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Faculty of Informatics

Game-based audience participation in live performances

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DIPLOMA THESIS

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in

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by

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Vienna, 1st October, 2017

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Erklärung zur Verfassung der Arbeit

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Wien, 1. Oktober 2017

Lukas Gartlehner

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Kurzfassung

In den darstellenden Künsten nehmen technische Hilfsmittel einen immer größeren Stellenwert ein. Dies unterstützt zwar die Umsetzung neuartiger künstlerischer Ideen, bringt jedoch in vielen Fällen eine Distanzierung zwischen Publikum und Künstlern mit sich, wodurch technologische Artefakte zu einem Hindernis in der Interaktion werden können. Ziel dieser Arbeit ist es neue Methoden des Einsatzes von Technologien in der darstellenden Kunst zu erforschen die dem Publikum ermöglichen eine aktive Rolle einzunehmen. Dieser partizipative Charakter soll durch spielerische Elemente unterstützt werden. Das Design, die Entwicklung und die Evaluierung eines Prototypen für technologisch unterstützte Publikumsinteraktion stehen im Mittelpunkt dieser Arbeit.

Im Vorfeld der Konzeption des Prototypen wurden dabei umfassend Daten über den Einsatzbereich erhoben. Hierfür wurden Interviews geführt, ein Workshop abgehalten und eine Kooperation mit Musikerinnen aufgebaut. Die Entwicklung des Prototypen basierte auf einem iterativen Vorgehen, wobei der Stand der Entwicklung regelmäßig mit kooperierenden Musikerinnen besprochen wurde. Für die Evaluierung des Prototypen wurde ein Feldtest durchgeführt. Während dieses Feldtests wurden mit unterschiedlichen Methoden Daten erhoben. Zu diesen Methoden zählten Fragebögen für das Publikum, eine Videoanalyse zum Verhalten des Publikums während der Veranstaltung, die Auswertung von Logfiles der Software sowie anschließende Interviews mit den mitwirkenden Musikerinnen.

Durch das erhobene Material konnten Parameter für erfolgreiche Publikumsinteraktion identifiziert werden. Darunter sind der Aufbau eines stetigen Spannungsbogens, Raum für Improvisation sowie ein hohes Vertrauen in die einwandfreie Funktionsweise der technologischen Hilfsmittel.

Für die Sicht des Publikums konnten wir die hohe Bedeutung einer einfachen und intuitiv verständlichen Interaktion erkennen. Weiter konnten wir feststellen dass es essentiell ist weder Publikum noch Musiker mit den zusätzlichen Mitteln der Interaktion zu überfordern. Durch die Dokumentation jeder Phase, sowie einer Analyse der eingesetzten Software- und Hardwaretools, konnten wir potentielle Fehlerquellen auf technischer wie konzeptioneller Ebene beschreiben.

Der Prototyp erfüllte die Zielsetzung Publikumsinteraktion positiv zu beeinflussen teilweise. Jedoch wurde das Konzept von den teilnehmenden Musikerinnen wegen der

Einzigartigkeit und dem experimentellen Charakter wertgeschätzt. Auch das Publikum war während des Feldtests in hohem Maße daran interessiert die Interaktion mit dem Prototypen zu erkunden.

Abstract

Modern performing arts is increasingly reliant on stage equipment. While technology has enabled artists to create novel performances, the use of technology often comes with the downside of putting more distance between audience and artists. Technological artifacts can act as an obstacle for interaction and audience participation. This thesis aims towards finding new ways to use technology in live performances that allow the audience to take an active role in a performance and to use game mechanics to foster audience participation. The design, development and evaluation of a prototype for technology mediated audience participation in concerts is the centerpiece of this thesis.

During the design of the prototype we gathered data about the context by interviewing experts, hosting a workshop and building a cooperation with musicians. The prototype development followed an iterative approach where the state of development was regularly reviewed together with the cooperating musicians. To evaluate the prototype we conducted a field test in which we gathered data from different angles. Our methods consisted of questionnaires for the audience, interviews with the musicians, video analysis on the movement of the audience during the field test and analysis of the logfiles of our software.

By analysing the gathered material we could identify parameters for successful audience participation from the musicians perspective. Among these are a steady arc of suspense with room for improvisation and a reliable setup that allow the musicians to concentrate on their performance without worrying about the technology. Moreover, we were able to develop a guideline for designing the audiences influence on a performance. For the audiences perspective we learned that successful interaction should be designed in a simple and easy to grasp way. Furthermore, we found that it is crucial not to overwhealm musicians and audience with complex interaction. By providing a detailed overview on each phase of the process, including a analysis of the software and hardware tools we used, we were able to depict potential pitfalls both on the conceptual and technical level.

We conclude that our prototype did partially fulfill the requirements for successful audience participation. The interaction between audience and musicians did not happen as anticipated, mainly because the interaction concept was not intuitive enought. However, we learned that the musicians valued the unique and experimental character of the setup. From our data we further learned that the audience was slightly overwhealmed by the performance, but keen to explore the unique setup.

Contents

CHAPTER 1

Introduction

Performing arts have been part of human culture for centuries. Each era, region and people have their own history of performing arts that, in most cases, is tightly interwoven with the local culture and tradition. One of the classifications for performing arts is to distinguish theater, dance, music and opera as different categories of performing arts [36]. Despite the fact that many modern performances operate on the borderline between these traditional categories, there is one characteristic that these art forms have in common: they only exist in the moment of the performance.

This ephemeral characteristic is what demarcates performing arts from other forms of art. While movies, sculptures, novels or photographs have some kind of physical embodiment, performing arts vanish after the performance and leave behind only an empty stage. This ideal of creation exists in a sharp contrast to the maxims of our time, which is characterized by the reproducibility that mass media content offers and by the deterministic behavior of software that is designed to always act as expected. Plays are recorded and uploaded to online video platforms, live concerts are meticulously planned beforehand to deliver the exact same experience to all spectators of a tour, which arises the question how this changes the concept of ephemeral work of art.

Auslander calls this process of mass media interfering with performances "mediatized performance" and asks the question if this alters the liveness in performing arts [4]. This process of technology-induced change goes both ways, since live performances make use of reproducible media in various ways, for example by playing prerecorded music and video material in plays. Furthermore, the excessive use of technology in the context of performing arts has created an artificial barrier between audiences and performers. The orchestra pit of the opera can be found in different manifestations from rock concerts to techno clubs, creating a pulpit for the performing artists from which they address the audience.

Although it might be necessary for reasons of security and organization to separate the audience from the artists in various situations, for example open air concerts, this often enforces a unidirectional communication, putting the audience in the role of a passive recipient with little to no means of interaction.

1.1 Problem statement

Technology has become an essential part of modern live performances. Without spotlights, fog machines, strobes and amplified sound, only a fraction of todays productions in performing arts would be possible. However, this use of technology has created a barrier between audience and performer, reducing the possibilities for interaction. Not only does this effect the degree of interaction that is possible, it further changes the ephemeral aspect of the performance, effecting the experience of liveness that a performance creates. This technology-driven approach puts both the performing artists and the audience in predefined roles. Sound engineers manage the audio, technicians take care of the lighting on stage, musicians, actors and dancers act in the same manner, bound to their role in the same way as members of the audience, who often feel obliged to witness without interfering.

The primary research objective of this thesis is to find out if technology can help to intensify audience participation in live performances. More specifically, we ask if interaction concepts of games can be applied to the context of live performances and if so, which parameters have to be considered to create beneficial interaction between artists and the audience.

1.2 Aim of work

This thesis aims towards providing a broad view on the topic of audience participation and to use this insight for building a prototype setup for a live performance. The prototype makes use of game mechanics to foster the involvement of the audience and enables us to gather empirical data from the participating artists and audience. By developing a prototype and conducting a field test we aim toward finding out if this technological enhancement is perceived as adding additional value to a performance.

Furthermore, we want to find and describe factors that have a positive influence on technology mediated audience participation. In this thesis we will discuss all gathered data, but an emphasis is put on the musicians perspective. The practical aspects leading to the development and evaluation of the prototype are conjoint work with Naida Comaga, who also uses the gathered data for her thesis and will put the focus on the audiences perspective.

1.3 Methodology

As the development of a prototype is part of this project the work on the thesis is structured in three partly overlapping phases, which are the design, the development and the evaluation phase.

1.3.1 Design phase

This marks the starting point of the thesis and project. By reviewing the state of the art in the field a basic understanding of the possibilities and constraints was developed. Based on these findings we were able to host a workshop with representative stakeholders from the fields of music, performance and game design. The workshop allowed us to create knowledge maps for the context of audience participation and games.

In addition, an interview with the game designer Lev Ledit was conducted to gain insights in the area of interactive play. During the design phase we were able to establish a cooperation with two musicians with whom we met on a regular basis for over 6 months. These meetings allowed us to gain vital feedback on our initial ideas by presenting them to people with profound knowledge in the field of live performances. We collected ideas and created draft concepts which we then reviewed together with experts from the "Breaking the Wall" project.

1.3.2 Development phase

With the information gathered during the design phase we were able to define the technical setup for the prototype. We further planned a field test for the prototype and a procedure for evaluation during this phase. To evaluate the response of the audience a questionnaire was designed. For the evaluation of the artists perspective we designed a semi-structured interview. Moreover, we planned to record the audiences movements during the performance and added a logging feature to the software.

1.3.3 Evaluation phase

In the final phase we organizing an event which acted as a field test for our prototype. Local musicians, with whom we cooperated since the design phase, played during this field test and thereby used the prototype. We recorded the performance with a wide angle camera and analyzed the footage to find behavioral patterns in the audience. Furthermore we handed out questionnaires to the audience. After the performance we conducted semi-structured interviews with both musicians. By analyzing this diverse set of data we were able to assess the field test and find parameters we assume to be relevant for successful technology mediated audience participation.

1.3.4 Overview on phases and distribution of work

Although a complete separation of responsibilities in a cooperatively developed project is not practical, a rough distribution of roles and responsibilities was defined. This distribution of roles throughout the three phases is shown in the diagram 2.1. However, both thesis aim towards providing at least a basic overview on all relevant topics of the prototype and its evaluation.

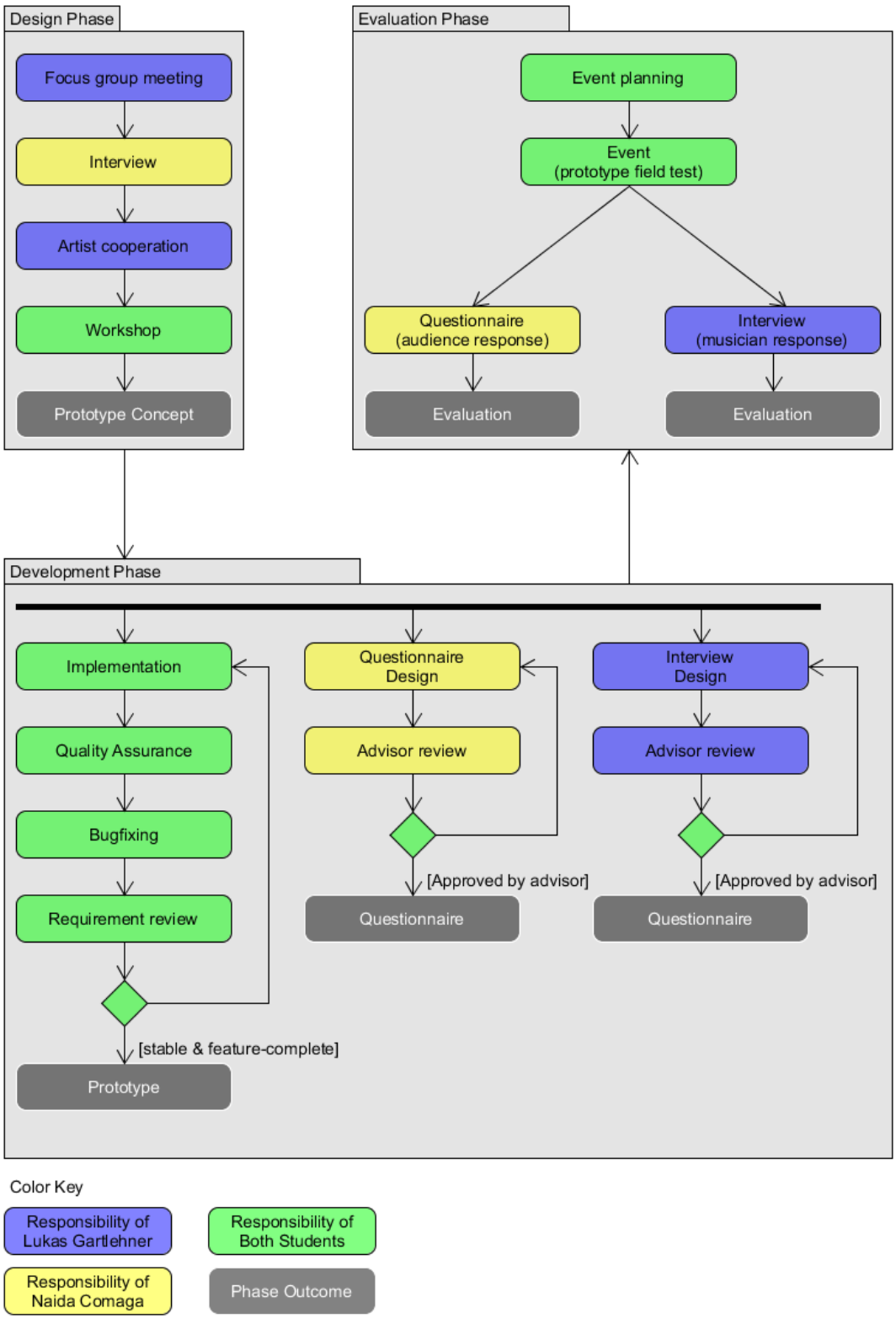


Figure 1.1: Overview on the distribution of roles between Naida Comaga and the author. During the design phase the responsibilities were divided by tasks, e.g. holding interviews or focus group meetings. The development of the prototype was done in a cooperative manner, as is the evaluation event. Naida Comaga focused on the evaluation of the audience perspective, while the author focused on the artists point of view.

CHAPTER 2

State of the art

In order to understand the current developments in audience participation it is first necessary to define and comprehend the context of audience participation. Therefore, this chapter will depict the history of audience participation in performing arts before presenting contemporary projects in the field of technology mediated audience participation.

2.1 Historic context

Identifying the sole origination of performing arts is close to impossible, since every ritual from dancing around the fireplace to making rhythmic sounds with found materials could be defined as a simple prestage to our modern-day understanding of performing arts. However, taking a look at the ancient Greek performing arts offers a well documented source of information that dates back over 2500 years. With the end of the era of monarchs and the rise of the free-born citizens in 508 BC begins the golden age of ancient Greek theater. In this period in Athens a dance-space is built, close to the temple of Dionysus, which is named orchestra and a viewing place close to it called theatron.

But far more interesting than the etymological origin of the words theater and orchestra is the close tie between the rise of democratic institutions and the increasing importance of theater in ancient Greek culture. The performers sang and acted in the form of contests, showing their talents in the dithyramb, a contest for singing and dancing, as well as the tragoidia, the tragedy. Moreover, the city magistrate organized the festivals and paid the actors and prizes. [10] In a society with highly developed institutions that existed without the technological means of mass communication, before the printing press, the radio or digital communication, it can be assumed that the forming of a public opinion was reliant on these competitions. With gatherings of 10.000 to 20.000 people in the theatron about 25% of the population of Athens would be present for the competitions, which would also be used as a platform for political ceremonial. [10]

The importance of these festivals for the city of Athens can be illustrated by looking at the life of Sophocles, who won the dionysian festival for twenty times and was later awarded the post of Hellonotamias, the treasurer and given a generalship in the Samic War. [17] Although performing arts can exist for the mere purpose of entertainment, the ancient history it derives from is, at least in the case of Greek theater, strongly connected to the ideal of polis and democracy. Performing arts are supposed to be more then reciting a texts for the audience, they are allowed to provoke, arise questions, get the audience to reflect their thoughts and ideally to trigger a discussion about the overall theme. Participation of the audience, in this case in the political and social domain, was an integral element of the ancient Greek theater.

Another form of audience participation in performances, although in a quite different manifestation, can be found in the theater of 18th century England. Due to changes in the structure of society theater was no longer a privilege of the upper class, but a form of entertainment for the wider public. This also meant that artists in the theater where not protected by rich patrons of the upper class anymore, but instead they were reliant on the audiences willingness to pay for their amusement. If the audience was displeased with a play it could lead to a variety of measures, from throwing fruit, to chanting or even climbing the stage and rioting. Since it was expected that the audience would react in such a manner, the theater managers used this response to adjust the repertoire and identify the popular actors. [18] Even though theaters in 18th century London did not have the same social and political role compared to the theater of ancient Athens, participation was also an integral component of performing arts, delivering valuable feedback to the artists.

Today it is hard to imagine that a Shakespeare play in an established theater would be accompanied by chanting crowds or fruit being thrown on the stage. The common perception of theater nowadays is often an image of dull bourgeois entertainment combined with the affordance to bow to intellectual etiquette. The Avant-garde performance movement of the 1950s questioned the image of theater as a static exhibit by creating a new genre of performance. Pioneered by Allan Karpow the idea of "Happening" was created. Inspired by the paintings of Jackson Pollock, who used the so called action-collage technique to assemble diverse materials in a fast paced process, Karpow wanted to create performances with "(...) a strong immediacy and physical presence" [26].

By questioning the traditional structure of theater, e.g. dramaturgy, roles of spectators and artists, coherent storytelling, Karpow aimed towards creating an immediate experience for his audiences. Happenings allow participation on another level, not the intellectual participation of the Greek theatron, neither the chanting of the 18th century Shakespeare play, but a way of participation that demands immediate reaction from the actors. According to Jean-Jaques Lebel Happenings should "(...) stir spectators out of the habitual passivity to which literary theater and the mass media have conditioned them" [26]. The idea of the Happening takes the participatory aspect one step further by removing the constraints of roles and dramaturgy. If every person in the room can take part in the Happening and no coherent storyline has to be preserved, it is possible to

create a truly unique and ephemeral experience for the audience. In the late 1960s and early 1970s Alan Karpow and Wolf Vostell added a socio-political nuance to the theory of the Happening. By undermining the anonymous element in culture, Karpow hoped for a renewal of culture which would subsequently lead to a new, more confident and intellectual society [51]. When Karpow wrote "The line between art and life should be kept as fluid, and perhaps indistinct, as possible." [30] this could be seen as part of an utopian vision of performing arts, in which performance and participation are so closely connected that they become part of the daily life and operate as a catalyst for the participation in political process.

2.2 Classification

When looking at arts at large it seems that the boundaries of forms of art are clear and delimitable. But by observing these boundaries in detail it becomes apparent that there is room for uncertainty in most definitions.

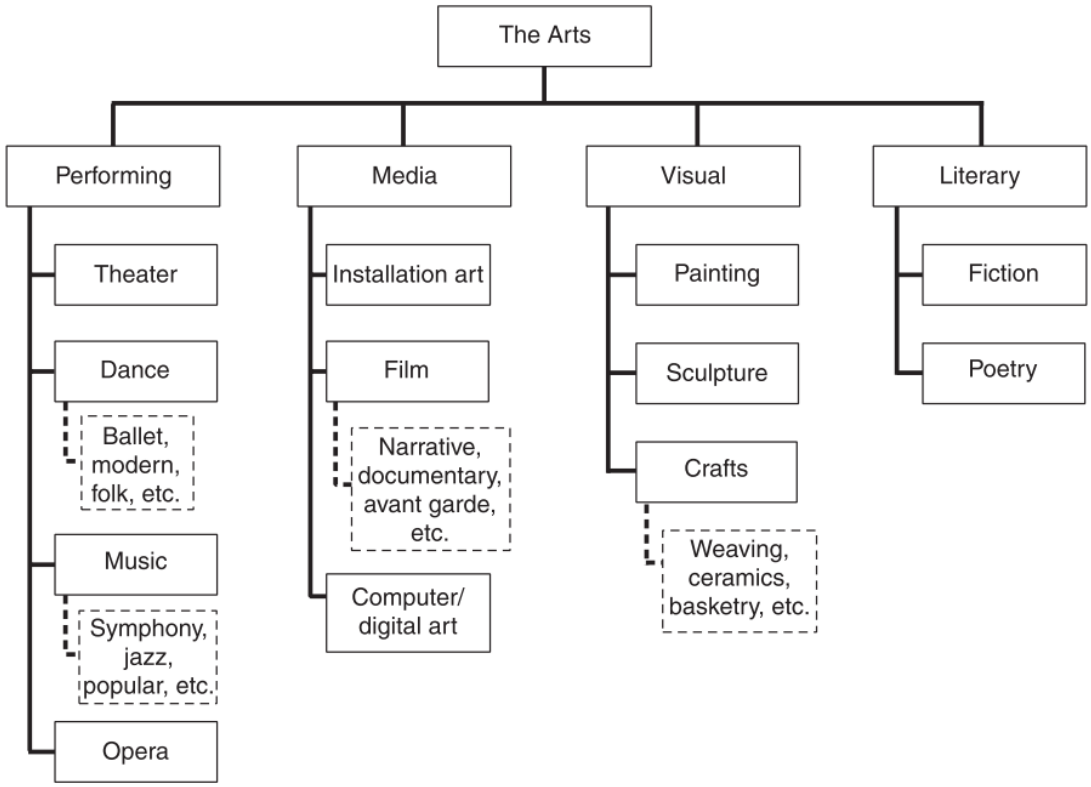


Figure 2.1: Classification of arts by categories, defining performing, media, visual and literary as the four main categories. Taken from [36]

As figure 2.1 shows a common approach to segregate art forms is the division into four categories which are performing, media, visual and literary. Perhaps visual and literary

qualify as the most distinguishable of those four categories, since the product of these arts are well defined. In the case of visual arts a painting or sculpture is the physical artifact that represents an evident manifestation of the process of creation. Contrary to that, literary does not create a single artifact, but a reproducible intellectual product. In the case of media both these assessments could be true at the same time, since a mixed media installation could make use of both visual and literary content. The scenario gets even more complex if we take a close look at the category of performance in this definition.

