentational aspect of a concert, but the participatory. The popularity of the aforementioned internet services proves the public’s desire for deeper interactions with artists, and recent experiments with interactive systems at live performances have produced impressive results. Lastly, participatory technologies at rock music performances have yet to undergo an academic investigation. I believe, then, that it is worthwhile to survey this fledgling field and better understand its implications on the modern music performance.

1.2 Objectives

The goal of this thesis is to explore how digital technologies can be used to make live music performances more participatory experiences. I have divided this task into three objectives. The first objective is to study relevant literature and perform case studies on existing projects. Literature reviews will pull from works in musicology – to examine the nature of music as a social activity – and human-computer interaction – to understand how interactive systems can be designed for large groups of people. Precedent projects will be analyzed, observing what was done right and what issues are outstanding. After reflecting on what I have learned, my next objective is to identify questions that remain unanswered and conduct my own primary research that addresses them. This will involve surveys and

⁸<http://hexler.net/software/synk>

interviews with frequent concertgoers and performers themselves. The final objective is to determine the criteria for a successful participatory concert technology through multiple rounds of prototyping and user testing. A final version will be implemented at a live music performance, and its effectiveness will be evaluated.

This work brings up some other topics that, while interesting, will not be addressed here. For example, while there exist a wealth of music genres and performance styles, I will be focusing on Western rock concerts performed in standard venues. These environments are commonplace and can accommodate large audiences who are generally free to move around and be vocal; additionally, they are places that I feel comfortable and familiar with. Many of the projects I reference were dependant on a large budget, but, to avoid placing limitations on my own work, financial matters will not be considered. These sorts of issues are outside the scope of this project.

1.3 Overview

- **Chapter 2: Background**

To begin, I will examine related academic and professional work. I will examine music as a social activity, outline research done on designing technology for crowds, and describe some relevant projects that have been implemented at real-world events.

- **Chapter 3: Research Question**

In this chapter, I will establish and justify a research question. I will then describe the approach I will be taking to answer this question.

- **Chapter 4: Preliminary Research**

I will begin tackling my research question by examining the problem from both the audience's and the performer's point of view. This will be accomplished through surveys and interviews with concertgoers and musicians.

- **Chapter 5: Development**

This chapter will cover my prototyping process in detail. For each phase of development, I will first state my objective. Next, I will describe the steps taken to achieve the objective. Lastly, I will present the results of user testing conducted with each prototype.

- **Chapter 6: Implementation.**

Here I will describe the production of the final version of my device. The implementation of the device at a real-world event will be thoroughly examined, and I will reflect on its execution.

- **Chapter 7: Conclusion**

To conclude, I will summarize the overall outcomes of my work and briefly discuss possible future directions for the project.

Chapter 2

Background

This chapter provides a brief history of music as a human activity, live performance, and performance technologies. I also conduct case studies on some specific live music events that are closely related to my interests. Lastly, previous research investigating designing interactive systems for crowds is reviewed.

2.1 Music and Performance

Music is a part of being human. “The archaeological record,” Daniel Levitin (2006) explains, “shows an uninterrupted record of music making everywhere we find humans, and in every era” (p. 256). Early music making was purely rhythmic, with simple objects being used as percussion instruments. As primitive wind and string instruments were crafted, rhythm was joined by melody. Music making gradually evolved in cultures all over the world, and it has grown to serve many different purposes. In New Guinea it is a gift to one’s host; in the Democratic Republic of the Congo it is used to settle lawsuits; Australian aborigines use music to tell intricate stories; and some African tribes believe repeating musical chants can draw harmful spirits out of inflicted individuals (Jourdain, 1997; Turner, 2011). In modern Western cultures, of course, music is everywhere – performed at live concerts, scoring film and television, being shared on the Internet. Regardless of culture, there is no denying the music is an inherently social activity.