Even inside this category there are discrepancies, since for example opera is a separate subcategory, although it might be viewed as a combination of features from theater and music, raising the question if musicals should be listed as a separate category as well. However, keeping in mind the ideas of the Happening and Fluxus movement, the dividing barriers between performing and media seem hard to preserve. A avant-garde play in the spirit of Karpow and Vostell would most likely make use of mixed media elements, leading to a combination of at least installation art and theater. Furthermore, creating a separate subcategory for digital art that exists only in the domain of media seems slightly anachronistic in a time of rapid informatization. Of course digital art can exist on its own, but it has become a supporting element in many other forms of art.

In [12] the "Broad Categories of Art" are similar to the four main categories described above, with only one addition, the category of "Design, building, decorative". However, the definition of these broad categories this complemented by a table defining the types of art, which holds examples for both the term "Media Arts" and "Multimedia and other performances". While media arts, according to the definition of [12], can be animated film, computer art, choreography and the composition of music videos, the type multimedia and other performances includes happenings, exhibitions or the circus. This definition seems to offer less distinction between forms of art when compared to [36], but due to its flexibility it offers more leeway for forms of art that are hard to describe with the traditional categories.

It might be argued that specific productions still would not fit into this set of categories, but many artists work in a way that aims towards pushing the boundaries of traditional genres, therefore an exact classification of types of art is a task that is unlikely to succeed. Nevertheless, these definitions create boundaries that separate types of art not for the purpose of limiting the creative process, but to raise awareness that these constraints exist and maybe even to encourage artists to deliberately cross these boundaries.

2.3 Ephemerality

As mentioned beforehand the momentary shape is widely seen as the defining element of a live performance. In the previously described context of the ancient Greek theater or the 18th century theater of London this momentary shape is quite well defined, since there was no means of recording. After the performance had happened, it vanished and only lived on in the memories of the audience. This understanding of ephemerality was

slowly undermined by the possibilities of audio and video recording. Documenting unique performances saves these moments from being lost for those who were not there, but it destroys uniqueness of the moment. Reason describes this tension as "(...) both the saviour and the death of live performance" [41] and further states that by documenting and saving these moments the original performance gets "overwritten". In conclusion he describes video as a way to create lasting documents of otherwise momentary events. Due to its direct and simplistic approach, putting a camera in the room and pointing it towards the event, he states that recording creates immediacy.

Then again this immediacy is full of artifacts that derive from the process of recording, since the position of the camera defines the point of view, the resolution of the recording changes the sharpness of the image and the color space and compression ultimately influence the aesthetics. Therefore, recorded immediacy can only be the illusion of immediacy, very much like the pipe in René Magrittes famous painting "The Treachery of Images" is not the real pipe, but a mere representation of the real object. The recording of a live performance is as much live and ephemeral as the pipe in the painting can be stuffed with tobacco. Reason further argues, that recordings themselves can create ephemerality because analog media, such as magnet tapes, lose a little of their original quality with each time they are played. But digital preservation of data has made this argument obsolete.

Auslander is taking this discourse even further by using the term "mediatized performance" [4] to describe the reciprocity between the live and the recorded. The word mediatized, which was originally coined by Jean Baudrillard, is used by Auslander as a term for the technical reproduction of cultural objects by mass media. He states that the mediatized culture has created "an impossible oscillation between the two poles" of the live and the recorded. Pointing out that live is a synonym for something that actually happened, therefore it is real. If this liveness is recorded, the record itself derives its authority from something real, but the recording will have an influence on the perception, therefore the recorded influences the real, hence creating what Auslander calls impossible oscillation. To exemplify this he refers to Theodore Gracyks observations on rock concerts, where musicians deliver their recordings in a most accurate way, playing what the audience expects them to play, since the majority of the audience usually has listened to recordings of the band before they even thought about going to the concert.

These ideas are very much resemblant to the term of the aura that was introduced in the 1930s by Walter Benjamin, whos work was re-edited by Theodor Adorno and Gershom Scholem in the 1970s and 1980s. In his writings he assessed that by reproduction of art the original piece of art loses some of its value. Although he was focusing on paintings, the general idea can also be transformed for the use in the context of performing arts. He defines the term aura as "A strange tissue of space and time: the unique apparition of a distance, however near it may be" [6]. But this does not imply that the aura of a piece of art or the liveness in a performance is about to be destroyed by its potential reproduction. Moreover, it points out that liveness is a concept hard to describe, very much like the idea of the aura, but that both aura and liveness may exist in different

shades.

Type of liveness	Significant characteristics	Cultural forms
“Classic” liveness	Physical co-presence of performers and audience; temporal simultaneity of production and reception; experience in the moment	Theater, concerts, dance, sports, etc.
Live broadcast	Temporal simultaneity of production and reception; experience of event as it occurs	Radio, television, Internet, etc.
Live recording	Temporal gap between production and reception; possibility of infinite repetition	LP, CD, film,DVD, etc.
Internet liveness	Sense of co-presence among users	Internet-based media
Social liveness	Sense of connection to others	Mobile phones,instant messaging, etc.
Website “goes live”	Feedback between technology and user	Websites, interactive media, chatterbots, etc.

The above table is taken from [4] and shows an approach towards a differentiated sense of liveness. Without going into detail on the levels themselves, the connection between individuals seems to be a core element of all types of all liveness. Without an audience, there is no ephemerality, no liveness and no aura.

Hence the question should not be how to preserve a certain idea of a unique experience, but how to break the constraints between those types of liveness, adding the semi-live, the technologically enhanced liveness, to the "Classic liveness" and therefore using the feedback of the real as a catalyst for creation. A creative feedback loop that is induced by this very technology. For that reason technology should act as conjunctive element that links individuals in order to allow them to experience the ephemeral and real.

2.4 Novel ways of involvement

In the previous sections we have shown that little involvement of the audience in modern live performance is a phenomenon that derives from the perception of art as a product that is to be consumed, rather than seeing art as a process that one can get involved in. The extensive use of technology in performing arts may have acted as an accelerator for this perception. However, technology could also be the very element that allows for more audience participation in performances.

One approach on how this could be achieved was described by Bongers [7], using a classic model of Human-Computer Interaction, an interaction loop, as the starting point for his research. Furthermore, he divides interaction in three general categories:

1. performer - system
2. system - audience
3. performer - system - audience

The first two categories can be described by using the human-computer interaction loop. The idea is that human motoric capabilities are mirrored by the machine on the level of actuators and displays. Vice versa, the human senses find their counterpart in the sensors of the machine.

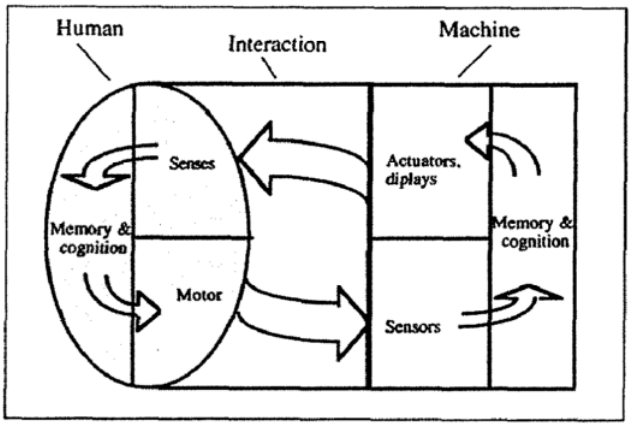


Figure 2.2: Human-computer interaction loop that describes in a simplified way how humans can exchange information with machines. Image taken from [7]

Bongers takes this interaction model and adapts it to the scenario of live performances. In this model interaction can happen on two separate channels. The first one is the direct interaction between performer and audience, the second one uses the technical layer of a system in-between performer and audience to allow bidirectional communication.

The machine-part of the classic model acts as transformational unit, linking the human counterparts on an abstract level. Bongers puts "Memory & Cognition" in the center of this model, as the area where inputs from both audience and performer are collected. It is this part of the system that can be used to trigger responses to actions of either performer or audience. This shows how an algorithm for this purpose should be designed - as a mediator between sensors, actuators and human beings.

But Bongers points out that a system could also be designed without the stage of "Memory & Cognition" by mapping each input to a predefined output, hence making the system reactive instead of interactive. Furthermore, this diagram of the interaction loop emphasizes that every item of the equipment from speakers to screens and microphones is part of the system, which means that every single item of equipment could be interconnected. Moreover, this model shows interaction through modern digital artifacts is

not a replacement of existing modes of communication, rather than a second channel that allows to interact through a deterministic system.

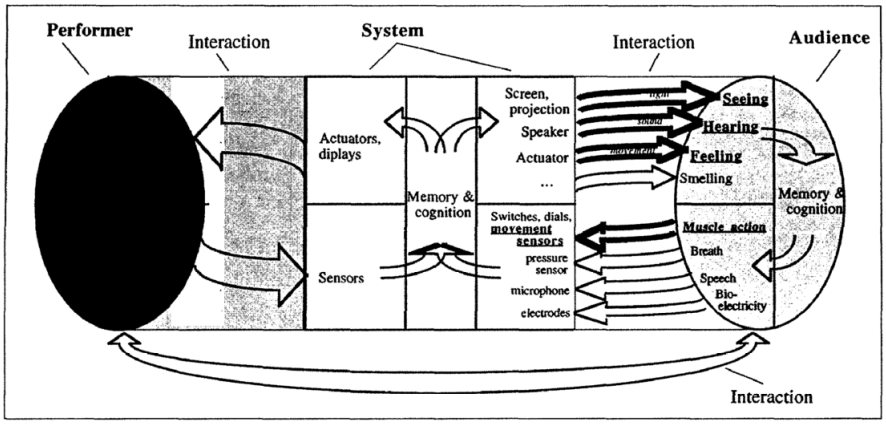


Figure 2.3: Performer-System-Audience interaction. A interaction model based on the HCI loop describing how audience and performer can interact through a (digital) system. Image taken from [7]

Based on a different methodology Burgheim [11] has created an overview of contemporary work in digital performances by analyzing various works in this field. As part of her work she defined broad categories that represent sub-genres in digital performances, which are:

- Digital performances combining computer graphics, 3D images, as well as cinematic techniques
- 'Augmented' performances in which the scene and/or the actors are interfaced via captors or technological and/or digital objects
- Performances using artificial 'performers' or virtual characters
- Digital performances that connect (an)other stage – either real or virtual – and play with the interconnection of different spaces of performance, perception and reality
- Out-of-stage works that involve the audience – mostly individual spectators – through tools allowing them to move inside the scene or interact with what they perceive, in a virtual recreation of the stage
- Walking performances inviting the audience to move around on the stage or in the public space
- Trans-media performing arts
- Artivism

As the list shows several categories are defined by the use of virtuality or augmentation. One way this is used is as a means of expanding the stage outside its physical space, hence by adding virtual stage to the physical stage.

Another way this is used, is by adding virtual elements (e.g. performers, objects) to the physical stage. While an augmented performance can be described by the performer-system-audience relation of Bongers HCI model, since it coexists with the direct communication between performer and audience, the virtualization can go even further. A virtual performer, for example a computer generated animation of an actor, deconstructs this model by unifying the system and the performer.

However, this arises the question if this level of virtualization still qualifies as a performance, since the virtual performer is based on deterministic algorithms, which in conclusion contradicts the idea of ephemerality.

Aside of virtual and augmented performances, Burgheim further lists the category of "Trans-media performing arts". She describes this as "interaction among the different media or platforms, in which the audiences play a crucial role in the creation and circulation of information" [11]. One interpretation of this idea could be the realtime integration of social media content into a performance. Even in a simple scenario like the display of twitter comments on a screen this would imply that the audience is not a passive group of people in the room, but a distributed, loosely coupled network of people.

Concluding this, Bongers model of interaction is still a valid baseline for the context of a live performance. However, the multitude of new forms of media has led to the partial deconstruction of this interaction model by adding virtual, augmented and distributed elements to the process.

2.5 Related Work

The previous sections have shown that both classifications and models that are used to describe performing arts, audience participation and interaction are often not enough to fully capture the possibility space that new technologies have opened up. To get a comprehensive understanding of the field it is necessary to take a look at the approaches current developments in the field of audience participation take. The following subsections are not an attempt of classification, but rather aggregations of projects that share a similar conceptual approach.

2.5.1 Natural User Interfaces - Embodied Interaction

In "Techniques for Interactive Audience Participation" [35] three methods of implementing digitally enhanced crowd interaction are described. These methods are not bound to performances or any other specific context, although they were evaluated with computer games that are played by an audience. Besides interacting with the shadow of a beach ball and with laser pointers on a screen one of the methods described is the tracking by

audience movement. In this case the audience in a movie theater could play the game "Pong" simply by leaning to the left or to the right. A camera facing the audience would then be used to track the movement and create game input according to the movement. The fact that this interaction does not require the audience to handle hardware or learn new patterns of interaction makes this simple setup remarkable.

"Tweetris" [20] is a project that also lets the audience use the position of their body to interact with a publicly played game. On stage in front of a live audience players have to mimic the shape of a specific Tetris-tile in the form of a competition. The person mimicing the tile is then tracked by a Kinect IR-Camera and once the task is completed an image is sent to other players via Twitter, allowing them to use the tile in their game of Tetris.

Although this is not a work of performing arts, the connection of virtual and public spaces, that Burgheim highlights, is exemplified in this setup. Furthermore, the characteristics of a Trans-media performance, which foster creation of content by the audience and connecting audience off site with new technologies, can also be found in the Tweetris project.

2.5.2 Crowd Engagement in events

In "Engaging the Crowd" [5] a project was presented that aimed towards providing non-biased and interactive voting for band contests. The project consists of a simple cheering meter that uses the input of microphones to show the overall noise level on a screen in realtime. The algorithm stops measuring after several seconds of cheering and shows the peak-level of the applause. This project was evaluated in the context of rap battles and due to its non-intrusive character and the fact that it uses existing behavioral patterns (cheering) it was well accepted by the audience.

The idea of creating a means of interaction that does not exclude parts of the audience by creating an artificial technological barrier was also a key criteria in the project "Be a Judge" [3]. With the aim to create an easy to use voting system for sports events the project used a combined setup of microphones to record the noise the audience makes (clapping and cheering) and wristbands that send RF pulses when members of the audience start clapping. Similar to "Engaging the Crowd" this project makes use of an already known behavior, which is clapping and cheering.

The setup does not require the audience to learn a new technique and is scalable by design. Furthermore, the already existing methods of interaction in this context are not effected by the setup. These approaches encourage the members of the audience to take an active part in the event by using one of the most intuitive gestures for live engagement.

2.5.3 Social Interaction in Public Places

Similar to facilitating engagement in crowds the participation in public places focuses on how to motivate a group of semi-random people to interact with an installation and each other. But compared to crowd engagement in concerts and sports events the interaction in public places is more delicate, since the audience is not deliberately looking for interaction in this context and installations have to be designed with care in order to be non-intrusive.

The Humanquarium project [46] aimed to encourage occasional bystanders to interact with musicians in a tiny portable stage. The stage is a 1.5m cube of transparent acrylic with two musicians sitting inside. The front wall of the cube is touch sensitive and by touching this wall the audio produced by the musicians inside is modified with effects and a visual feedback appears on the rear wall of the cube.

One reason why this project is of interest, is because it allows the audience to directly manipulate the audio output. Influencing the music of a live performance is a difficult act since this overrides a part of the performance and can, in the worst case, act as a disturbance of the performance. However, by putting the stage on the street, outside of the theater, it is not simply an installation, it also acts as a cultural probe. This allows to observe the feedback of people that might otherwise not get in contact with an interactive installation of this kind.

Figure 2.4: The Humanquarium project puts musicians into a transparent cube and encourages bystanders to interact with the musicians by touching the cubes front wall. Image taken from [47]

In a similar context Hespanhol and Tomitsch designed and built an installation for public

spaces with the constraint to create only little impact on the flow of people passing by. With "Chromapollination" [23] they built an installation consisting of flower sculptures and LEDs. By passing the flowers in a certain distance the LEDs simulated the exchange of "light pollen" between the flowers by displaying certain light patterns.

Since this installation was located close to a transport hub, the aim was to attract a certain attention, but not so much that the flow of people would come to a halt. For the evaluation different sensors were used to track the movement of the people passing by over time. Therefore, the evaluation was non-intrusive since no special effort was necessary for the spectators and no personalized data was gathered. In their approach Hespanhol and Tomitsch refer to the work of Martin Ludvigsen, who has created a framework for public social interaction.

In their findings Hespanhol and Tomitsch found similarities to Ludvigsen's conceptual framework of social interaction [33]. In Ludvigsen's framework four levels of engagement in situations of social interaction can be observed:

1. Distributed attention
2. Shared focus
3. Dialogue
4. Collective action

The first level describes a situation in which people share the same space, but experience the situation on their own. In the level of shared focus the general interest and focus goes towards a specific object or person in the room. Once the level of dialog is reached, people are starting to approach each other. If the level of collective action is reached, the goals of the individual will overlap with the goal of the group.

Although it could be argued that complex behavioral patterns of groups might not be thoroughly explained in a four level framework, Ludvigsen's framework can act as a guideline beyond the context of installations. Public games, as well as performances that aim toward audience participation, can make use of these levels of engagement and take them into account when designing a specific setup.

2.5.4 Object based interaction

One of the most well known examples that puts artifacts in the center of interaction is the tangible music interface "reactable" [28]. The interface allows people without any background in music production to collaboratively create electronic music by moving plastic tiles and cubes on a table. Since the table is also a screen it provides instant visual feedback to the users actions. The reactable is a remarkable example for tangible interaction that inspired various other projects.

Schnell and Bevilacqua built a prototype with a purpose similar to the reactable, but integrated the device in a familiar object. By using a ball that could be spinned or passed from one person to another they used an already known artifact with properties well known to the participants as an interface for complex control. Depending on the speed, position and rotation of the ball the pitch and tempo of an audio source changed [44]. The benefit of using tangible controls lies in the affordance that is represented by an artifact. In the case of the ball the interaction is mainly self explanatory.

Hödl, Fitzpatrick and Holland [25] also made use of the distinct affordance that a balloon provides and conducted a field-test in the context of a concert. The spatial position of a big red balloon that was tossed around by the audience would change the overall sound of the performance. The position (x,y,z) and acceleration (v) were used as an input vector for a chorus and vocoder sound effect, providing four degrees of freedom. The similarity between approaches shows that many experimental music interfaces can also be of use for audience participation in performances.

To gain a deeper understanding of the possibilities and constraints of putting artifacts in the center of interaction Bongers conducted a study in a museum, allowing interested guests to interact with a visual installation over wooden physical modules [8]. The study aimed towards exploring the extent to which participants would engage with these interfaces.

Similar to Ludvigsen's framework the study was conducted under the assumption that there would be several stages of engagement, which in this case were labeled as:

1. Unaware
2. Aware
3. Approach
4. Interact

By tracking the level of engagement of the participants over time, empirical data about the overall engagement was gathered, which in this particular case showed that 44.1% of the participants were unaware of the installation and only 20.9% would eventually interact with it. Aside of the level of engagement the interaction was further categorized and summarized, adding up to 81.18% of collaborative use (e.g. participants spontaneously playing together) and 18.82% of conflicts in interaction (e.g. participants fighting over the use of the interface).

These results are only partially of interest for this thesis, since the context of an installation differs in several aspects from the context of live performances. However, Bongers gathered data by conducting semi-structured interviews, observing interaction from a distant position and analysing video footage. This methodological approach, which consists of a combination of methods, allows to gather data from several perspectives and acted as a guideline for the set of methods used in this thesis.

2.5.5 Distributed computing

The previously described projects focus mainly on a single point of entry. Many of these projects are built as installations that use an artifact or tracking system to allow interaction. Contrary to this, a different design approach can be taken by using workstation-like devices. Such systems can consist of nodes that preprocess data and communicate with a central system or they can be designed without a central system, as a distributed system that only relies on the processing power of the individual nodes.

With "Composition for Conductor and Audience" Roberts and Höllerer were among the first to experiment with the idea to use smartphones as a distributed orchestra [42]. In this case a conductor gave instructions to the audience who had to comply with the instructions by using virtual sliders on a smartphone app. With their interaction on the smartphone the audience had a direct influence on one instrument of a concert piece. In the test run problems with the device connectivity affected the initial setup of the experiment in a way that participants were distracted from the actual task.

Using a similar setup, but reversing the flow of information, Visser and Vogtenhuber described a setup in which the smartphones of the members of the audience were used to "create a cloud of sound sources distributing the audio played live by the performers" [50]. The idea of the performance is to create a concert situation in which the audience is essential to the live experience since they need to provide a part of the hardware. A further objective of the project was to create an impression of liveness by imperfection of the sound, which derives from the different quality and loudness of the individual devices. In these examples each member of the audience becomes a node in a network of participating elements that take influence on the performance.

These approaches offer an incredible space of possibilities regarding the extent of influence participants can take. The pitfall arising thereby might lie in the distraction of the audience. The use of a smartphone makes it necessary for the participant to start an application and focus on the device, the emphasized liveness of the experience could be obstructed by this distraction.

In "Graph Theory: Interfacing Audiences Into the Compositional Process" Freeman takes this approach of distribution even further by creating a graph model for the composition to be played in a concert [21]. In his project website-users could navigate through the parts of the composition to be played, which was displayed in a graph visualization online. By choosing a favorite path through the parts of the composition, the edges of the graph were weighted according to their popularity amongst the users, allowing these users who would later be part of the audience to influence the performance before it even started.

This is a noteworthy approach since the audience, a network of participants, influences musical information of a performance in the form of a graph. This process is decoupled on a spatio-temporal level from the actual performance, making the interaction highly abstract, but solving the problem of potential distraction during the performance.

2.5.6 Conclusion and Summary

By looking at historic examples in performing arts we were able to describe different objectives of audience participation. In the Ancient Greek Theatre audience participation was to some extent also political participation, while theatre in 18th century England allowed the audience to provide an immediate response to a play by articulating their likes and dislikes. Moreover, the concept of Happenings that Alan Karpow and Wolf Vostell developed showed how a utopian theory, a theory of social progression through art, can be integrated into performing arts.

The question that arises from these examples is to what extent it is possible to foster a collaborative experience without destructive effects on the dramaturgy and the audiences experience. Due to the widespread use of smartphones and similar devices it seems to be an obvious choice to use this technological basis as a means for interaction in performances. Nevertheless, this should be done in a cautious way, firstly because handheld devices, which require the user to look at the display and use touch controls for interacting, can distract the users.

In the case of "Composition for Conductor and Audience" [42] these distractive properties of smartphones are exemplified. But furthermore because the limitations of smartphone hardware are not always apparent. Depending on the smartphone model the differences in computing power, quality of sensor data and sound output can be enormous. This in turn can lead to a very different experience for the user depending on the device in use. Additionally, when using mobile devices as sound sources, as Visser and Vogtenhuber did in their project [50], the frequency range of the output is bound to the physical constraints of such devices, which will very likely result in the loss of lower frequencies and a low acoustic pressure.

Equally important is the aspect of temporal and spatial displacement. By allowing the audience to influence the set-list of a performance in advance or by using realtime input from a remote audience such concepts can easily be implemented. Then again, this raises the question if the audience will still perceive this as a participatory act, if the immediacy of the interaction is not given. Although this might contrasts with the comprehensively discussed concept of ephemerality and liveness, displaced interaction can offer added value if the influence on the performance is coherent with the overall context. But if the displaced interaction appears to be a random event, it can be expected that the participants will ignore this event or even worst, will be confused by it.

In the Performer-System-Audience model of interaction [7] the system that allows enhanced interaction is reduced to a machine with input and output parameter, sensors and actuators. What has to be kept in mind while designing such a system is that it will be used by humans in a very specific context. Unless the purpose of the system is to cause a deliberate distraction, this system has to be designed in a way that allows a seamless integration into this context.

Furthermore, several of the projects described in this section aim towards using technology to initiate interaction between members of the audience. But individuals may react

very different on the attempt to involve them. Some might be keen from the start to explore an installation, while others might hesitate or even refuse to be part of such an experiment.

Both Ludvigsen's conceptual framework of social interaction [33] and Bongers observed levels of interaction [8] lead to a final level of "collective action" or "interaction". However, participatory work of art should be designed in such a way, that members of the audience who do not want to participate will not feel uncomfortable when they choose to step away from the spotlight.

Based on this analysis we can emphasize several constraints that have to be considered when designing interactive systems for live performances, which we subsumed in the following design-questions:

Devices - What kind of interface should be provided for the audience? Is it sufficient to use optical tracking, should users share a physical device or does each individual need a device?

Displacement - Does the context allow for a spatial or temporal displacement in the interaction or should all interaction happen ad hoc?

Distraction - How much influence on the performance can be permitted without confusing the audience or the performer?

Distance - What can be done to facilitate collective action? Is there a place for bystanders who wont approach the area of interaction?

These four clusters of questions are not a comprehensive guide for designing technology mediated audience participation. Depending on the context of each performance there may be a wide range of issues worth considering, but as a starting-point for an initial concept these questions can act as a guideline.

CHAPTER 3

Research Approach

As we described in the first chapter the aim of this research is to examine, if methods of game design and human computer interaction can be applied in the context of live performances, in order to foster participation of the audience. To gather evaluable data the goal was to create a prototype that enables this kind of participation. The prototype consisted of hardware and software which was integrated into a live performance. The setup we developed was used to build a technological bridge between the performing artists and the audience.

The prototype, as the centerpiece of the evaluation process, was tested in the context of a live concert. Evaluable feedback was gathered from both the musicians and the audience of the concert.

We structured the process leading to our results in three phases which we named the design phase, the development phase and the evaluation phase. In this chapter we will depict the research approach based on these phases.

3.1 Design Phase

In the first phase the focus was to collect information in the scope of live performances, in order to fully understand the context and to be able to identify the limiting constraints. Since the research goals can only be answered in a multidisciplinary way, by taking into account the perspective of game design, human-computer interaction and performing arts was crucial to include actual stakeholders from the beginning.

3.1.1 Stakeholder Analysis

In a first step we identified the stakeholders for the given context of live performances to be able to conduct workshops and interviews. This was done by creating a stakeholder

map based on a stakeholder analysis [34]. Since the stakeholders were not individuals of an actual organization, they were defined by roles that were to be considered for the context of live performances. The questions that were to be answered in this analysis were:

1. What general stakeholder-roles are there?
2. What responsibilities are associated with these roles?
3. What kind of resources are connected to each specific role?
4. Does the prototype interfere with those responsibilities?

3.1.2 Workshop

After identifying the involved roles, a workshop was held. The objective of the workshop was to gather feedback from people with specific knowledge in the field of live performances and events. The feedback included artistic, technical and administrative views on the domain. The questions asked during the workshop aimed towards successful audience interaction and gratification in games.

Furthermore, these questions led to a discussion about the possible synthesis of performance and game design. The workshop was conducted as a hybrid of a focus group and a workshop. For reasons of simplicity we will refer to it as workshop. The participants were introduced to each other by explaining the role they represented and were then asked for their opinion on the topic. But contrary to a classic focus group the session featured an open discussion on the topic, allowing the participants to change the overall direction and outcome. The workshop followed the knowledge mapping technique [40], to create a visual map of the discussion that represents the domain-specific knowledge of the participants.

3.1.3 Interview

Following the workshop an interview with a game design expert was conducted. The aim of the interview was to survey which of the results of the workshop could be used in the design of the prototype. The interview allowed to identify common pitfalls for games in public spaces and to gain a deeper understanding for the constraints of game development in general.

3.1.4 Expert Review

Before looking for suitable artists to cooperate with, the state of the project was reviewed by experts in the field of HCI, game-design and performing arts. Researchers of the "Breaking the Wall" project, a research project with the topic of technologically-mediated audience participation, were available for this review. The review was conducted in the

form of an open discussion. The goal of the expert review was to eliminate unfeasible ideas in an early project stage and find new approaches based on the collected data.

3.1.5 Artist cooperation

For the creation of the prototype it was crucial to find cooperating partners from the field of performing arts who would be willing to incorporate the prototype in their performance. The cooperation included regular meetings with the artists to iterate the initial design ideas and identify the necessary features of the prototype as well as to find problems in the design.

3.2 Development Phase

Based on the concept, that was developed in the course of the design phase, the actual prototype was created during the development phase.

3.2.1 Prototype Development

Since the prototype was developed to provide real-time feedback to several users and further includes hardware artifacts to the interaction, it was necessary to test the software as early as possible. Out of this reason a lean testing approach was taken [24]. Completed features would be evaluated during the development process to identify potential problems as early as possible. Furthermore the cooperation with the artists was continued in this phase. Each stable version of the prototype was tested with the artists and the feedback was used for the next design iteration.

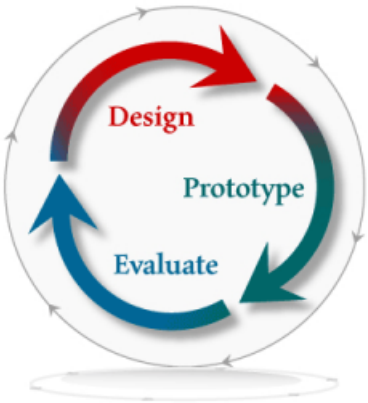


Figure 3.1: Iterative design following the loop of design - prototype - evaluate in order to identify problems in an early stage of the development. Image taken from [24]

3.2.2 Evaluation Concept

Aside of the development of the prototype the creation of an evaluation concept was part of this project phase. The evaluation of the prototypes relied on two sources of feedback. Firstly, the audience that was present in the field test. The response of the audience was evaluated using a questionnaire. The questionnaire was handed out to the audience directly after the performance and the audience was asked to fill out the questionnaire directly on site, to ensure a high participation rate on the feedback. The questions aimed toward finding out, if the prototype added value to the experience of the live performance. Moreover, if the use of the prototype would be perceived as beneficial for the performance, to explore the reasons for this assessment.

The second aspect of the evaluation relies on the perspective of the performers, in this case musicians. Their assessment was documented in the form of an semi-structured interview, since this allows for a more diverse feedback. The design of both, interview guideline and questionnaire, were part of the evaluation concept.

3.3 Evaluation Phase

All means necessary for the setup, realization, analysis and evaluation of the field test are subsumed in the evaluation phase. The prototype had to be set up in a suitable venue for the field test and a demo event had to be organized, including stage, sound, light and of course a participating audience.

The event was recorded with a wide angle camera and the footage was analyzed afterwards. In the process of this analysis we reviewed the footage several times and coded distinctive patterns of behavior that were observed in the audience. Furthermore the footage was used to find out how the distribution of the audience in the room changed throughout the performance. The time line of the video footage was then compared with the time line of the prototype log files to find correlations.

To gather feedback from the audience we handed out questionnaires on site, asking general questions about music and performances as well as specific single choice and open questions about the performance they had seen in the course of the field test.

After the event we conducted semi-structured interviews with the musicians which we coded using a combined deductive inductive approach [22] and used the transcript for content analysis. Finally, we did a reflection on our own subjective perception of the field test since we also had an active role throughout all phases of the field test.

3.4 Summary

In this chapter we discussed the overall guideline for the creation of the prototype, the centerpiece of this thesis, and the methodological approach that was necessary for the evaluation of the prototype. Moreover, the distinction of the three phases, from the design, to the development until the evaluation was described.

In the design phase we gathered data by meeting with experts and refining initial ideas to draft a concept.

In the development phase we created the prototype with an iterative approach. In the evaluation phase we conducted a field test with the prototype we developed. During and after this field test we gathered data from questionnaires, video analysis, interviews and by reflective writing.

CHAPTER 4

Design

4.1 Introduction

Based on the proposed research approach we described in 3.1 this chapter will discuss in detail which steps were taken during the creation of the concept for the prototype. Furthermore, we will describe how the underlying conditions for the fieldtest and the evaluation were defined.

The questions we tried to answer in this processes were:

- What are the roles and responsibilites that have to be considered in the context of live performances?
- What are the technical and artistical constraints when building a prototype for technology-mediated audience participation for live music?
- What kind of Performer-System-Audience interaction is feasible for the prototype?
- What game mechanics can be applied in the context of live performances?
- Which technologies (software and hardware) will be used in the actual prototype?

4.2 Stakeholder

In order to conduct a workshop we first had to establish an understanding of the stakeholders involved. Instead of actual persons we described our stakeholders by defining roles. Since there is a vast number of job descriptions for the area of performing arts [13] we reduced these to six generalized roles. This was done simply to reduce complexity and there is no claim on universal validity of these roles.

First there are the essential roles of performers and audience. Beside these roles there are technical roles, which we reduced to the roles of light engineering and sound engineering. Of course there is a huge amount of possible technical roles, but due to the simplicity of the model the reduction features a sound related and a non-sound related technical role.

Finally there are organizational roles. On one side the security aspects have to be handled. This is usually done by dedicated security personnel, depending on venue this includes fire authority, police or other people that carry out safety instructions. Finally there is a role that in software development would be called product owner. This can either be the producer of a play, the owner of a venue or even the manager of a band. However, this role is focused on providing a trouble-free workflow before, during and after an event. In many cases this role is also in charge of the financial aspects of an event.

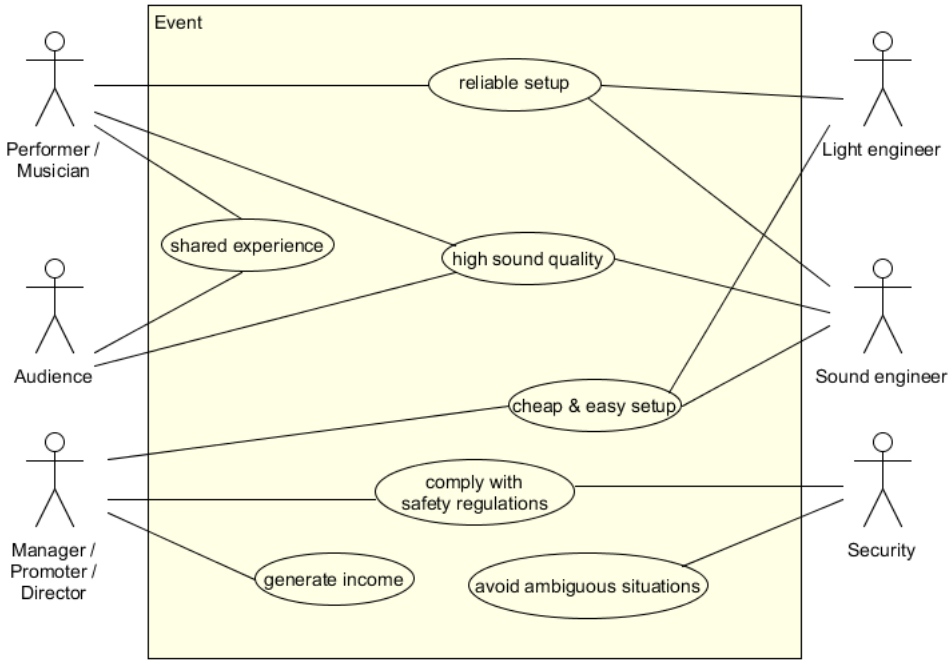


Figure 4.1: Use case diagram of roles and interests in the context of a live event.

The Use Case Diagram shows the distribution of responsibilities among the roles. This can be subsumed by a simplified stakeholder analysis table [34]. The diagram and the table are informal methods used to prepare for the workshop. We used these methods in order to be able to document the decisions that were made before the workshop meetings.

Role	Expectation	Provides	Controls
Performer	Shared experience, reliable setup, high sound quality	Perfomance (music, dance ...)	Course of events
Audience	Shared experience, high sound quality	Reaction to events, applause, revenue	Feedback to events, possibility to interact
Manager	Cheap and easy setup, comply with safety regulations, generate income	Infrastructure, budget, venue, oversight	Resources, collaboration
Light Engineer	Reliable setup, cheap and easy setup	Stage effects (lights, strobe, fogmachine)	Non-audio stage equipment before and during performance
Sound Engineer	Cheap and easy setup, reliable setup, high sound quality	Sound	Sound
Security	Avoid ambiguous situations, comply with safety regulations	Save environment	Who is allowed to enter and what is allowed inside the venue

From this analysis we can see that the role of the performers and the audience is of course crucial for the design of the prototype. The performers are in the center of attention, they need a reliable technical setup and control the flow of events throughout most of the performance. The role of the audience is a generic role, since it could be represented by almost everyone with a general interest in live music.

However, we concluded that a person that has visited many concerts and has strong communication skills would be beneficial for the workshop since we aimed towards getting qualified and nuanced feedback. Representing the managerial role we planned to invite a person who had already organized a public event and could therefore assess ideas from an organizational viewpoint. To represent the technical roles we concluded that we would need to invite at least one light engineer or sound engineer.

Finally the role of security had to be considered throughout the design process in order to comply with safety regulations. However, since the actual security measures that have to be taken are depending on the venue and the type of performance there was no need to include this role in the workshop.

4.3 Workshop

The workshop revolved around two essential questions for our prototype development. We wanted to know how beneficial interaction between audience and performers can be characterized. To simplify the discussion we limited the context to modern pop or rock concerts. Therefore we first asked the participants what was necessary for a performance to be good and followed up with the question about what was necessary for good interaction between musicians and audience.

Figure 4.2: Creation of the knowledge map during discussion with the group

The second segment of the workshop aimed towards the game aspect by asking the participants the simple questions what their favorite games are and why these games are enjoyable. The follow up question in this case was what kind of reward these games offered to them.

In the final part of the workshop meeting we tried to bring both aspects of the discussion together by allowing the participants to have an open discussion on how games and live performances could be combined. By asking the participants to think of ways how gratifying elements of games could be applied in a live concert we wanted to find out how we could foster interaction by using game mechanics.

Our workshop consisted of four participants. We invited the front man of a band, who represented the role of the performer. A music journalist was invited to get qualified feedback from the audiences perspective. Furthermore a sound engineer represented the technical viewpoint. Finally a game designer and organizer of various street games provided insights on the organizational aspects of the project.