Why did music evolve with humans? Anthropologists believe it may have initially been a tool for social bonding, or perhaps a clever survival method (Jourdain, 1997; Levitin, 2006). A drum circle around a fire could improve a group's coordination, but it may also serve to keep everyone awake and ward off predators. In less primitive societies, music is still valuable as a social activity. Musicologist Thomas Turino (2008) talks about the benefits of making music with others – what he calls “sonic bonding.” Referencing the work of anthropologist Gregory Bateson, Turino posits that such artistic experiences promote deep connections to others that are crucial for “social survival.” Thus, music making may be a strong tool in forming and developing rewarding relationships. Christopher Small (1998) suggests that live music performance forms communities that represent ideal relationships; perhaps, in the moment, participants forget reality and feel one with those around them. Anthropologist Edith Turner echoes this idea and gives it a name – *communitas*. “Communitas,” she explains, “occurs through the readiness of the people – perhaps from necessity – to rid themselves of their concern for status and dependence on structures, and see their fellows as they are” (p. 1). Turner identifies *communitas* at work at sporting events, in the workplace, and even during disasters, but she claims music to be the most reliable source of *communitas*. Music is ephemeral, emotional, and it cannot be constrained by rules. “Its life is synonymous with communism, which will spread to all participants and audiences when they get caught up in it” (p. 43). Though we cannot share our bodies with one another, Turner explains, music allows us to share time. It is clear that live music performances can be powerful events; it is important to realize, however, that not all performances are the same.

2.1.1 Performance Types

In his book *Music as Social Life: The Politics of Participation* (2008), Thomas Turino divides music performance into two categories – participatory and presentational. Most cultures exhibit some sort of participatory performance. Peruvian communities perform in large groups with each participant either dancing or playing a panpipe or flute; many

different religious ceremonies involve singing in unison or in a call-and-response structure; line dancing in North America features choreography that is closely tied to the music. In general, the emphasis is on the intensity of the interactions over the quality of the performance, and participatory performances have characteristics that support this. In a purely participatory performance, Turino explains, “there are no artist-audience distinctions, only participants and potential participants performing different roles, and the primary goal is to involve the maximum number of people in some performance role” (p. 26). Equality among participants can lower self-consciousness and lead to a more relaxed atmosphere. Having different roles, on the other hand, allows individuals of different skill levels to contribute accordingly. “Core” and “elaboration” roles, in Turino’s words, cater to less- and more-advanced performers, respectively; core participants keep the performance moving along while elaboration participants add flourish. Another common feature of participatory performances is repetitiveness. This open form allows newcomer participants to easily join in. Additionally, Turino explains, there is a “security in constancy” that allows performers to become more comfortably immersed in the music. Performances may also incorporate loud volumes, densely overlapped sounds, and loosely tuned instruments as “cloaking function” to make individuals more comfortable participating. Solos are not common, although sequential soloing sections are sometimes included; karaoke is an example of sequential participatory performance. Overall, participatory performances allow all participants to feel as though they are contributing, and this makes them quite different from presentational performances.

The opposite of the participatory performance is the presentational performance. Here, the performer presents prepared music pieces to an audience that does not directly participate in the performance (Turino, 2008). A typical Western rock concert is a good example: a band on a stage performs rehearsed songs to an attentive audience whose main role is listening to the music. In contrast with the open form of participatory performances, here there is a focus on detail, smoothness, and coherence. Predictability is key; the artist knows how the performance will progress. While participatory performances rely on constancy,

contrasts are implemented in presentational performances in order to keep the audience's attention. Participatory performances foster connections between participants, whereas presentational performances seem to tease a connection between artist and audience without ever realizing it: "leave them wanting more." Indeed, the goal of a presentational performance is typically to sell as many tickets as possible. It is, in fact, this desire for profit that caused the evolution of presentational performances over the last few centuries.

2.1.2 Evolution of Presentational Performance

Public concerts were virtually unheard of before the 1600s (Jourdain, 1997). Outside of church, commoners rarely had the opportunity to hear "serious" music, and any other music performance was relaxed and participatory in nature. The 'professional' musicians of this era, musicologist Christopher Small (1998) explains, were those hired by aristocrats to accompany them as they played. It was not until the time of the Industrial Revolution that savvy musicians realized that the middle class would see live performances as opportunities to display their newfound wealth. These "traveling virtuoso-entrepreneurs" made money touring from town to town and performing in local parlours. By the 1800s, ticketed events were gradually becoming more abundant and "art music" concerts began transforming the state of the live performance. These were seen as formal events, says Jourdain, and those wealthy enough to attend were expected to follow the established etiquette – sit quietly and listen. Music listeners had been turned into consumers.