For each segment we first presented an introductory question which we briefly discussed with the participants. Then the participants had five minutes time to write down relevant keywords to the question. The keywords were put on the whiteboard one by one and roughly clustered. After this first step we clarified the meaning of the keywords in a discussion with the group, changing the structure of the clusters, adding new keywords and linking the clusters with connections. As a result we created a knowledge map [40] for each main question and refined this map by discussing it with the group. The result of this discussion was as follows:

Figure 4.3: Final state of the knowledge map

4.3.1 What is necessary for a performance to be good?

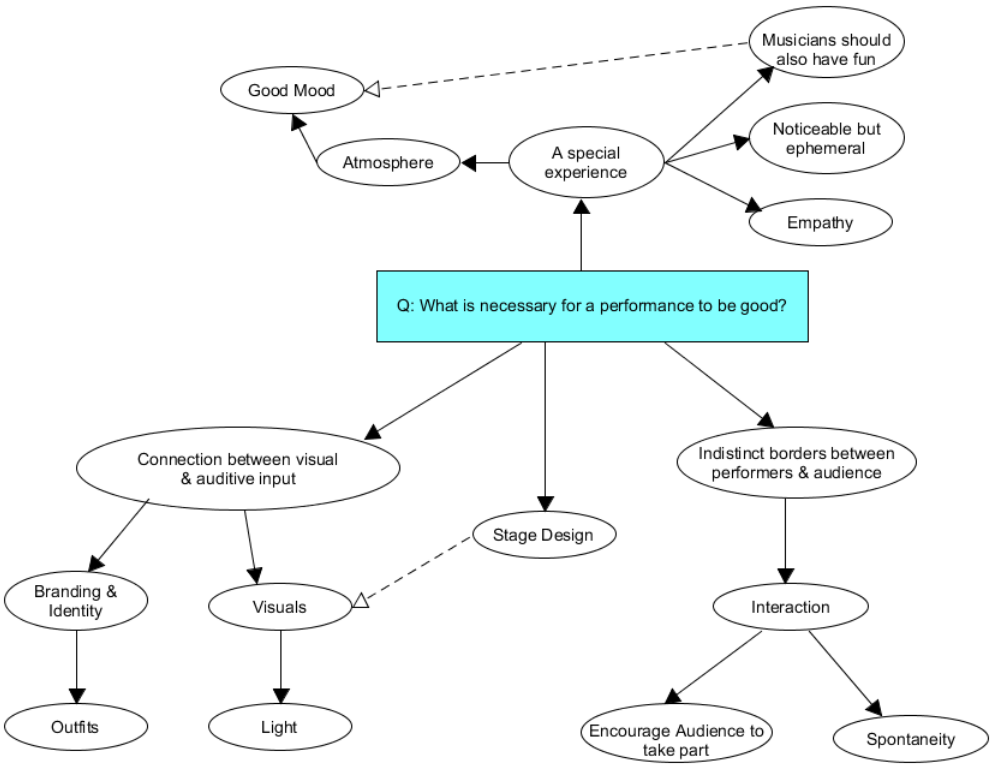


Figure 4.4: The first question of the workshop focused on finding out what elements were necessary for a performance to be considered good.

The answers that the participants provided to this question could be clustered in three areas. The first cluster is described by the special experience a performance creates. Since terms like "Good Mood" and "Atmosphere" are highly subjective, this cluster is vague in terms of significance. However, this highlights that a positive attitude of musicians towards their audience and their willingness to create a unique, memorable experience is highly valued by the audience.

Another group of terms revolve around the overall appearance of the performers. The participants emphasized that the design of the stage, including visual and light design, should be coherent with the outfits or costumes of the band and of course with their music. Despite the fact that performances are artificially created experiences the authenticity of the performance was highly valued by all participants. Finally the borders between performers and audience should become indistinct so that the audience can be encouraged to interact with the band. It was emphasized that a spontaneous and unstudied way of interaction was seen as a more encouraging approach by our participants.

4.3.2 What is necessary for good audience interaction?

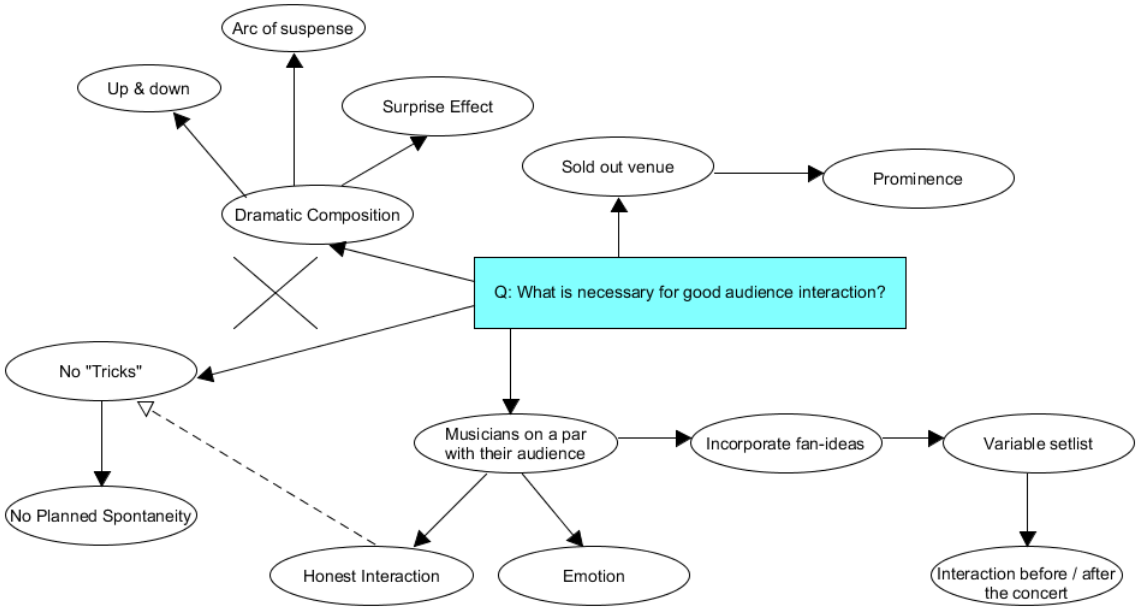


Figure 4.5: The second question of the workshop focused on factors for good audience interaction

In the discussion that followed this question we were able to create 4 clusters of items. We could later identify similarities and contradictions between those clusters. One cluster consists of the demand for a prominent artist and a sold out venue. Although this will most certainly have an effect on how a performance is perceived, the means of influencing

these factors are beyond the scope of our work. The second cluster revolved around the idea of a dramatic composition. The participants argued that a concert has to have a arc of suspense that is similar to the dramaturgy of theater plays. This is contradicting the third cluster, which consisted of the assertion that good interaction should neither be planned nor based on "Tricks", but should rather be spontaneous.

In the last cluster several arguments were introduced that pointed towards incorporation of the audience at eye level. The participants agreed that the interaction did not necessarily have to happen right away, but could also happen before and after the event, e.g. by effecting the set list of a concert, which supports the idea of temporal and spatial displacement in interaction that was introduced in chapter 2 and discussed through the example of Freemans "Graph Theory" approach [21].

The interesting aspect in reference to the expectation of our participants was that they concurred that a performance should be designed in a dramatic way, building up an arc of suspense. At the same time the performance should appear spontaneous and unstudied. The participants seemed to expect some kind of surprise element from a good performance while at the same time they are expecting a well planned show that follows a dramatic plot. This contradiction reflected one of the main concerns we faced during the prototype design and development, which is the questions of how much interaction can be granted without destroying the musical or dramatic structure of a performance.

4.3.3 What are your favorite games and why do you like them?

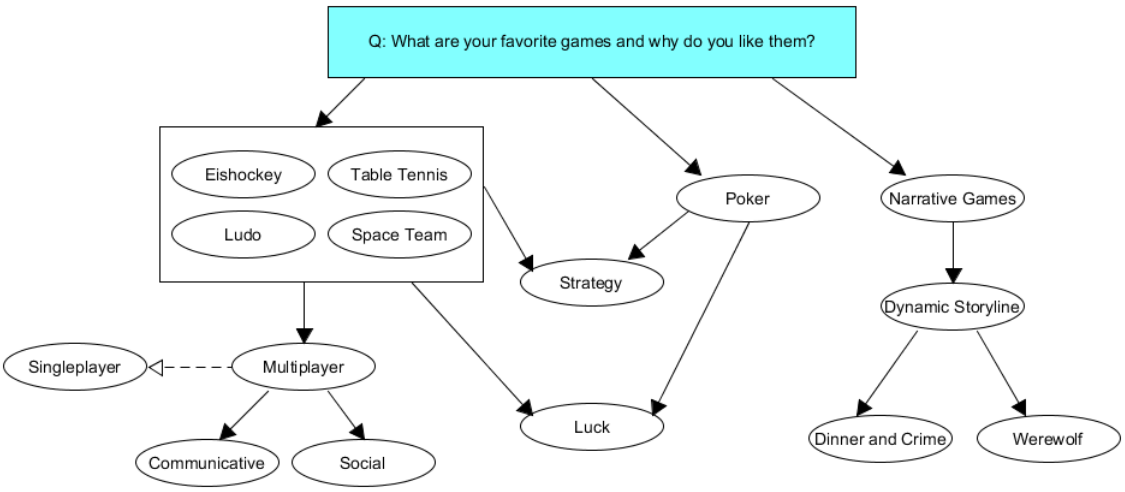


Figure 4.6: The third question of the workshop triggered a general discussion about games

The purpose of this question was primarily to steer the discussion towards the topic of games and game mechanics. However, from this map we were able to extract a few

fundamental questions for the design of our prototype, which were:

- What is the game mode (Singleplayer, Multiplayer, Cooperative, Competitive, Groups against Groups)?
- Will it be necessary to balance luck and strategy?
- Will there be a theme, storyline or narration?
- If there is a storyline, will it be possible to influence it dynamically?
- How could the theme be linked with the performance?

These aspects were of importance for our prototype concept, in the course of the workshop this was mainly used to build up to the next question which was designed to find out more about the individual motivation for playing games.

4.3.4 What is the reward of playing these games?

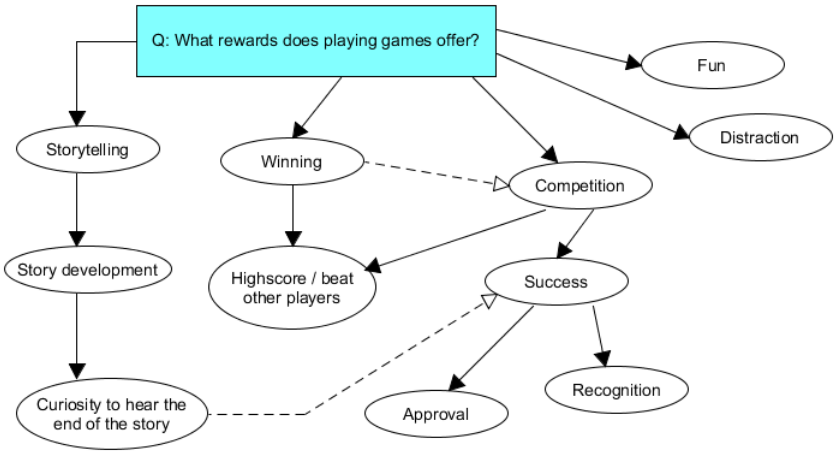


Figure 4.7: The fourth question of the workshop focused on the aspect of gratification that well designed games provide

The main reason why our participants started playing games was for fun and for distraction. But during the discussion two partly linked motivators became apparent. One seemed to be the idea of a progressing story that unfolds during the game. By playing the game the story develops itself and therefore creates curiosity. The second motivator is competition, either against an artificial opponent or another human player. Scoreboards and other players reactions were mentioned as motivating factors, but in general it was

the moment of success that our participants seeked. Both motivators intersect in a sense of achievement and success.

In "Why We Play Games" [32] Nicole Lazzaro tried to explore the motivational factors of player experience in an extensive study. This study revealed four keys to emotion in player experience which in many parts overlapped with the findings we made in our workshop. In the following table we compare the knowledge map nodes of our workshop to the attributes Lazzaro described for each player experience key.

For three out of the four keys we could find matching nodes in our knowledge map. The "Internal Experience Key" is characterized by distraction and fun, which emphasizes the aspect of simple enjoyment that games offer. The "Challenge and Strategy Key" focuses on competition and winning. In the "Immersion Key" the unfolding of a story and the idea of being part of an adventure seems to be the main aspect. Interestingly the "Social Experience Key" aspects, which point out the communicative and social aspects of games were not introduced into the discussion at this point. Although in the previous question exactly these aspects were associated with multiplayer games, when we asked for rewarding elements in games the properties of the "Social Experience Key" were not mentioned.

Keys to More Emotion in Player Experiences according to Larazzos study [32]	Workshop results
The Player: The Internal Experience Key • Clearing my mind by clearing a level • Feeling better about myself • Avoiding boredom • Being better at something that matters	• Distraction • Approval • Fun
Hard Fun: The Challenge and Strategy Key • Playing to see how good I really am • Playing to beat the game • Having multiple objectives • Requiring strategy rather than luck	• Competition • Success • Winning • Highscore / Beat other players
Easy Fun: The Immersion Key • Exploring new worlds with intriguing people • Excitement and adventure • Wanting to figure it out • Seeing what happens in the story, even if I have to use a walk through • Feeling like me and my character are one • Liking the sound of cards shuffling • Growing dragons	• Storytelling • Story development • Curiosity to hear the end of the story
Other Players: The Social Experience Key • It's the people that are addictive not the game • I want an excuse to invite my friends over • I don't like playing games, but it's a fun way to spend time with my friends • I don't play, but it's fun to watch	-

4.3.5 Open discussion

In the last segment of the discussion we encouraged our participants to think of combinations of the items we added to the whiteboard. We led the discussion by asking them how aspects of live performances, audience interaction and game design could be combined to create a unique game-based performance.

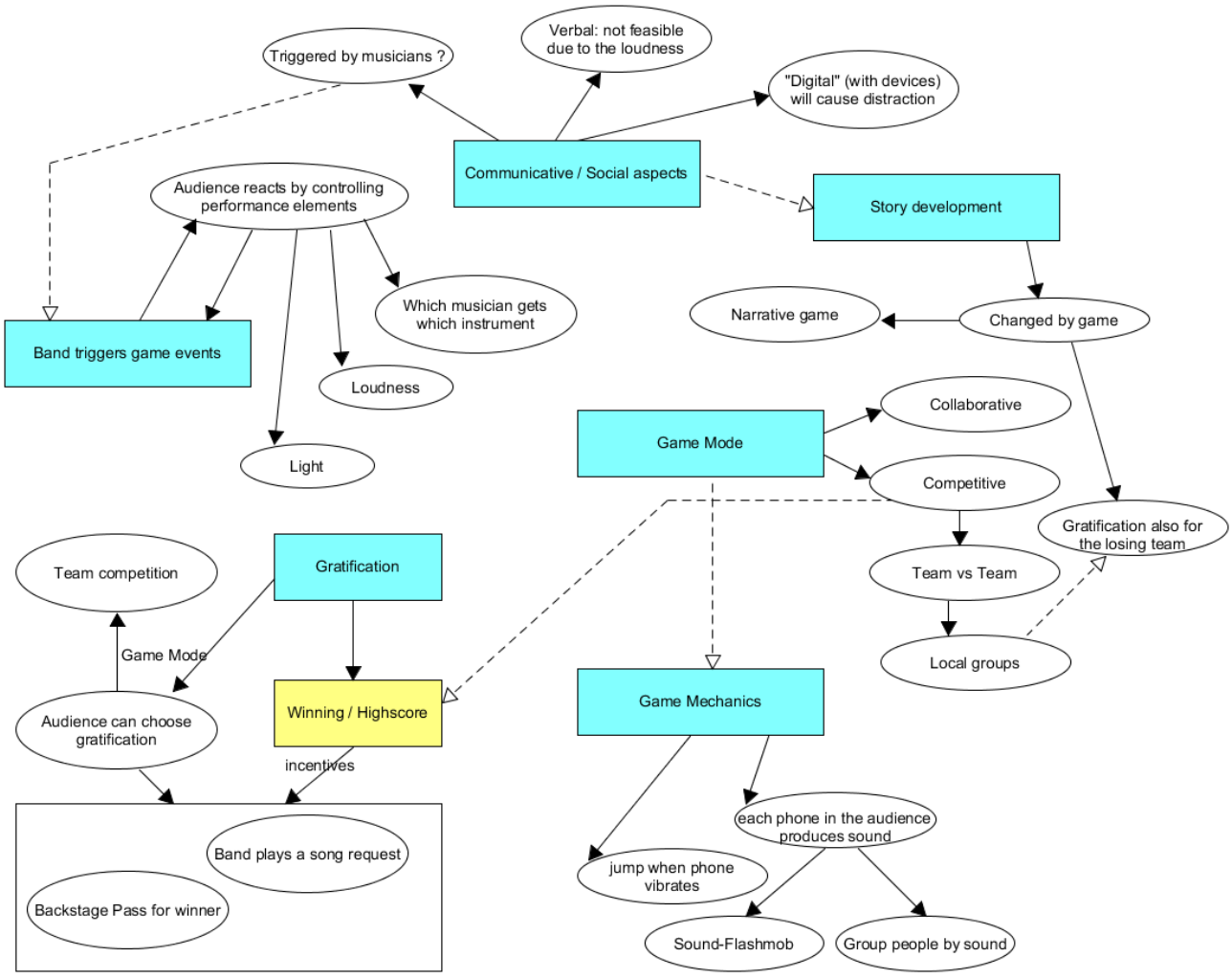


Figure 4.8: Figure of the last workshop segment that represents the open discussion on the items that were introduced in the four previous workshop segments

In the discussion the aspect of "Social Experience Key" [32], which was not mentioned in the previous question, was much more present. The participants argued that, although it would be possible to use digital devices (e.g. smartphones) to support the communicative aspects, this would have the downside of people being preoccupied by the device itself.

Relying on the audience to talk to each other was also seen as unfeasible, since the level of loudness in a concert venue can make it quite difficult to communicate verbally. One idea on how to solve this was to give the musicians control over the flow of events while at the same time allowing the audience to influence parameters like loudness of instruments or the intensity of the light. Another controversial idea was to let the audience choose which musician will get which instrument. However interesting this idea is, it is unlikely that many bands would agree to this kind of experiment.

Furthermore the idea of a dynamic storyline for a performance was discussed. Our participants integrated the idea of a dynamic storyline as it was known to them from narrative games and proposed to allow the audience to actively change the flow of events in the performance. In a competitive game mode this could also mean that members of the audience who are winning are also choosing how the performance will progress. The participants strongly linked the aspects of gratification with a competitive game mode, which led to the emphasis that incentives (e.g. backstage passes, song requests) should be given to the audience. Collaborative modes in which the audience would win or lose together were only briefly discussed by the participants.

As we asked for possible game mechanics the participants focused mainly on how smartphones could be used as game elements. One approach was to use smartphones as actuators, signaling the audience that a certain action (e.g. jumping) should be carried out. The second approach was to make use of smartphones as an audio source to create a "Sound Flash mob".

4.3.6 Workshop Summary

Our workshop participants pointed out that good interactive performances are often relying on subjective perception of the spectator. The use of terms like "atmosphere", "good mood" and "special experience" emphasized this view. However, the fine line between setting up a solid dramatic composition while still leaving enough leeway for spontaneous and honest interaction was mentioned several times during the workshop. Furthermore, we came to the conclusion that allowing the audience to change the flow of events during the performance would most likely be perceived as being part of the performance.

4.4 Interview

In the course of the design phase my colleague Naida Comaga conducted an interview with the game designer Lev Ledit. The interview questions focused on how to encourage people to take an active part in a game that is played in a public space. The thesis of Naida Comaga describes the findings of the interview in more detail. However, we will give an overview on the most significant aspects of the interview.

One of the topics discussed during the interview was how gratification can be provided to the audience for playing a game. According to our interview partner it is most crucial

for games to give an immediate feedback to the audience. Letting participants know that they did something right is very important in this case. Even if the challenges for the audience are trivial, the motiviation to play along can be fostered by the feeling of personal achievement.

The difficulty in good game design lies in balancing these challenges. Ideally everyone should get the chance to experience personal achievement by mastering a challenge. In terms of complexity a challenge should not consist of many subtasks or complex requests, since this could lead to the audience losing track.

Furthermore, during the interview the option to include a dynamic storyline in the game was discussed. Our interview partner advised to give the audience only narrow options to change the course of events. Otherwise the risk would be very high that the story develops to a dead end.

4.5 Expert Review

After we gathered information through the initial literature research and the workshop we structured our findings and drafted three possible interaction concepts, each with a distinct technical setup. The concepts were presented to our advisors and to several members of the "Breaking the Wall" project, including attendees from the University of Applied Arts Vienna. The scope of this meeting was to discuss our ideas and gather feedback in an early stage of the design process. We presented the following concepts:

Stationary - Two or more stations are located in the venue. The audience forms informal teams around each station. The stations could be set up using tangible interfaces or real-world artifacts (e.g. with Arduino & RFID) . By solving puzzles and mini games at these stations the teams compete. The winning team can pick actions that change the course of the performance.

App-Based - The audience uses their phones to create crowd based effects. The interaction could be triggered by tapping the screen of the phone or moving the phone to a certain rhythm. Feedback to the musicians could be given by the flashlight of the phone (strobe), the speaker (distributed sound) or the display (ambient light)

Room-Based - The position of people in the room is used as primary input parameter for the interaction. No physical artifacts need to be used. Colored light sources could be used to highlight certain regions in the room and thereby give feedback to the interaction. The game in this scenario could be triggered by the performers e.g. to influence where and how the audience moves in the room.

As for the stationary concept the use of artifacts was discussed in detail. One of the proposed approaches was to use artifacts in an active way, for example letting the audience explore the room to find interactive components or to let the performer hand out these

artifacts at a turning point of the performance. Another approach that was discussed was to use artifacts as a non-digital starting point to emphasize a theme or storyline in the performance, but then move on to a storyline that is digitally enhanced by the use of smartphones.

The idea to mark interactive stations only by projections instead of using hardware stations, linked the room-based concept with the stationary concept. Using the position of the audience in a certain area of the room as an input parameter and showing immediate feedback in the form of a projection would allow for a combination of both conceptual ideas.

The app-based approach did only trigger limited discussion. Our assumption was that this is due to the fact that we ourselves were doubtful when we presented this idea. The downsides we identified with app-based approaches are that firstly the use of smartphones for interaction will create a technological barrier for anyone who does not possess or use such a device. Secondly the different hardware features (display size, processor power) will most likely result in different user experiences. But most importantly we did not want to attract the attention of the audience away from the stage and onto the display. As Eddie, Ye and Stevenson pointed out the use of smartphones in the context of social interaction can also lead to negative feedback loops. If one person interrupts a face to face interaction by looking a the phone the other person is also encouraged to look at their phone, making it hard to maintain social interaction [14]. Considering these aspects we decided to develop a concept that does not rely on the use of smartphones.

Aside of these approaches the discussion focused on how a theme or story could be integrated in the performance setting. It was pointed out by the participants of the review that a storyline and a dramaturgic sequence of events could be used to connect the stage performance with the game elements. Both the idea of a dynamic storyline as well as the necessity to implement an arch of suspense throughout the performance were also mentioned before in the workshop.

Furthermore, the levels of involvement for an installation or game in a public space were also discussed in this meeting. Our participants classified these as "Involved Audience", "Observers" and "Spectators". These levels of involvement are similar to the zones "attraction, observation and interaction" [8] which we had found earlier in our literature research. The important aspect for our concept was that we needed to create a setup that allowed all three of the mentioned levels of involvement. Putting "Spectators" in an active role against their will could lead to an uncomfortable experience for these individuals and would undermine the overall goal of the prototype.

4.5.1 Expert Review Summary

We eliminated the approach of using smartphones to foster interaction and focused on the idea of creating interaction by using simple and intuitive interfaces. The necessity of a theme or story to link the elements of the performance was recognized as a centerpiece for the prototype. Further we understood that when using a room-based approach, as

described above, we also needed to consider the different levels of involvement. Finally we recognized that the actual prototype would be depending on a cooperation with artists, since the theme and the possible degree of influence on the performance would be different for each artist.

4.6 Cooperation with musicians

During the design phase we were able to establish a cooperation with two musician, a singer and a violinist. We presented them with the state of our project after the expert review and met on a regular basis afterwards. In these meetings we worked together to find answers to the questions stated in the introduction of this chapter. Mainly what kind of interaction would be feasible to integrate in their live performance and as a derivative question what technological setup we would have to implement in order to meet those requirements. In the course of our regular meetings we were able to map out the common ground for the artistic and technological setup for the performance and the prototype.

4.6.1 Theme

The musicians contributed the idea to use "borders" as an overall artistic theme. Since the problem statement of this thesis dealt with new ways to overcome the barriers between audience and performers we decided to deliberately make these barriers visible. During the cooperation the musicians further created footage (images, videos) based on this theme.

4.6.2 Stage setup

Starting out with the theme of borders and the room based concept that would make use of projections, we decided to separate the audience and the performers with a canvas. The canvas would be used as a projection surface, so instead of seeing the musicians, the audience would only see a projection. This canvas would have an active part in our game mechanics. The game aspect of the interaction would be to allow the audience to gradually bring down the canvas and by doing so to fully open up the stage.

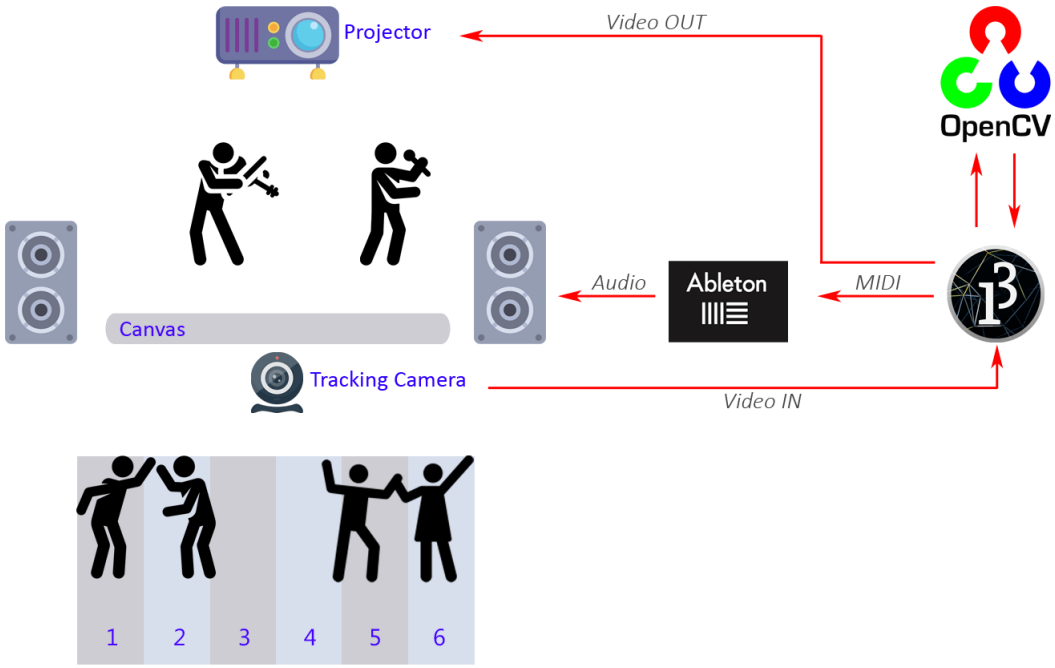


Figure 4.9: Simplified sketch of the stage setup for the performance. Audience and musicians would be separated by a projection surface. The movement of the audience would be tracked by a camera and used as an input for our algorithm.

We then decided to use visual tracking as a means of interaction for the participants. In dependence on the stationary concept we defined that the area in front of the stage would be divided in 6 sectors. In each sector we would track the movement of the people with a camera. The canvas for the projection would also consist of 6 segments. The canvas segments in front of a zone would fall down earlier during the show if a lot of movement took place in this zone or slower if only little movement was tracked in that zone. As a reward for moving, dancing and waving the audience in these sectors would see the stage.

Moreover we chose to use the projection on the canvas to provide feedback to the audience. The tracking itself as well as the state of each canvas segment should be made visible to the audience through the projection.

We further decided to use two layers of canvas for the projection to give the audience enough time to explore the setup and learn how to interact with the musicians.

4.6.3 Influence on the performance

The final decision on how much influence we would grant the audience during the performance was open for discussion even during the development phase. Only by letting the musicians try different versions of our software in the rehearsal room we were able to find a level of interaction with which the musicians were comfortable with. During

the design phase we roughly classified the influence the audience can take in 4 levels of intensity:

1. Non-musical: All stage equipment that is not connected to the sound (e.g. strobe, lights, projections)
2. Timbre: Influencing the sound by effects (e.g. delay, reverb, filters) without effecting the harmonies or the arrangement
3. Music: Direct influence on the arrangement or the harmonies of the concert
4. Mixed: A combination of the above

In the first meetings we started out with the idea to stay on a non-musical level of influence. However, during the iterative design process we learned that it was possible for our musicians to also work with a dynamically arranged backing track, which allowed us to combine musical and non-musical influence.

4.7 Summary

During the phase of design we were able to identify performers, audience, light and sound engineers, promoters and security staff as roles for the context of live concerts. We gained insights on the responsibilities and expectations of these stakeholders by conducting a workshop and establishing a cooperation with musicians.

Furthermore we learned that the implementation of a technology mediated live performance relies on a solid understanding of the performer that will be using the system. Hence we concluded that a prototype tailored to the specific needs of an artist or a band would be most beneficial.

4.7.1 Prototype

In the course of this process we were able to answer the 4 design questions of subsection 2.5.6, which we subsumed as "Devices, Displacement, Distraction, Distance", as follows:

Devices - The audience should be able to interact without the need for any physical device. This was implemented by using optical tracking.

Displacement - All interaction should happen directly on site and in realtime.

Distraction - Influence on both musical and non-musical elements of the performance was granted to the audience. Musical by influencing the arrangement of the backing track, non-musical by influencing the projections.

Distance - Due to the room based concept there were zones of interaction. The distance to the camera that tracks the movement also allowed the audience to switch from active engagement to the role of a spectator.

As a result of our workshop we found that often games offer gratification to the players by creating a curiosity for a story and then step by step revealing this story (4.3.3). We incorporated this idea in our design by creating a barrier in the form of a canvas and revealing the stage one piece of canvas at a time.

On a technical level we defined the following requirements for our prototype:

- Graphic user interface to control and adjust the application in realtime
- Output window for projection (full-screen mode on second monitor)
- Camera integration and optical tracking
- Tempo-based events with the option to set the speed in BPM (Beats per minute)
- Save and output music and control data (MIDI or OSC)
- Automated drop for the canvas elements

CHAPTER 5

Development

5.1 Introduction

In this chapter we will describe the technical details of the prototype which we conceptualized in the design phase. We will describe the software architecture, give an overview on the implementational details and elaborate on some of the pitfalls that we had to overcome in order to develop this software. Finally, we will summarize the lessons we learned for future projects.

5.2 Software Architecture

After defining the requirements for the software to be developed we evaluated different software development kits that could fit our needs. We decided to use the C++ based library OpenCV [38] for all image processing related functionality necessary for tracking. Since we decided to develop in an iterative manner, we did not want to use native C++ for our programming, but instead were looking for a framework that allowed us to do rapid prototyping and moreover that would enable us to deploy the project on different operating systems if necessary.

First we tried to use the game engine Unity 3D [48] for the prototype development. However, using the standard C# wrapper for OpenCV did not work in a satisfying manner, since there was only limited documentation on how to import and use the necessary components out of Unity 3D. Therefore we looked for other frameworks that allowed us to use OpenCV. As alternatives we considered Python 2.x and Processing 3.x. Finally we chose to work with Processing, since it is optimized for rapid prototyping and allowed us to integrate a vast number of Java libraries.

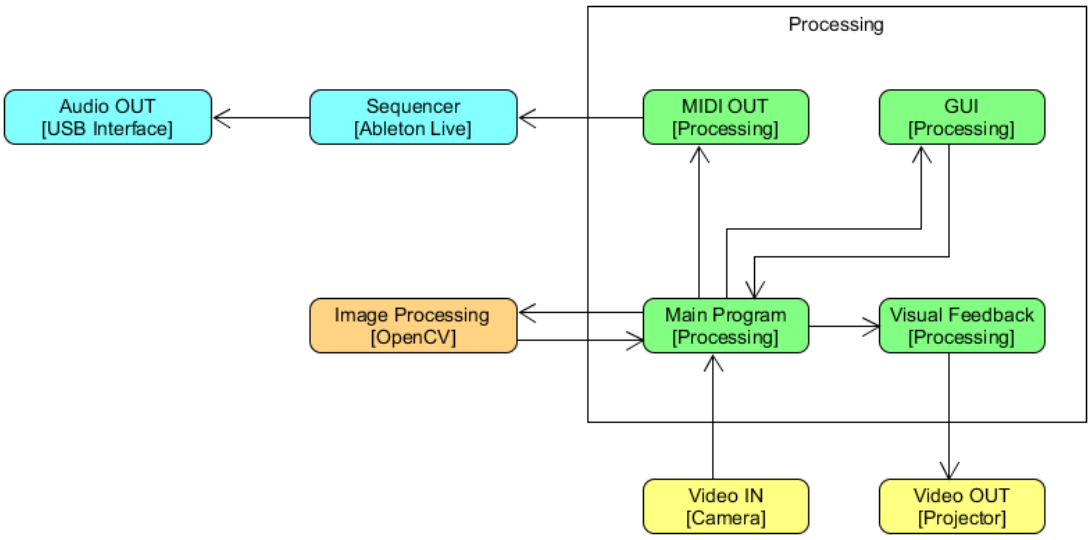


Figure 5.1: The diagram shows the main components of the software and the data flows between those components.

The figure 5.1 shows the core components of the prototype which were built with Processing. The main program controls most of the data flow. This part of the software receives captured frames from a camera and uses a wrapped OpenCV library to find differences between those frames. The visual feedback component creates a video output based on the tracking. The tracking itself is done by the main program. The GUI component provides an interface to the main program to change settings at runtime. Besides video the application also creates sound by sending MIDI data to a sequencer software.

5.2.1 Third-Party Software Components

OpenCV for Processing

For the image processing aspects we included OpenCV for Processing [43], which is a convenient Java wrapper for OpenCV. It offers only a limited range of OpenCV functionality, but is optimized for an easy integration into Processing.

The MidiBus

The MidiBus [45] is a lightweight MIDI library that focuses on realtime I/O operations of MIDI. It does not support advanced operations (e.g. reading and writing MIDI files), for those features we used the native Java package "javax.sound.midi".

MIDI (Musical Instrument Digital Interface) is a standard that was introduced in 1982 mainly for sound engineering purposes [2]. It was designed to connect synthesizers,

samplers, drum machines and other studio equipment and allows to synchronize tempo, send notes, control parameters and send control information (e.g. start, stop, record). It is not in the scope of this thesis to discuss the MIDI protocol itself, however, it is important to mention that MIDI is still a highly relevant standard until today. The vast majority of modern audio software and hardware can still be operated using MIDI. Since we wanted to create flexible software that could easily be adapted we decided to use the MIDI protocol. By this approach it is possible to use different sequencers or even analog studio hardware with our prototype.

loopMIDI

loopMIDI is a standalone tool for Microsoft Windows that allows the user to create virtual MIDI ports [15]. We used this tool to create a software MIDI port to which our Processing application sends MIDI messages which are then received by the sequencer (Ableton Live).

Ableton Live

Instead of playing back samples directly in Processing we decided to use the professional sequencer application Ableton Live [1]. The main advantage of this setup lies in the clear division of responsibilities. Our software controls what is to be played (notes, harmonies, tempo), whereas all detail on the sound itself is controlled in Ableton Live. This allowed us to prepare different sets of samples and software synthesizers. Furthermore we were able to mix the output sound more accurately than it would have been possible from within Processing.

GUIDO

For the graphic user interface we used another lightweight library called GUIDO [27]. This library simply provides a GUI management component that creates callbacks for user input. Among the available callbacks that GUIDO provides are mouse events like "mousePressed" or "mouseReleased", which we used in the custom GUI elements we created. The GUIBuilder itself contains a simple listener that we wrote to handle these events. The appearance of the GUI elements can be created by using the drawing functionality that Processing provides, which allowed a very high level of customization of the user interface.

5.3 Implementation

5.3.1 Class Structure

By choosing Processing as a framework several implementation details were defined by the conventional standards of Processing. First of all, every window that creates visible output inherits from the Processing Applet (PApplet). Each PApplet implements the

methods "setup" for initialization and "draw" which is called in a recurring manner to create and update the visual output. Processing can be programmed with only little consideration to the object oriented nature of Java. However, we designed the application with an emphasis on clean object oriented code.

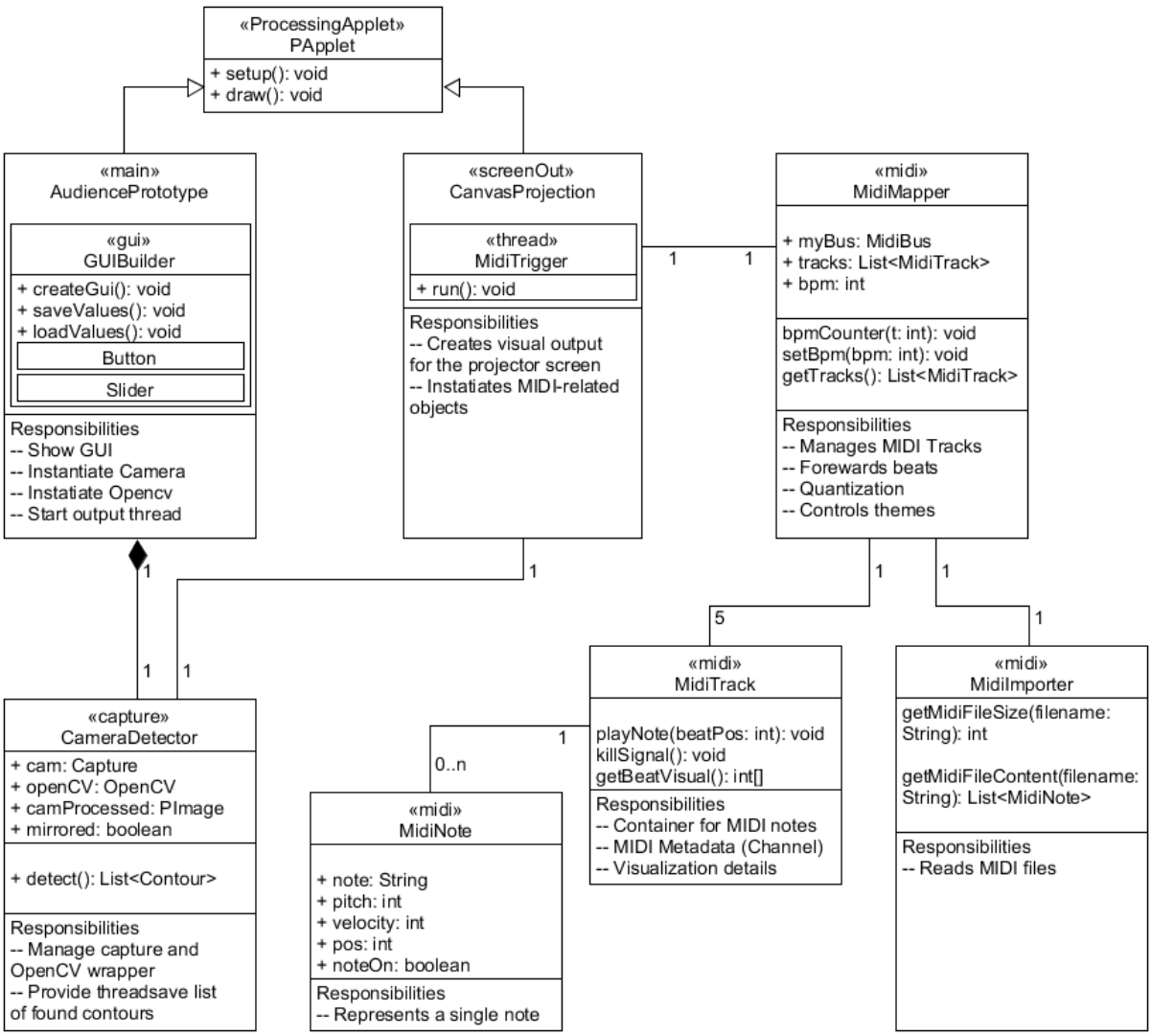


Figure 5.2: Use case diagram of roles and interests in the context of a live event.

In the following paragraph we will explain our design considerations regarding the class structure of the diagram 5.2. The class AudiencePrototype acts as the entry point for the application. In a regular Java application this PApplet would have to be called from a static main method, but by using Processing these structures do not have to be

considered, since they are created automatically when building the application. The AudiencePrototype class shows the GUI elements, which are created and maintained by the GUIBuilder. The GUIBuilder is implemented as an inner class of the AudiencePrototype. This approach was chosen since the GUI and the main window are strongly tied together and the GUI would not be used outside of this context. All GUI elements are also implemented as inner classes of the GUIBuilder.

The AudiencePrototype instantiates an object of the type CameraDetector. The CameraDetector holds the reference to the OpenCV wrapper as well as to the Capture, which represents the input stream of the camera. Therefore this class is responsible for reading the input stream from the camera, processing the camera stream with OpenCV and providing the result in a thread-safe way.

Furthermore the AudiencePrototype instantiates another PApplet of the type CanvasProjection which will run in a separate thread. The CanvasProjection is in charge of creating the output for the projector and therefore is designed to run on a second window in full screen mode. In the CanvasProjection no GUI elements are implemented. However, the CanvasProjection instantiates a thread of the type MidiTrigger, which was designed as an inner class. This MidiTrigger thread simply checks every 5 milliseconds if another 1/16th note has to be played and if so sends a signal to the MidiMapper, which is also created by the CanvasProjection.