Music consumption in the last century has revolved around recorded music. Wax cylinders, records, cassette tapes, compact discs, and digital files have allowed listeners to experience music performances from the comfort of their homes. Today, live performance's purpose is typically to "re-present" these recordings – "reviving the musical corpse," as Jem Kelly (2007) puts it. This does not necessarily make recorded music the primary form; Small (1998) believes that "performance does not exist in order to present music works, but rather, musical works exist in order to give performers something to perform" (p. 8). He suggests that, since technology now allows people to experience performances at home, the

significance of a real live performance actually increases. There are certainly aspects of a live music performance that cannot come from recorded sound. Musicologist Jane Davidson (2006) explains, for instance, that many musicians seem to perform better when in front of an audience; thus, it is possible that the quality of a live performance often trumps that of a recorded performance. Live performances can also be great sources of cultural influence. Ian Inglis (2006), a sociologist studying music performance, agrees: “In its ability to simultaneously reflect and influence patterns of socio-cultural activity, it is one of the principal avenues along which musical change and innovation can be introduced and recognized” (p. xv). For example, an event as momentary as the 1965 Newport Folk Festival – where Bob Dylan first went electric – seemed to change the course of both folk and pop music (Marshall, 2006). The loud guitar startled most audience members, and Dylan was booed as he left the stage. When it comes to popular music today, of course, many will say that louder is better.

Arena rock concerts make use of arrays of powerful speakers, dense lighting rigs, and multiple giant screens, sometimes also incorporating huge stage pieces and complex mechatronics. The main function of this equipment is to amplify the sights and sounds of the performance. As Kelly (2007) explains, however, it also serves to amplify the persona of the performer. Large screens, for instance, often show closeups of those on stage along with visuals that reflect the identity of the performer. When executed properly, says Kelly, these can create a “theatrically structured intimacy” that draws the audience deeper into the performance. This sort of claim is counter to Walter Benjamin’s idea that technological intervention and the desire to get closer to a work causes its “aura” to “decay.” Kelly maintains that amplifying a performer’s presence can serve to enhance the experience in new ways. Showing clips from Madonna’s music videos as she performs live, for example, connects the performance with memories of the past in a way that could not be done without technology. Benjamin’s concerns are further challenged by artists like Gorillaz – an alternative rock band fronted by cartoon characters. Live performances often feature real musicians silhouetted by projections of the fictional band members. German electronic

band Kraftwerk has taken it a step farther for live performances of their song “Robots,” leaving the stage entirely and being replaced by their ‘robotic’ analogues for the duration of the song. The fact that audiences will cheer for a stage void of the performers indicates the influence technology has had on live performance.

So why have visuals become such an important part of concerts? As Philip Auslander (1999) explains, theatre and mass media are in competition, and, since mass media is dominating, theatre has responded by imitating its competitor. Live sporting events make use of big screens and instant replays, for instance, and television shows and movies are regularly adapted for the stage. Live music performance, similarly, became greatly influenced by MTV. As Music Television reached the height of its popularity in the 80s and 90s, concerts began looking increasingly like music videos. Jaap Kooijman (2006) points to Michael Jackson’s 1983 performance of “Billie Jean” at the *Motown 25* concert, where Jackson’s outfit and dancing directly referenced the “Billie Jean” music video. The audience screamed as Jackson exhibited his signature dancing style – never noticing, or perhaps not caring, that he was lip-synching the vocals throughout. Shortly after, Madonna’s performance at the 1984 MTV Video Music Awards...

2.2 A Return to Participatory Performance

Is participatory performance gone forever? Recent behaviour indicates it may not be...

Artists still encourage participation, and some are using technology to do so...

2.2.1 Recent Examples

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.

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.

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.

2.3 Designing for Audiences

Designing for large groups of people has only recently attracted notable interest in the field of human-computer interaction (HCI). As interactive systems become increasingly ubiquitous, HCI researchers are asking how the needs of multiple people in a public space differ from those of an independent user. The characteristics of live performance make it an especially useful venue for these investigations; thus, conveniently, much of the research done in this field focuses on concerts, theatre performances, and dance clubs.

2.3.1 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.

2.3.2 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.

2.3.3 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.

2.3.4 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.

2.3.5 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.

2.3.6 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.