In the MidiMapper class is the centerpiece of the communication with the audio sequencer. It holds a reference to the MidiBus, which is connected to the virtual MIDI device. Furthermore the MidiMapper imports MIDI data from files on the harddrive via the MidiImporter class. In the MidiImporter MIDI data loaded from previously saved files. Once the data is loaded the application uses its own internal format which consists of MidiTrack and MidiNote classes. The MidiNote stores pitch, intensity and if it is a start or end of a note, whereas the MidiTrack acts as a container for several MidiNotes to be played and stores the meta data for a clip.

5.3.2 GUI

Most features of the software are defined by configuration parameters, therefore the main use of the GUI is to provide easy access to parameters that might have to be adjusted during runtime and further to provide a clear visual feedback on the current program state.

Figure 5.3: The header area of the GUI provides access to tempo settings and displays the status of the canvas

In the header area, which is shown in screenshot 5.3, the reset button allows to set the current session back to initial values. The "+" and "-" buttons allow the adjustment of the tempo (BPM). By clicking the "Set 1" button the loop position is set back to the first beat. In combination with the tempo adjustment this can be used for a very basic synchronization of the applications audio output with an outside source. The sliders below the buttons represent the canvas segments which divide the musicians from the audience. For areas where a lot of motion is detected the slider fills up faster, which is indicated by turning red. Once the slider filled up to 100% it turns black, which indicates that this canvas section will fall to the ground. For safety reasons the release of curtains was not controlled from within the application, instead a separate notebook was directly connected to the Arduino board.

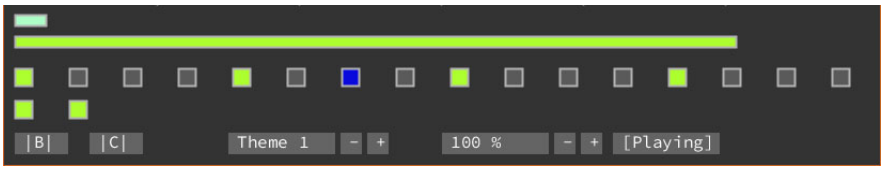


Figure 5.4: The footer area provides an overview on the loop status

In the footer area 5.4 the first indicator, which fills up from left to right, shows the time line of the performance. The time line is defined by the total amount of events that can occur. An event is either a new musical element being introduced, which means a new loop is being started or a canvas segment dropping to the ground. When the last piece of canvas drops to the ground the performance comes to an end since no new loops will be started after that.

The bar below fills up every 4 bars. All events that occur are being collected over the course of 4 bars and take place at a quantized point in time. Triggering events on the first beat of a 4 bar phrase ensures that new elements do not contradict the rhythm. Below the 4 bar indicator the array of squares shows the 16th notes of the current bar. This view is similar to the blinking lights that can be found in studio equipment (e.g. drum machines). In this case the blue square indicates the current loop position. For each event that will occur at the end of a 4 bar segment a square is shown below the 1 bar indicator. On the very bottom of the footer the buttons labeled "B" and "C" allow to disable the display of bounding boxes or the camera feed in the preview. The theme number shows the active set of MIDI files from which new loops are imported. Next to the theme buttons a percentage is shown which represents a multiplication factor for the tracking. By using the "+" and "-" buttons this factor can be adjusted, resulting in changed sensitivity for the tracking, which can be used to influence how fast new events will be added. Finally the "Playing" button can be used to change to a "Paused" state in which no new events will be introduced.

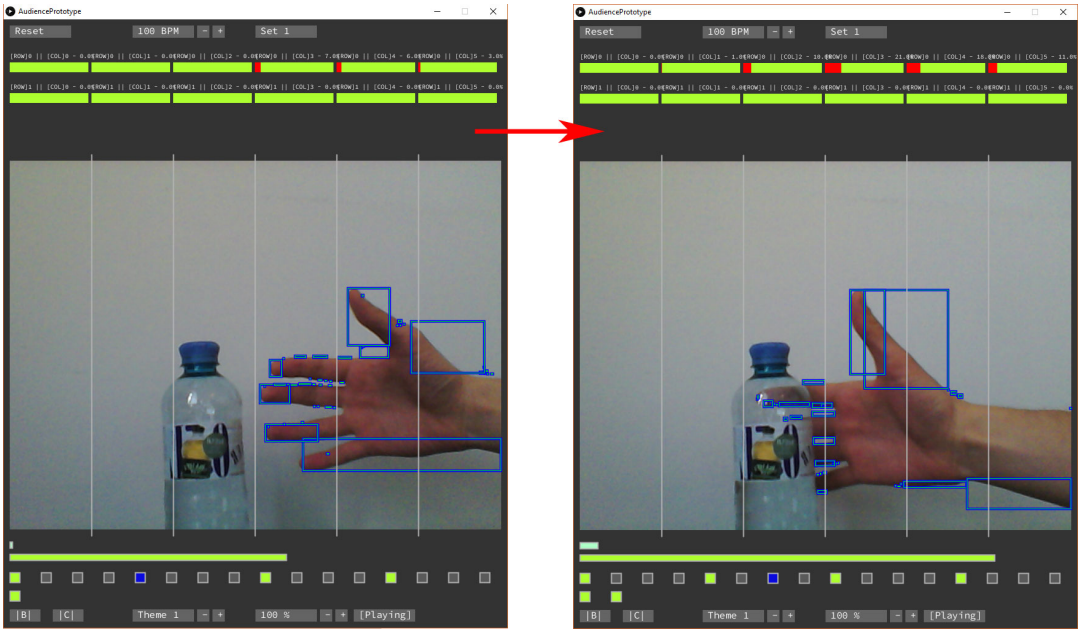


Figure 5.5

The application at runtime, including the preview window with active tracking, can be seen in 5.5. The right screenshot shows the GUI about 1 minute after the left screenshot was taken. In the GUI preview 5 thin lines separate the 6 zones of tracking. The blue rectangles that are shown on and around the hand are bounding boxes. Each bounding box wraps an area where movement was detected. Between the left and the right image changes between the indicators which have been described above (canvas sliders, time line and 4 bar indicator, event list) can be observed.

5.3.3 Projection Screen

In this subsection we will explain briefly how the output on the second screen, the projector, is generated. Details on the computer vision aspects and the interaction design follow in later sections of this chapter. As the screen 5.6 shows the application can be started in a demo mode by activating the output of a grid in the config and setting the status to "Paused" in the GUI. The tracked movement, which is indicated by bounding boxes in the GUI preview window, is visualized as a contour in the projection screen. The contour can be blended with video footage, a still image or a single color. In the screenshot a video is used for blending. The demo mode of the output was mainly used to calibrate the camera and the projector.

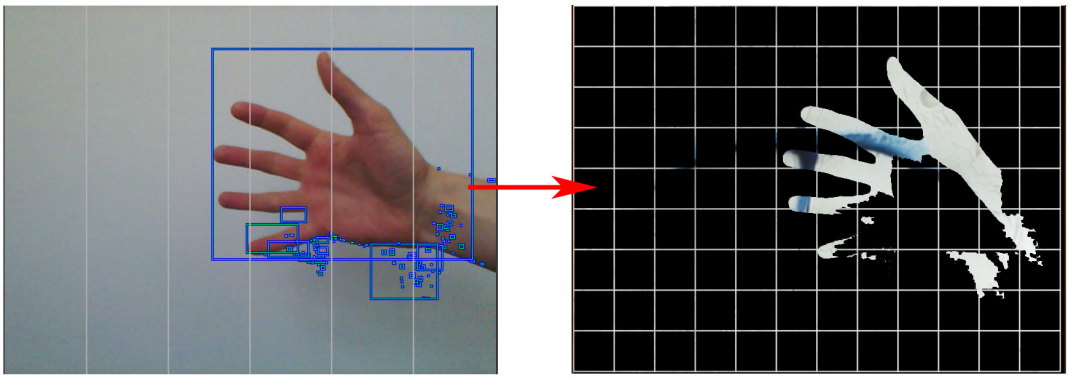


Figure 5.6: Projection screen in demo mode, showing only tracking data and a grid

The screens in 5.7 shows the application in live mode where the grid is not visible anymore. Furthermore several squares of the grid are now "opened", which means the underlying video is visible in these areas. The tracking image is still visible, but it is combined with the squares to a mask that blends onto the video. This combination of squares and tracking image is tied to the music and represents the visual feedback, which is projected on the canvas between audience and musicians.

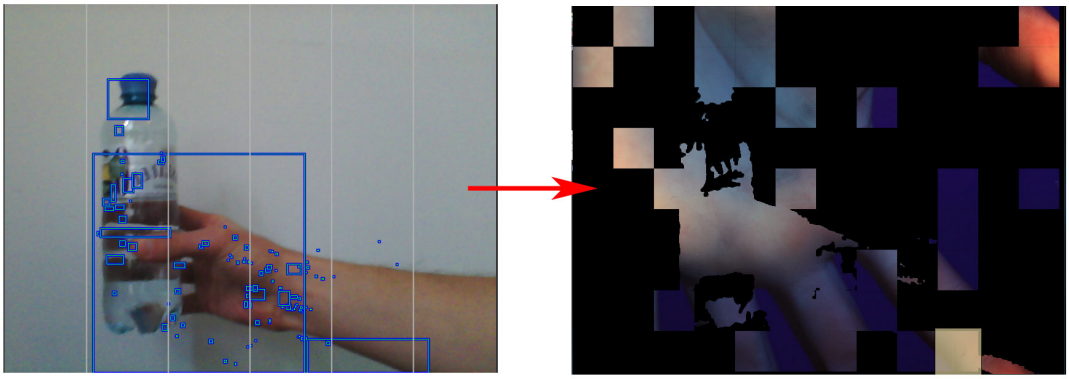


Figure 5.7: Projection screen in live mode shows both activated squares and tracking data

5.3.4 Tracking

The computer vision functionality is composed of only a few simple OpenCV operations on the camera image. After the OpenCV wrapper is instantiated the background subtraction is started. This operation, in the simplest implementation, takes two images and subtracts the RGB values of the second image from the first image pixel by pixel. By applying a threshold on the output of this operation a binary image is created that shows white pixels for areas of change and black pixels for areas with no change or only little change.

However, this very basic method of background subtraction only works well in very specific environments, since it has no way of dealing with shadows, changed lighting conditions or camera noise. OpenCV offers more sophisticated methods of doing background subtraction. In the C++ and Python implementation two Gaussian Mixture-based segmentation algorithms and one statistical background image segmentation algorithms can be used [39].

In the OpenCV-wrapper for Processing which we were using, only a Gaussian Mixture-based implementation for background image segmentation based on the algorithm described by Kaewtrakulpong and Bowden [29], is available. This algorithm is optimized for realtime applications, is robust, fast, needs only little time to learn and implements a shadow detection.

After applying the background subtraction to a frame the resulting image is first transformed by a dilation and then eroded. Both methods are basic morphologic operations in computer graphics and represent complementary actions based on convolution. When first applying dilation and then erodation the operation is called closing. The result of this operation is that blobs that are close to each other in the source image are connected afterwards. The closing operation is a connected-component algorithm [9] and is used in this application to merge areas of the foreground.

All of these operations are implemented in the CameraDetection class. By calling the "detect()" method of this class a list of type "Contour", which is basically a polygon structure, is returned.

Listing 5.1: Detection method for tracking in Processing with OpenCV

```
1  /**
2  * Constructor for CameraDetector
3  */
4  CameraDetector(Capture c, OpenCV o) {
5          this.cam = c;
6          this.openCV = o;
7
8          cam.start();
9          cam.read();
10
11         opencv.startBackgroundSubtraction(5, 3, 0.5);
12 }
13
14 /**
15 * read camera image and calculate difference
16 * @return a synchronized list of OpenCV Contours
17 */
18 public List<Contour> detect() {
19
20         if (cam.available() == true) {
21                 cam.read();
22
```

```
23                  cam.loadPixels();
24                  opencv.loadImage(cam);
25
26                  opencv.updateBackground();
27                  opencv.dilate();
28                  opencv.erode();
29          }
30
31          return Collections.synchronizedList(opencv.findContours());
32  }
```

The code sample 5.1 shows how the CameraDetector is instantiated. In the constructor a reference to OpenCV and Capture objects are provided. The first frame of the camera is then read and also the background subtraction is started. After that both threads (GUI window and projector screen) simply call the detect method to get a thread-safe copy of the found contours. Since it In case both threads call the method before a new camera frame is available the last contours list will be returned.

5.4 Audio and Interaction Design

To give the audience a direct visual feedback we used a combination of the tracking image and a grid image in which each active MIDI track correlates with a cell. Both images are added to a single binary image and are then used to mask the underlying image or video. The grid consisted of 9 * 12 cells 5.6 in our setup, but the amount of rows and columns is dynamic and can be changed through application parameters. Every 2 columns represent a single curtain in the stage setup, which will be explained in more detail in the field test section 6.2. Additionally every active MIDI track lights up its cell in a specific color when a note is played. When a new MIDI track is added it is automatically spawned in a cell that was empty before and the oldest active cell gets inactive at the same time, limiting the maximum concurrent MIDI tracks to five. Inactive cells stop blinking but are still part of the binary mask. Once a curtain is full it falls to the ground, which means all corresponding cells are cleared visually and will not send MIDI notes anymore.

One of the bigger challenges when developing this visual output was the difference in image resolutions, which consists of three separate streams: camera feed, background video and output. Ideally all three streams would have the same resolution, but since this is not practical scenario the resolution of the output stream also defines the other resolutions. The application automatically scales the input streams to the size of the output stream to prevent problems with tracking or displaying. However, these scaling operations are costly in Processing, therefore the frame rate of the application on a regular notebook were below 20.

The MIDI notes that are played are loaded from a number of MIDI files on the harddrive. Each musical theme consists of the same amount of files named in the same convention. Therefore when the theme changes the application simply loads files from a different folder.

The five MIDI tracks that can be loaded represent kick drum, snare drum, percussion, bass line and melody. Additional to that there is an ambience track. When a new melody track is spawned there is a 20% chance it will be an ambience track and a 20% chance it will be empty. This is a simple measure designed to prevent the melody from playing constantly and leaving no headroom for the musicians.

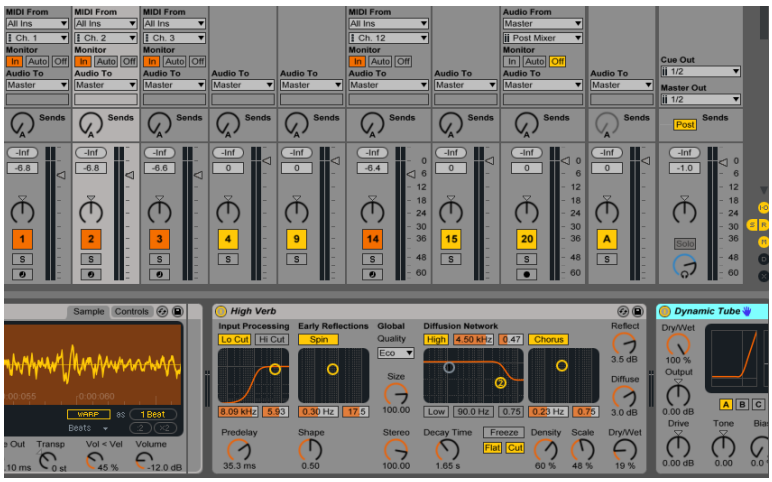


Figure 5.8: MIDI tracks in Ableton Live are mapped to the MIDI output of the application by matching MIDI channels

Each MIDI track in the Processing application sends to only one MIDI channel of the virtual MIDI port. In Ableton Live this MIDI channel is then routed to one of the sequencers MIDI tracks 5.8 where incoming notes trigger either a beat to be played from a drum machine plugin or a sound to be played from a virtual synthesizer (VST plugin). The advantage of using third party software to control the audio output is the ability to use advanced tools and techniques of mixing. In our case these are reverb and EQ plugins for beats and percussions and a mastering plugin (multi band limiter, harmonic exciter, stereo imaging, maximizer) on the master out.

5.4.1 Timing related aspects of development: Quantization, Synchronization and Concurrency

MIDI related actions are managed by the MidiMapper class, which holds a reference to the virtual MIDI port though the MidiBus plugin. The MidiMapper also holds an instance of MidiImporter which allows the application to open MIDI files from the harddrive and store the information of these files in an internal format, which is described in the MidiTrack and MidiNote classes. Inside the MidiImporter all MIDI related actions use the native Java package "javax.sound.midi". MIDI does not save absolute time or a regular musical note value like quarters, instead the positions of events are defined in relation to the pulses per quarter note (ppqn). In this specific case we use a ppqn of 96 since this is also the resolution that is used to export MIDI files with Ableton live.

This means that each 16th note can again be divided into 24 smaller steps. However, to reduce the complexity the prototype allows no smaller division than 16th notes.

In an early version of the prototype we allowed events, e.g. the introduction of a new melodic part, to occur instantly. During early tests with musicians we got the response that this sudden changes make it very difficult to play along since the music could change at any point in time. Therefore we not only implemented a quantization at note level, but also at loop level by allowing a new loop to be started only at the first beat of a 4 bar segment.

Another approach we took in an early version of the prototype was to synchronize Ableton Live with our prototype via MIDI clock signals. When we tested the MIDI synchronization with our application as master, sending clock signals, and Ableton Live as slave we encountered various tempo glitches. These glitches occurred in the form of the tempo wrongly dropping for several bars before getting back in sync with the application. When we logged the exact time between 16th notes in milliseconds we learned that there were small variations in the timing. As described in this section every 16th note consists of 24 clicks. When small timing errors add up this leads to notes not being recognized in the intended tempo, which then leads to severe timing errors. By running the MIDITrigger, which is the class containing the MIDI clock, in a separate thread we were able to lower the variations from up to 30 milliseconds per click to a maximum of only 3 milliseconds per click. Despite this enhancement we removed the MIDI sync feature since it was still not reliable enough.

Besides the MIDITrigger both the AudiencePrototype and MidiMapper classes run as separate threads of the application, since they create visual output on separate screens. The computations in both threads rely on the same camera input and image processing. To prevent deadlocks, resource conflicts and unnecessary calculations the CameraDetector class was created. This class provides the current camera capture and list of contours in a thread-safe way.

5.4.2 Hardware Components

In our setup we needed to develop a part of hardware that allowed us to let parts of the projection canvas fall to the ground on demand. We decided to use Arduino as a micro-controller and to build a simple setup where one or many Arduino boards would simply control servo motors. These components were chosen because they are cheap and because it is relatively easy to build functional prototypes with them. Furthermore it is fairly easy to create a communication between Arduino and Processing, which would have made it possible to control the hardware from within our application. To keep full control of the flow of action we did not integrate Arduino, but we wanted to have this option at our disposal. How the hardware was integrated on stage will be explained in the subsection Stage Setup . A comprehensive explanation on the implementation of the hardware will be given in the thesis of my colleague Naida Comaga.

5.5 Discussion

One of the most time-consuming aspects in the development process was to produce a stable and quantized MIDI output. The naive approach to simply send MIDI data directly from a Processing Applet failed since the Applet can only send MIDI as often as the output refreshed, hence the notes would be bound to the frame rate. We have learned that it is therefore necessary to put time-critical MIDI functionality into a separate thread. An alternative to this approach would be to use the MIDI time of Ableton or a similar sequencer software and simply start predefined MIDI loops inside the sequencer. In this scenario the sequencer would be in charge of time and quantization. The downside however would be that the Processing application would delegate all control over the notes that are played. Furthermore we chose to work with the MIDI protocol, despite the fact that there are newer protocols available, e.g. OSC, that are optimized for software music interfaces. This decision was made to ensure we could use almost any other sequencer software or hardware.

Furthermore the issue of multi-threading and concurrency was a critical aspect during the development. As described we used two threads to create the two output windows and another thread to handle the MIDI time. The camera was used as a shared resource. For future works it would be possible to create a fourth thread that constantly reads and processes the camera stream. This could enhance the maximum frame rate since it removes the camera as a resource bottleneck.

Working with Processing was a good choice for the early phases of development as it allowed us to do rapid prototyping, discuss the prototypes with the musicians and iterate based on the discussions. However, once the project grew it became difficult to refactor the code. It also was not possible to build the project from a high level IDE like Eclipse since several Processing libraries could not be loaded. Therefore we only used the lightweight editor Atom to write our code. In retrospective it might have been a better choice to use Python 2.x to develop the prototype, since we learned later that Python has a very tight OpenCV integration that offers almost all features of the original C++ implementation and is in some cases more flexible than Java. Writing a larger application in Processing is not something we would recommend because the possibilities for scaling and refactoring are very limited.

5.6 Summary

In this chapter we described the process that lead us to our choice of software architecture and tools, which consisted of Processing and Ableton Live. We found third party libraries for Processing that allowed us to build a simple GUI and handle the MIDI protocol. The centerpiece for our application was the integration of OpenCV for image processing. In the course of the development phase we created a prototype that is capable of tracking movement in a camera feed by using background segregation algorithms. This captured movements were then used to influence the output of a background track. We created

a visual output based on the tracking to show the audience that they influence the music. The main challenge for the final prototype was to create an application that was performant, therefore we used several threads and overcame concurrency issues in the course of this process. Finally we built a basic hardware setup that allowed us to release parts of the projection canvas.

CHAPTER 6

Evaluation

6.1 Introduction

In this chapter we document the practical measures taken to conduct the field test. For this field test we arranged an event in an artist-run gallery and concert venue. The musicians with whom we started a cooperation in the design phase played live during this event using the software prototype and concert setup that we described in the previous chapter.

Aside of the technical and organisational aspects of this event we will describe, evaluate and discuss the data that we gathered in the course of this event in the form of video footage, program logs, interviews with the musicians and a questionnaire we handed out to the audience.

6.2 Field Test

Due to the support by artist ran venue mo.ë in the Viennas 17th district we were able to test our prototype in a real-life performance scenario. In this section we will describe how we prepared and conducted an event to test our prototype.

6.2.1 Location

The event took place in the hall of the venue. We cooperated with an exhibition called "Rezeptfreie Arcade Häppchen", which displayed interactive installations in the remaining rooms of the venue. Our field test was named "border.games" and took place on the 9th of March. We promoted the event via social media, email and through our own website [1]. Aside of the main event we organized a display of works of the photographer Thomas

[1] http://border.games

Steineder, which focus on the topic of borders, accompanied by a live set of the local producer and musician "Parterre".

The preparations on site started four days prior to the event. During the preparation we assembled the stage setup (curtains, projector, camera, wiring) and rehearsed with the musicians and the sound engineer.

(a) Day 1 (morning)

(b) Day 1 (afternoon)

(c) Day 2

(d) Day 3

Figure 6.1: Stage setup in the hall of the venue mo.ë. Footage taken from time lapse video.

The venue itself was an old factory with one spacious hall with two pillars located in the center of the room. Since our concept was based on the idea of hiding the stage from the audience at first, we used the pillars to mount curtains. These curtains where also used as a canvas for the projections We documented the building process with a time lapse video 6.5.

6.2.2 Stage setup

We used two layers of curtains, each with six canvas elements that we could drop to the floor individually. Dropping the canvas elements to the floor was controlled with

an Arduino micro-controller. Each curtain was attached loosely on one corner, while the other corner was attached to a small wooden stick that we could move with a servo motor. The servo motors were put into small electrical junction boxes 6.2 in pairs of two. This way we were able to control two curtains per box, reducing the total amount of cables needed to connect all the servos. The junction boxes were then mounted on a heavy duty lashing strap. We used two lashing straps with a total of 12 meters and wrapped the straps around the pillars. With this construction we were able to connect the cables and test the setup from the ground level.

Once this basic setup was working we slowly moved the lashing strap to a height of roughly 4 meters 6.3. Due to the length of the cables and the amount of servos all connected to a single Arduino micro-controller we experienced problems with the signal strength. This led to occasional servo glitches and in order curtains falling to the floor uncontrolled. We could work around this issue by disconnecting and reconnecting the servos one by one each time the Arduino was unplugged.

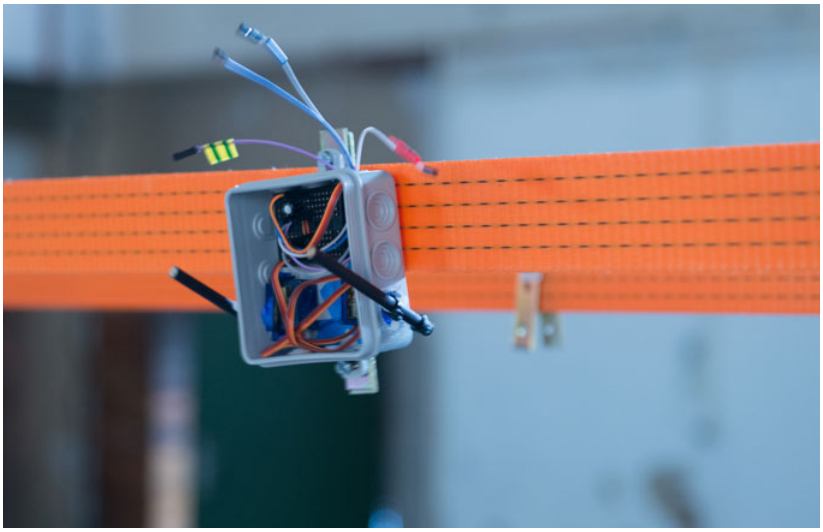


Figure 6.2

Figure 6.3

Projection Canvas

For the first layer of curtains, which was facing the audience, we used a very thin fabric. Since we projected from the inside of the stage this layer was used simply to make the projection slightly blurry in the beginning. This way it was possible to show the effect of falling curtains without revealing the inside of the stage too early.

From the pillars to the rear wall of the room we mounted regular curtains without projections for the purpose of hiding the stage. The size and position of the curtains was mainly defined by the conditions of the room, which resulted in a total projection size of roughly 4 meters width and 3 meters height. Due to the total canvas size of almost 12 square meters we had to place the projector in the neighboring room to create enough distance between projector and canvas.

Sound

The setup of sound and monitoring turned out to be more complicated than we anticipated. Instead of a standard monitoring situation, which usually consists of one monitoring speaker per musician, we needed a customized monitoring setup with headphones for the musicians. The reason for this was that the backing track which, based on the activity of the audience, could change in very unpredictable ways. Therefore the musicians articulated their need to hear very clearly what was changing so they could react to the change. To cope with this requirement we hired a sound engineer and started with sound checks and adjusting the speakers the day before the performance.

Camera and Light

We used the Creative Live!Cam, a simple, off the shelf webcam, for the tracking. The camera was placed in the middle of the canvas and was connected with an active USB cable to the controlling notebook on the rear side of the stage. Since the quality of the webcam feed was highly dependent on good lighting conditions we took several hours to adjust the lighting system and added smaller light sources in the corner of the room to get a good lighting situation throughout the location.

6.2.3 Dramaturgy

> "nothing is communicated or represented except through its attachment to an object. ...It is the play of consciousness of myself my actors and my audience. ... This differs from conventional theater in that the communication is less fixed ... more in doubt ... there is a sequence but not plot or given relations to the events and objects as they occur" [37]

In this quote Claes Oldenburg depicts the idea of Happening as a participatory event that has no spectators and involves everyone who is present. When we decided how to structure the course of events we did not go as far with the deconstruction of performances, but we deliberately aimed for participation to happen spontaneous and without guidance. Therefore we did not provide any instructions prior to the performance.

We closed the doors to the hall until the remaining rooms of the location were crowded and only then opened up the hall and instructed a moderator to kindly ask the audience to enter the room. After that, we let the audience wait for another 10 minutes without any music and showing only a loading-screen on the canvas. Finally we activated the prototype. The idea behind this approach was to give the audience time to enter the room and settle. By doing so we aimed to prevent people to feel as outsiders entering an already progressing interaction if they arrived later in time.

6.3 Video Analysis

In this section we will present the findings of the field test based on video footage. The footage was recorded with a GoPro wide angle camera positioned on one side of the room. During the analysis of the video footage we will take a closer look on how the audience interacted with the prototype, but also if the setting fostered interaction among the members of the audience. Furthermore, we wanted to find out if the interaction was clear to the audience and how engaged the attending people were during the performance.

6.3.1 Procedure

In the audience participation study of Bongers, which was briefly discussed in the state of the art section 2.5.4, an approach towards evaluating interactive video installations in

a museum was described. Bongers used several methods to gather data, including non-obtrusive observations to semi-structured interviews. In his study the level of engagement with an installation is evaluated by looking at video footage. These levels of engagement are classified as unaware, aware, approach and interact. Furthermore, he describes the goal of interaction design as:

> "Designing a successful interactive artwork or system is about facilitating and creating opportunities for use; proposing rather than imposing, opening up rather than inhibiting, suggesting rather than enforcing, and gently guiding." [8]

However, during the first iteration of viewing the footage it became apparent that we needed to approach the footage we recorded in a different way. Bongers evaluated the video footage of an interactive installation, but in his study the installation was placed in the hallway of a museum and was observed for several days. In our study the context of the observation is created by the event. People were not passing by, we can therefore assume that our audience was already aware of the installation when they entered the room, which makes a classification of unaware and aware redundant.

Based on this finding we discarded our initial idea to look for levels of awareness and interaction on the footage. Instead we used the inductive Whole-to-part approach [19] and coded the video without prior assumptions. We cut the video into several sections and analyzed where engagement did happen and how it developed over time. For the coding of the footage we used Atlas.ti. We first reviewed the footage as a whole, then defined relevant aspects and iterated over these segments until we were able to highlight distinctive moments during the performance [16].

6.3.2 Results

As planned we opened the doors to the hall an waited for ten minutes until the room was crowded and the audience had time to settle. In the first few minutes the audience used most of the space in front of the curtains. Over time the room got more crowded and the people moved away from the curtains. When the performance started the audience moved even further away from the curtains, creating an empty area of several meters between the tracking camera and the first row of people.

From this point on we could observe several reoccurring pattern of behavior which we described as:

Dancing - Rhythmic movement while facing the camera and looking at the projection

Gesturing - Moving significantly while looking at the projection

Moving away - Increase the distance to the camera

Moving closer - Moving closer to the camera while observing the projection

Peeking - Trying to look inside the stage area

Walking by - Moving though the field of view of the camera

Waving - Waving at the camera while looking at the projection

In the coding overview 6.4 the distribution of codes over time can be observed. Aside from reoccurring behavior several key events were noticed. Those were the moments when the stage was visible for the first time, when the light was changed by pointing an additional spot towards the audience and when several of the last remaining curtains fell, which then opened most of the stage to the audience.

Furthermore we found that several of the events we observed happened in a short time, while during longer periods, especially in the beginning of the performance, only little activity was found.

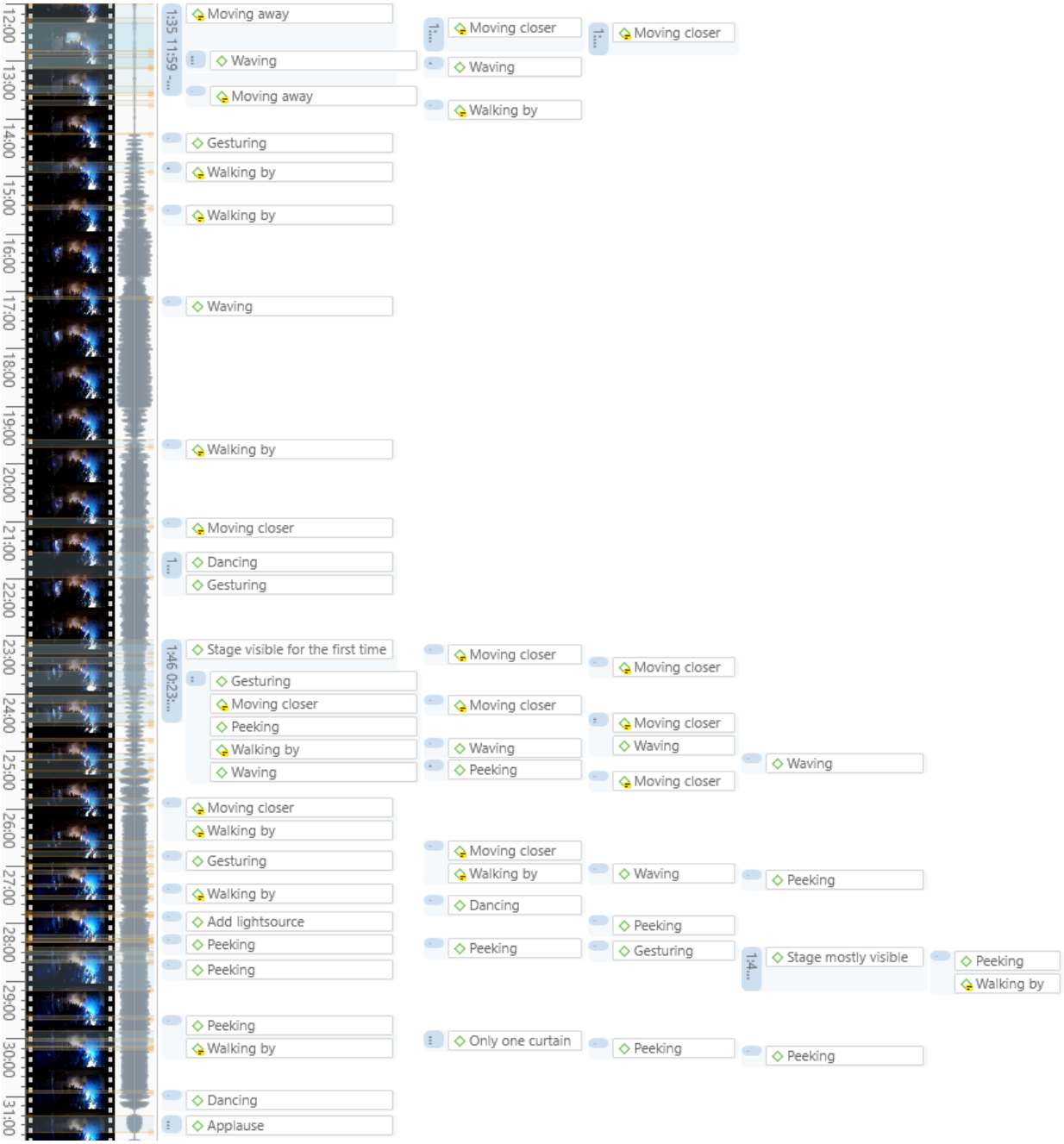


Figure 6.4: Overview on distribution of codes of the video analysis over time

6.3.3 Discussion

In the first minutes after the performance started we observed a rather withdrawn behavior in the audience. Many people moved away from the projections. The audience

seemed reluctant and almost shy towards the performance. Only occasionally people tried to interact with the projection, mainly by waving towards the camera and in some cases by walking by the camera. We interpret this behavior as a phase of cautious exploration of the installation. People in the audience seemed to look for the right way to use the installation, acting cautiously and therefore making only small attempts to trigger interaction. We assume that the lack of a description on how to interact with the performance caused some confusion and, at least in the first stages of the concert, lead to passive behavior of the audience.

Roughly 10 minutes after we activated the prototype we observed that some participants occasionally were approaching the camera or moved closer to the canvas. We interpret these careful attempts to interact as breaking the ice. Shortly after that a key event occurred when parts of the canvas fell to the floor and the inner stage was partly visible for the first time. After this the interaction progressed. The audience was moving closer to the canvas over time and occasionally people peeked inside to see the inner stage. We assume that, after the distanced behavior in the beginning, the audience got more curious once it became clear that the canvas was interactive.

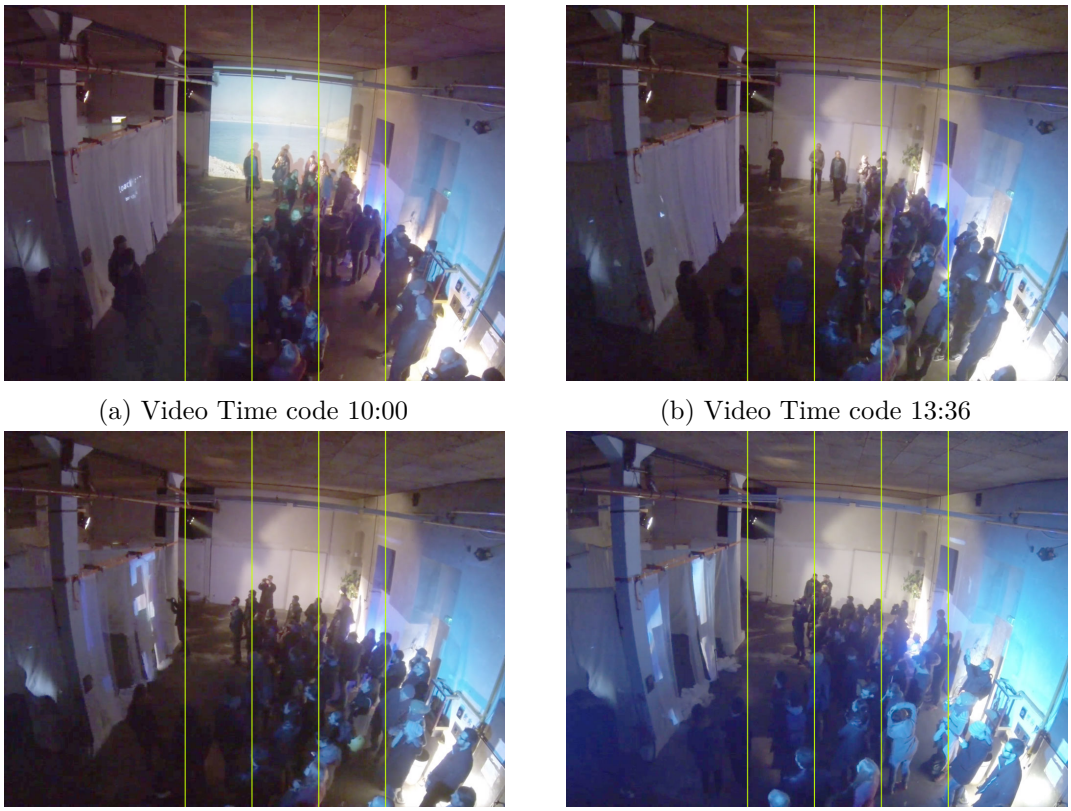
However, there was only little targeted behavior towards the tracking camera. It seemed that people where moving around in front of the camera to explore if something happened, but they did not engage in a continued interaction with the installation. Regarding the interaction with each other the video footage offered only limited insights. Although we observed several little groups of people talking to each other and approaching the installation together, it is unclear if the installation fostered the communication between those individuals.

In the final segment, around 17 minutes after the beginning of the performance, most of the stage was visible. From this point on we observed less peeking and moving towards the canvas and it seemed that people were already awaiting the end of the performance. The distribution of events showed us that in only 7 minutes of the total 20 minutes most of the coded segments occur. We assume that this also describes the arc of suspense during the event. After a long phase of only a minimum of attempts to interact a phase of intense interaction followed which ended abruptly once most of the stage was visible. We anticipated a smooth transition from a crowd of passive bystanders to an engaged audience that would open up the stage gradually and explore the installation. Instead we found that most of the time only very little engagement could be observed and most interaction was triggered by just a few key moments.

The distanced behavior of the audience can also be observed by looking at the distribution of people in the room over time. In the four exemplary frames taken from the video footage 6.5 the audience keeps its distance from the canvas at first (a. Time code 5:00). As time goes by the audience moves closer to the canvas. However, the center area in front of the camera stays empty until the end of the performance.

Aside from the reaction of the audience the video footage also shows that several canvas elements (2,3 and 6) fell to the ground quite early during the performance. For the other

canvas elements it took almost to the end to fall to the ground. Since we monitored the tracking output during the performance we know that this was mainly due to the lighting conditions in the room. Although the lighting was carefully adjusted before the performance the live situation created different circumstances. We had to deal with more shadows and dark areas on the feed of the tracking camera than we had expected during the rehearsals.



(a) Video Time code 10:00

(b) Video Time code 13:36

(c) Video Time code 27:21

(d) Video Time code 37:06

Figure 6.5: Footage taken from time lapse video during the event. Vertical lines were added and brightness adjusted to outline the distribution of the audience over time.

6.4 Audio Log file Analysis

As described the audience influenced the music by triggering changes in the background track. In this section we will briefly describe the structure of the background music and how it was influenced by the audience during the field test. By looking at the log file output of the prototype we will discuss how the audience influenced the structure of the music.

During the development phase we created a set of MIDI loops that we used for the

background track. We created three musical themes. Each theme follows a rhythmic and harmonic pattern, so all MIDI loops of one theme can be combined freely. For the transition between these themes a fourth theme was created. The fourth theme consists mainly of ambient sounds, therefore it can easily be combined with other themes and acts as a bridge between these parts. Each canvas element can have 15 events (change of MIDI loops) before it falls to the ground. With 6 canvas elements and 2 layers this creates a total of 180 events throughout the performance.