2.3.7 Gates, Subramanian, and Gutwin

This paper examines the complex interactions between DJs and audience members in nightclubs from an HCI perspective. The authors gathered their information by observing behaviours at nightclubs, surveying DJs, as well as conducting lengthy interviews with them. Most DJs had similar preferences and performance styles. For example, all of the interviewees said they preferred venues where audience and DJ are mutually visible; this allows them to adjust their performance based on visual cues from the audience. Using quick glances, DJs can observe audience members’ facial expressions and body language and the flux of people on to and off of the dance floor. Many DJs stated that they will often exaggerate their movement or speak into a microphone to energize the crowd. Small, direct interactions can also occur between DJs and audience members, such as exchanges of facial expressions or gestures. DJs use the information they glean from their audience to shape their performance. Most DJs will craft a playlist before performing based on the venue, event type, and expected audience; during the performance, however, the energy of the crowd ultimately guides how the tracks are mixed. In general, the authors found that, as long as there is sufficient visibility, DJs are extremely competent at adjusting their per-

formance based on the audience. Interviewees saw little need for technology to aid their performances; one of the few wishes the DJs expressed was for a method to discover the musical preferences of a given audience.

Based on the information collected, the authors present some design recommendations for those wishing to bring interactive technologies to nightclubs. For example, they state that, considering how skillful DJs are at observing audiences, any technology meant to gather information from the crowd must be more efficient than DJs themselves. Such technology, the authors suggest, would be most useful for gathering “invisible” information like musical preferences. They recommend against using biofeedback systems or systems where audiences have a direct influence on the performance; these methods do not help DJs do their job. The researchers state that gradual changes are more satisfying than immediate ones. Lastly, they emphasize the importance of respecting the DJ’s art; technologies should allow them to stay in control of the music and should not add to their already-demanding cognitive load.

2.3.8 Feldmeier, Paradiso

Blah...

Chapter 3

Research Question

This chapter will provide an in-depth examination of my research question. Through referencing the existing research outlined in the previous section, I will justify the need for my work. I will then explain the steps I will be taking to address this question.

3.1 Research Question

How might technology be used to add participatory elements to traditionally presentational rock and pop concerts?

3.2 Hypothesis

3.3 Approach

Chapter 4

Preliminary Research

One of my first goals was to get a sense of modern concertgoers' and performers' feelings about participatory performances and interactive technology. I sent out a brief online survey for music fans that helped me to understand how they generally responded to these topics. Interviews were also conducted with multiple musicians to shed light on their perspectives.

4.1 Audiences

An online survey was created in order to obtain a sample of modern music fans' opinions on interactive performances. The survey was completed by ninety-nine participants recruited via social media. The first few questions informed me of what type of concertgoer each participant was – asking their favourite genre, the size of the venues they frequent, and how often they attend live music performances. I also asked how often the participants communicate directly with musicians through their social media presences. Next, the survey focused on concert behaviours. Participants were asked in which actions they typically partake at live music performances; choices included applauding, headbanging, and holding up lighters. They were asked how they might like to interact with their favourite performer and what sort of message they would send them if they could. I asked for their thoughts on getting involved in performances, bringing new technologies into concert settings, and interacting with musicians using social media services. (For complete results, see Appendix

X.)

The results were not shocking but certainly informative. Most participants favoured rock music or some variation (“indie,” “alternative”); the majority attended multiple concerts per year – some even on a weekly basis; and most usually went to shows at small- to medium-sized venues. The majority of participants claimed to communicate with artists through social media either sometimes or regularly, though a sizeable amount indicated they never do this. The most popular concert actions were applauding, singing along with the performer, clapping or stomping to the beat, dancing, jumping up and down, and chanting words or phrases along with the other audience members. When asked how they might want to interact with a performance, many said they would like to choose the songs that are played, while much fewer expressed interest in manipulating visuals and contributing to the music; around one quarter of participants stated they did not have interest in directly influencing a live music performance at all. Given the opportunity to communicate with their favourite performer, most participants responded with praise or appreciation (“Thank you,” “I love you!”). Other messages included song requests and suggestions like, “Don’t bury the vocals,” or “More rock, less talk!” The majority of participants indicated that they enjoy when performers ask them to participate in a performance – clapping or singing along or call and response, for example. Lastly, the majority also said they were excited by the idea of bringing new technologies into a live music setting.

Upon further analysis of the responses, some correlations were uncovered. There are clear relationships between show-going frequency, venue size, and interest in interaction and technology. Participants attending shows more frequently are more likely to visit smaller venues. This group also expressed the most interest in being involved in performances; they are more inclined to interact with their favourite artists via social media; and they are more welcoming to the idea of unfamiliar technology in a concert setting. The opposite, thus, can also be said: participants who go to fewer shows tend to go to larger venues, are more likely to refrain from participating in shows, are less likely to contact artists through social media, and are less interested in new technologies.

A few general conclusions can be made from these results that are particularly relevant to my research question. It is encouraging to confirm that most participants are not quietly standing still at live performances; they are cheering, moving, and singing along. A surprising find was that, given the chance to say anything to their favourite artist on stage, most participants would choose simple messages of praise or thanks – something ostensibly achieved already by applauding. Also intriguing was the relative lack of interest in influencing lights and visualizations. Instead, the majority of participants showed great interest in choosing the set list for the performance. Regardless, it is clear that most respondents have little to no reservations about being directly involved in a show and doing so with new technologies. Seemingly, this willingness to interact is more common in those who frequently attend performances at smaller venues. Perhaps, then, artists that play to smaller crowds and can offer more direct interactions both on and off stage have fan bases that are more willing to experiment with new interactions.

4.2 Performers

With a broad overview of audience attitudes, the next step was to speak directly with actual performers and see how their opinions compared. Four musicians – Christian, Erik, and Blake – were interviewed, all members of different bands that perform some variation of rock or pop music, with typical audience sizes ranging from fifty to five hundred people. After briefly establishing their history as performers, I asked each about how they like to interact with their fans. The musicians were shown video of some of my case study subjects (including Xylobands, Wham City Lights, Kasabian), and I asked for their reactions and general thoughts on technology-enabled performances. Lastly, the artists were asked how they might want to incorporate participatory technologies into their own shows.

Christian is the frontman for a Toronto-based new wave group that has been active for several years. He comes from a theatre background but has been playing in bands since he was fourteen. Christian was performing acoustic music during his post-secondary degree, but he was growing increasingly fond of dance music, and he eventually formed a duo that

made use of computer software to play danceable pop music.

Chapter 5

Development

This section describes the chronology of this project’s various prototypes. The successes and failures are described, detailing the story of how I arrived at my final product.

5.1 First Phase

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 a system that allowed seven users to simultaneously manipulate a video loop by performing “audience-like” motions.

5.1.1 Prototyping

The first step in creating an initial prototype was deciding on the hardware and software that would be used. Wii video game controllers have an abundance of sensors: they contain eleven digital buttons, an infrared sensor, an accelerometer, and a gyroscope (in the newer “Wii Remote Plus” models), and all of this data can be sent wirelessly to a receiver via Bluetooth technology. In addition to these affordances, due to the console’s popularity, the Wii controller is also something that many people are already comfortable moving with – shaking, waving, swinging. With these considerations, I decided that the Wii controller was

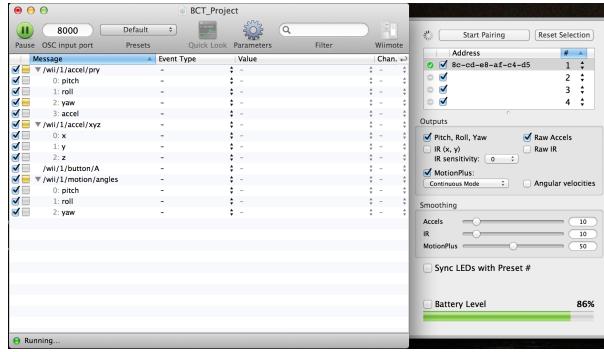


Figure 5.1: OSCulator software receiving data from one Wii controller

a suitable input device for my experiments. Next, I had to find software to process this data. After consulting multiple sources, it became evident that the best way to interface with Wii controllers was to use a combination of two software packages called OSCulator and Max. OSCulator is a program that receives data from devices like MIDI controllers and outputs it using the Open Sound Control (OSC) protocol. Fortunately, it is also preset to communicate with Wii controllers, conveniently displaying live data from each sensor. The OSC data can then be sent to Max, a visual programming environment that is especially useful for handling multimedia. Max is commonly used by musicians and video artists to create highly customized and interactive programs.

My first milestone for 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 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

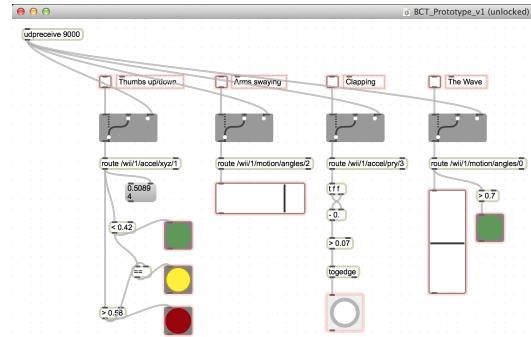


Figure 5.2: First Max patcher



Figure 5.3: Testing simultaneous input from seven Wii controllers

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, 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

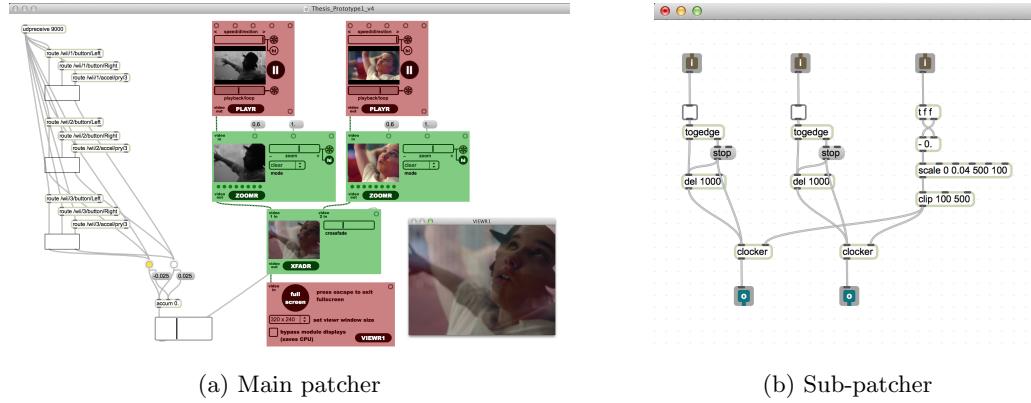


Figure 5.4: Video effect voting system with three users

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 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 controller’s B button, the performer has

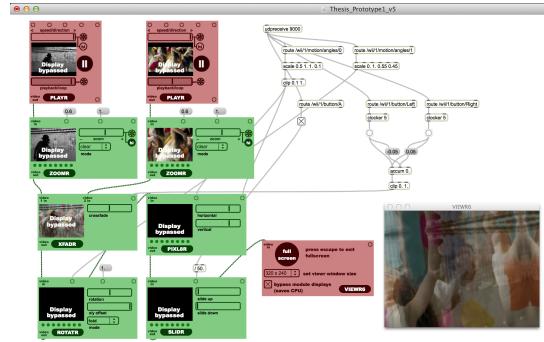


Figure 5.5: Wii controller VJ system

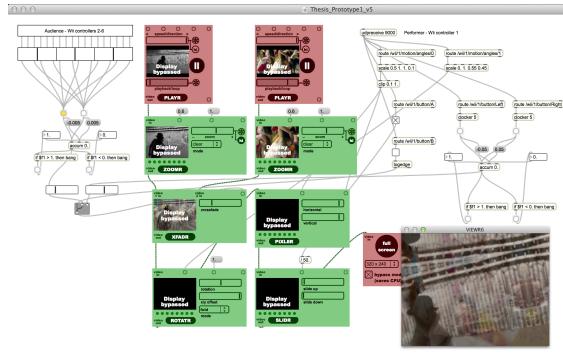


Figure 5.6: Audience-performer interaction system

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.

- I updated the look of the patcher, adding a dark background with light text.
- I added an auto-play function. This automatically flips through every round, playing each for a set amount of time.
- Added Lighters and Dance modes.
- Integrated video crossfade voting system within each mode.
- Added sub-patcher to lighten the processing load
- Polished off presentation mode.

5.1.2 User Testing

The first user testing was run at eLeo – an interactive exhibit hosted by OCAD University. My prototype was set up in a room with a wall-sized projection. Here, my goal was to observe how users approached the technology and how they performed the various inputs.

5.2 Second Phase

5.2.1 Prototyping

5.2.2 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

References

- Aigner, W., Tomitsch, M., Stroe, M., & Rzepa, R. (2004). Be a judge! Wearable wireless motion sensors for audience participation. In *CHI '04 Extended Abstracts on Human Factors in Computing Systems* (pp. 1617–1621). New York, NY, USA: ACM.
- Auslander, P. (1999). *Liveness: Performance in a mediatized culture*. Routledge.
- Barkhuus, L., & Jørgensen, T. (2008). Engaging the crowd: Studies of audience-performer interaction. In *CHI '08 Extended Abstracts on Human Factors in Computing Systems* (pp. 2925–2930). New York, NY, USA: ACM.
- Baym, N. K. (2012). Fans or friends? Seeing social media audiences as musicians do. *Participations: Journal of Audience & Reception Studies*, 9(2), 186–316.
- Bongers, B. (1999). Exploring novel ways of interaction in musical performance. In *Proceedings of the 3rd Conference on Creativity & Cognition* (pp. 76–81). New York, NY, USA: ACM.
- Burns, G. (2006). Live on tape. Madonna: MTV Video Music Awards, Radio City Music Hall, New York, September 14, 1984. In I. Inglis (Ed.), *Performance and popular music: History place and time*. Ashgate Publishing, Limited.
- Davidson, J. W. (1997). The social in music performance. In D. Hargreaves & A. North (Eds.), *The social psychology of music*. Oxford University Press, Incorporated.
- Feldmeier, M., & Paradiso, J. A. (2007). An interactive music environment for large groups with giveaway wireless motion sensors. *Computer Music Journal*, 31(1), 50–67.
- Gates, C., Subramanian, S., & Gutwin, C. (2006). DJs' perspectives on interaction and awareness in nightclubs. In *Proceedings of the 6th Conference on Designing Interactive*

- Systems* (pp. 70–79). New York, NY, USA: ACM.
- Inglis, I. (2006). *Performance and popular music: History place and time*. Ashgate Publishing, Limited.
- Jourdain, R. (1997). *Music, the brain, and ecstasy: How music captures our imagination*. William Morrow and Company.
- Karpovich, A. I. (2007). Reframing fan videos. In J. Sexton (Ed.), *Music, sound and multimedia: From the live to the virtual*. Edinburgh University Press.
- Kelly, J. (2007). Pop music, multimedia and live performance. In J. Sexton (Ed.), *Music, sound and multimedia: From the live to the virtual*. Edinburgh University Press.
- Kershaw, B. (2001). Oh for unruly audiences! Or, patterns of participation in twentieth-century theatre. *Modern Drama*, 44(2), 133–154.
- Kooijman, J. (2006). Michael Jackson: Motown 25, Pasadena Civic Auditorium, March 25, 1983. In I. Inglis (Ed.), *Performance and popular music: History place and time*. Ashgate Publishing, Limited.
- Levitin, D. J. (2006). *This is your brain on music: The science of a human obsession*. Penguin.
- Marshall, L. (2006). Bob Dylan: Newport Folk Festival, July 25, 1965. In I. Inglis (Ed.), *Performance and popular music: History place and time*. Ashgate Publishing, Limited.
- Maynes-Aminzade, D., Pausch, R., & Seitz, S. (2002). Techniques for interactive audience participation. In *Proceedings of the 4th IEEE International Conference on Multimodal Interfaces* (pp. 15–20). Washington, DC, USA: IEEE Computer Society.
- Néda, Z., Ravasz, E., Brechet, Y., Vicsek, T., & Barabási, A. (2000). The sound of many hands clapping. *Nature*, 403(6772), 849–850.
- Reeves, S., Sherwood, S., & Brown, B. (2010). Designing for crowds. In *Proceedings of the 6th Nordic Conference on Human-Computer Interaction: Extending Boundaries* (pp. 393–402). New York, NY, USA: ACM.
- Sexton, J. (2007). *Music, sound and multimedia: From the live to the virtual*. Edinburgh

- University Press.
- Small, C. (1998). *Musicking: The meanings of performing and listening*. Wesleyan University Press.
- Tseng, Y.-C., Huang, Y.-C., Wu, K.-Y., & Chin, C.-P. (2012). Dinner of Luciérnaga: An interactive play with iPhone app in theater. In *Proceedings of the 20th ACM International Conference on Multimedia* (pp. 559–568). New York, NY, USA: ACM.
- Turino, T. (2008). *Music as social life: The politics of participation*. University of Chicago Press.
- Turner, E. (2011). *Communitas: The anthropology of collective joy*. Palgrave Macmillan.
- Ulyate, R., & Bianciardi, D. (2001). The interactive dance club: Avoiding chaos in a multi participant environment. In *Proceedings of the 2001 Conference on New Interfaces for Musical Expression* (pp. 1–3). Singapore, Singapore: National University of Singapore.