However, since the changes only occur quantized it is also possible that several changes occur at the same time. There is a maximum of 6 parallel tracks (kick drum, snare drum, percussion, bass, melody, pad). With each event a change for one of these tracks is triggered. To prevent all tracks from constantly playing there is a chance that an event loads an empty MIDI loop, which will act as a mute for one instrument until the next change occurs.

6.4.1 Results and discussion

The histogram 6.6 provides a good overview on the rate of events triggered by the audience. The x-axis shows the minute of the performance, the y-axis the amount of events triggered by the audience in that minute. It should be noted that the video 6.5 time codes are 12 minutes apart since the video also shows the timespan before the performance started. During the first three minutes of the performance the monitored activity was very little. In the third minute the first tracks were activated and the music started. From there on a steady rate of events can be seen in the histogram. From the eleventh minute on a drop in activity is visible in the histogram. By comparing this with the video footage we can see that it is not the audiences activity that is getting less, but due to the lighting situation in the room. For areas with more shadows and less direct light from the main spotlights the tracking did not respond as well. In minute 16 we adjusted the main spotlights for the stage, which resulted in the peak of activity from minute 17 on.

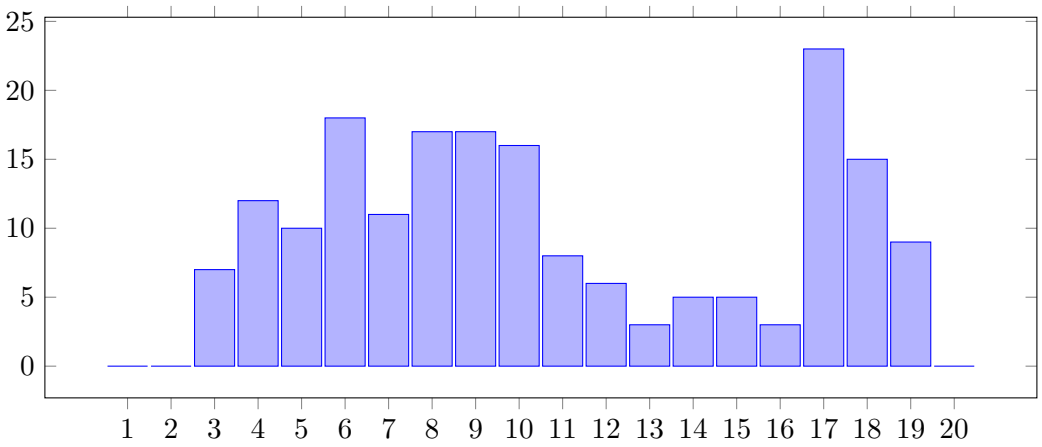


Figure 6.6: Histogram on the events per minute triggered by the audience

When comparing the activity log with the video footage we can see that we assessed the lighting situation wrongly. Since the audience moved away from the canvas the main spotlight was pointing to an uncrowded centerpoint where only little activity was monitored. At the same time the ambient light sources along the walls did not create sufficient brightness for the tracking camera. In conclusion we see that we would have needed a light technician or a different camera setup to overcome these issues.

6.5 Questionnaire

After the performance took place we handed out questionnaires to the audience. We prepared questionnaires both in English and German and further had a person moderating to ensure that most of the audience would take their time to complete the questionnaire and return them afterwards. The thesis of my colleague Naida Comaga will focus on the details of the design and analysis of this questionnaire in order to comprehensively evaluate the audiences point of view. However, a brief overview on the gathered data, in particular focusing on the participants perception of the interaction concept, will be provided in this section. The English questionnaire can be found in Appendix A 8.4.

6.5.1 Survey design

The questions are grouped in roughly 4 categories. First we asked general questions about age, gender, education, musical background and if the person played computer games. In the second part, consisting of a single choice list, we asked the participants for their motivation to attend a concert. The third group, also a single choice list, was designed to document thoughts participants had regarding the performance they just saw. The last group consisted of two open questions, the first one asking about the personal

opinion about the performance, the second one about the opinion on the interaction that took place during the performance.

6.5.2 Results

We collected a total of 42 questionnaires in which 19 participants stated to be male, 17 female and 6 did not provide information regarding their gender.

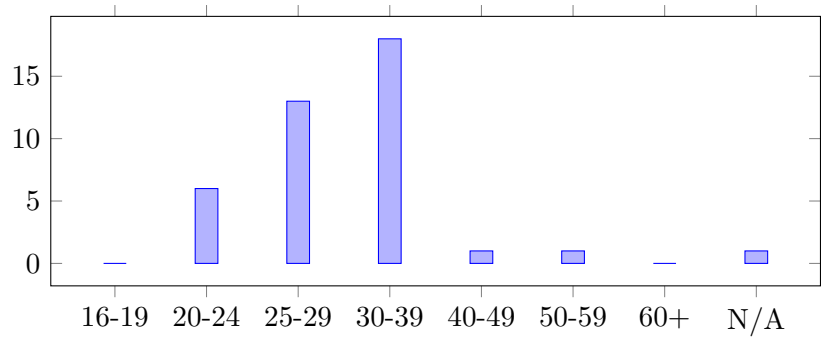


Figure 6.7: Overview on age distribution in the audience

The chart above shows that, with a combined total of 37 participants, the majority of the audience was in an age between 20 and 39 years. 21 participants stated that they play an instrument or have musical knowledge. From the answers provided in the single choice section only those regarding the performance itself will be shown here. These questions were:

1. The performance differs from the previous ones I visited
2. I could participate in the performance
3. I interacted with other audience members
4. I could influence the music with my interaction
5. I understood the concept of game elements
6. The concert provided an additional value to the interaction
7. I had a feeling I could interact with the performers
8. I couldn't participate in the performance
9. I didn't think I was influencing anything
10. I didn't understand the concept of the performance

11. I understood the curtains purpose at the performance
12. I understood the projection on the curtains

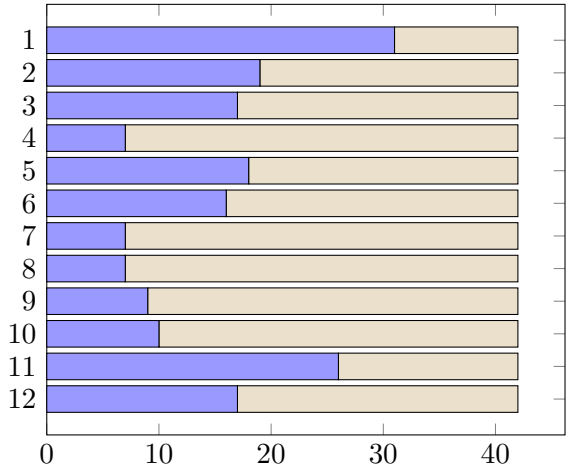


Figure 6.8: Overview on the answers to the single choice questions

In the bar chart above the left (blue) area of each bar shows the questions that have been answered with yes. Only question 1 (73.8%) and question 11 (61.9%) achieved an approval of above 50%. Questions 4, 7 and 8 (each 16.7%) achieved the lowest approval.

6.5.3 Discussion

In this section we will connect the quantitative results of the 12 questions in the bar chart with representative quotes from the open questions section and attempt to interpret these findings. The vast majority of the participants (73.8%) agreed that the performance was different from usual performances, which can also be found in quotations like the following:

> "It was definitely a new experience and something totally different I have ever seen. I was totally confused about the project and couldn't understand it. Great musical background."

Despite the fact that many of the members of the audience found the performance interesting and new, the gathered data clearly shows that the interactive elements were not obvious to most of the audience. Only 16.7% had the feeling that they could interact with the performers or influence the music with their interaction (questions 7 and 4). Most comments emphasized, similar to the quote above, that the music and atmosphere was to their liking, but that they did not fully understand how the interaction worked:

> "It was interesting not to have only the audience image but sometimes it felt like we were not having enough information about our influence. It was funny!"

Similar to the quote above:

> "It was wonderful! Sound was very nice, but I didn't fully understand how movements lead to "unlocking" of squares."

Both of these quotes point out that the audience did not have enough information to fully understand how the interaction worked. Since the interaction was intended to be understood intuitively, the feedback which was provided to the participants via projections was not expressive enough. Firstly, the projections of the "audience image", most likely meaning the contours we extracted from the camera feed, may not be sufficient as a visual feedback. Furthermore the metaphor of "unlocking squares" that we used to show the progress for each curtain, indicating how long it will take for the curtain to fall to the floor, was unclear to many participants.

> "I have the feeling one could get even more visual feedback from interactions. But as a concept and well executed prototype it is really good."

From this quote we conclude that the visual output of the prototype did not provide sufficient feedback on the interaction. This is supported by the fact that 61.9% of the audience wrote that they understood the purpose of the curtains in the performance, but only 40.48% stated they understood the projections on the curtains. Most of the participants provided positive feedback in the open questions section, mainly pointing out that they liked the music as well as the overall setup and atmosphere. However, it was also pointed out that the interaction was not clear to them and it was confusing at first, but became clear during the performance:

Original German quotation on the interaction during the performance:

> "Lange nicht wahrgenommen, dann war es super."

English translation:

> "Did not notice for a long time, then it was great."

From this overview on the results we can see that the majority of the audience stated a general interest in exploring the situation. However, it seemed that the interaction design itself was to vague to be grasped without any additional information. Furthermore, the potential influence on the performance was not or only at a very late stage during the performance realized by the audience. Finally, the connection between tracking, visual feedback and interaction was not as intuitive as we anticipated.

6.6 Interviews

Throughout the design phase we worked together with the musicians Melanie Asböck (Violin) and Lea Föger (Singer) to a very large extend in order to acquire feedback regarding conceptual ideas and the software we developed. Both musicians agreed to take the cooperation further by playing a concert in the setup they helped us to design. After the concert we conducted interviews with the musicians in order to get first hand feedback on the artists perspective of the field test. The interviews were designed as semi-structured interviews to allow the musicians to talk freely. In this section we will present the design, conduction and evaluation of the interviews as well as the results and findings derived from them.

6.6.1 Interview Questions

One of the key questions of these interviews, and of the thesis as a whole, is whether technology mediated audience participation is enriching the experience for the performers. Based on the findings we aim to describe factors for successful audience participation.

The interview guideline was designed in 5 groups of questions. Two groups of questions were designed to examine the individual preferences in regards to music, the other questions focused on different aspects of the project from the early design phase on to the performance itself. The original German interview guideline and an English translation can be found in appendix B 8.4.

1. About your own music:

   The first group of questions was used to introduce the topic to the conversation and to get an understanding of the musicians perception of the topic on a very general level. Furthermore we asked about the success factors for past gigs.

2. Music in general:

   These questions aimed to find out more about the musicians perspective on other artists performances. By asking about good and bad concert experiences from the audiences perspective, the question of success factors for gigs should be brought to a more abstract level.

3. Concept:

   Questions in this section focused on the role of the musicians in the conceptual phase of the project.

4. Preparation and setup:

   Setting up the performance space in the venue took 4 days of preparation. The musicians were present for several hours on each day in order top help with the setup and to rehearse. The fourth group of questions focused on the challenges the musicians had encountered during this phase.

5. During the performance:

   Finally, we asked about the personal experience of the musicians during their performance, how they perceived the interaction and how they would improve the setup for future performances.

6.6.2 Procedure

The interviews were held in German, therefore the original transcript was also written in German. The transcript was written based on the simplified rule set for transcription by Kuckartz and Dresing [31]. Subtle intonation was not taken into consideration for the transcript and conversational language was transformed to standard language, unless special vocabulary was used.

The transcript was created using EasyTranscript and based on the transcript a coding system was developed in MaxQDA. We used the combination of deductive and inductive approach to coding [22], starting with the main topics of the interview guideline as a list of parent code categories. After several iterations on the transcript, in which the codes were edited and extended, a coding system was developed in an inductive manner. Figures 6.9 to 6.14 provide an overview on codes and connected sub codes is provided. The size of the square next to each sub code represents how frequently the code was used.

Figure 6.9: Interview code "Personal Motivation" and sub codes

The first questions of the interview brought personal motivations for making music to the surface. These are mainly joy while making music and exploration by cooperating with other musicians and by trying out different styles of music.

Figure 6.10: Interview code "General Success Factors" and sub codes

Throughout the interviews the question for success factors for live concerts was very present, therefore it was standing to reason to create several sub codes to structure these factors. One interview partner strongly emphasized the quality of sound as an important factor. This aspect, as well as the need for sufficient time to prepare, the musical skills and a solid overall concept are aspects of professionalism that were pointed out. However, the code "subjective perception" represents a notion of artists having "it", which was described as a special quality in a musician that creates a connection to the audience. Closely related to this code are the aspects of authenticity, passion, spontaneous moments and the audience catching fire. These are aspects that are rooted mainly on an emotional level.

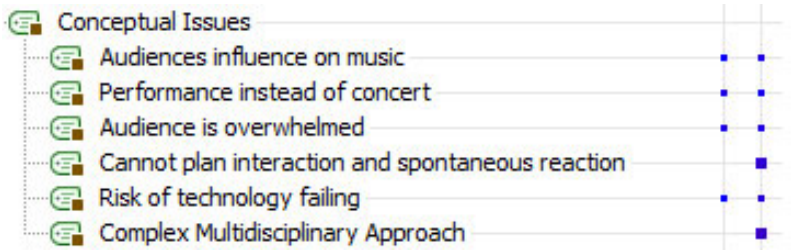


Figure 6.11: Interview code "Conceptual Issues" and sub codes

On the conceptual level both interview partners mentioned the importance of the audiences influence on the music, the differentiation of the performance from a concert and the risk of overwhelming the audience as well as the risk of technology failing. It was also emphasized by one interview partner that the complex multidisciplinary approach made the preparation difficult and that planning for spontaneous interactions is hardly possible since this contradicts the idea of spontaneity.

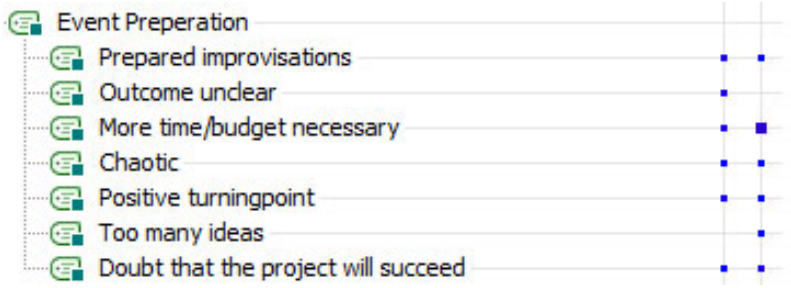


Figure 6.12: Interview code "Event Preparation" and sub codes

In regards to the preparation phase both musicians described their doubt that the project will succeed due to chaotic phases during planning. One interview emphasized the problem of having too many ideas to follow, which correlates with the conceptual issue of a complex multidisciplinary approach. The other interview partner pointed out the unclear outcome of the project. Furthermore, in both interviews a positive turning point

in the project was described that restored the confidence in the project. It was also mentioned that a project of this size would require more resources, both financially and in terms of time to prepare, which was already pointed out in the general success factors.

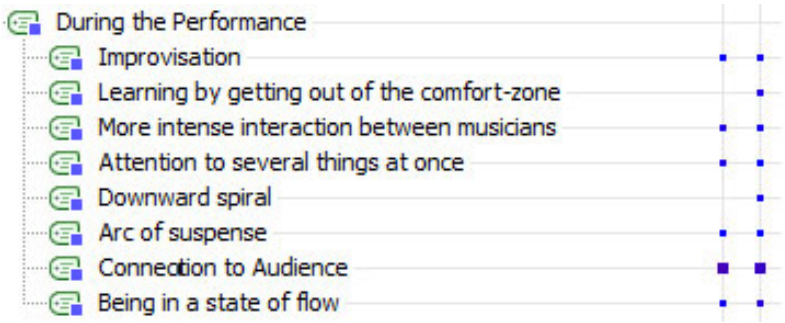


Figure 6.13: Interview code "During the Performance" and sub codes

During the performance the musicians reported a very intense interaction between each other which derived from the necessity to improvise while building up the arc of suspense. They further pointed out that getting into a state of flow and being able to connect to the audience was difficult, since there where many things at once that demanded their attention. This may be connected to the conceptual aspect of a complex multidisciplinary approach and the risk of technology failing.

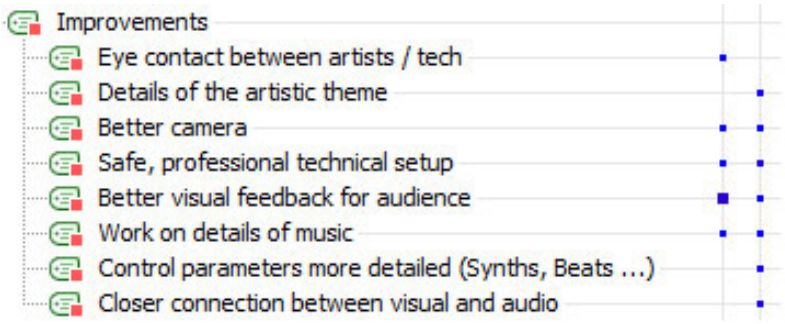


Figure 6.14: Interview code "Improvements" and sub codes

A safer and more professional technical setup, especially concerning the camera, was amongst the ideas for improving the setup. Also the visual feedback for the audience was repeatedly mentioned as well as the wish to further work on the details of the music. In terms of extending the setup a closer connection between visual and audio as well as the use of further control parameters for synthesizers and beats were mentioned. Furthermore, one interview partner added the need for a changed stage setup in order to have eye contact with the technician. Also refining the details of the artistic theme was mentioned as a means to improve the setup.

6.6.3 Results and Discussion

In this section we aim to provide an interpretation regarding interview results by showing how the codes of different categories are connected to each other as well as to other aspects of this work.

Liveness by experimenting

Both interview partners answered that their style of music and their typical gig situation was hard to describe, since they played in different constellations and genres. The emphasis on their personal motivation was on learning new approaches in making music by going out of the comfort zone and avoiding to have a regular or normal concert setting. Not technical perfection or commercial success, but trying out and learning seemed to be the personal factors of motivation for the musicians. During our initial workshop, which was discussed in 4.3, a good performance was described as a special experience that was defined by atmosphere, empathy, musicians having fun and being noticeable but ephemeral. This points out that, aside from the professional factors of the musicians skill set and a solid stage setup, there are aspects that are hard to define and highly dependent on subjective perception of the audience.

Original German quotation:

> "Es gibt sogar Konzerte wo man es nicht so gut hört und trotzdem haben die Leute sowas auf der Bühne dass es dich einfach mitreisst."

English translation:

> "There are concerts where you don't hear it well and still the people on stage got something that is just captivating."

Taking a closer look at this quote we assume that experimenting with new live scenarios is a way for musicians to explore these elements. It is possible to achieve a decent set of skills on an instrument through routines, but it seems necessary to take risks and step outside ones comfort zone in order to create a live exprience. The aspects of authenticity and spontaneous moments, which were also mentioned in both the focus group meeting as well as the interviews point out that there are factors for a good performance that are connected rather to the personality of an artist than to the set of skills this person has acquired. Despite all technological enhancements to performances, the "Classic" liveness that Auslander describes [4] and the concept of ephemerality are still at the core of performing arts, thus are still shaping our idea of liveness.

Expectation-Reality Gap

As a general success factor the need for sufficient time to prepare was mentioned several times. The need for financial resources and time was an issue that followed us throughout

all project phases and can also be found as a sub code of the event preparation codes. Also regarding possible improvements it was mentioned that the artists would like to further work on the details of the music as well as on the details of the artistic theme. These claims led us to the conclusion that the concept might have been too ambitious for the resources we had at our disposal. The mention of the event preparation being chaotic at some point in time seems to be related to this issue. The musicians cooperation started out with a very open discussion. Hardly any limiting constraints were set in the beginning. An initial phase of euphoria was followed by a phase of doubt in the project and an uncertainty regarding the outcome.

Original German quotation:

> "Es war glaube ich auch so eine Phase mal drinnen wo glaube ich alle Beteiligten geglaubt haben das wird nichts mehr"

English translation:

> "There was a phase where I think that all people involved thought nothing will come of this"

However, both interviews concluded that there was a positive turning point when the first prototype was capable of generating both audio and visual output was presented to them. A second positive turning point was described as the moment when the arrangement with a suitable venue was determined. We assume that such challenging situations are not specific to this context, but rather are an issue rooted in the design process. When the design aims towards high customization and the developers work very closely with the users, trying to incorporate many of the users ideas, this may lead to situations where details veil the overall goal of a project. We conclude that a transparent communication on the status and the resources of a project is vital for the motivation of the people involved.

Human senses as constraint

Both musicians emphasized the importance of being in a state of flow, building up an arc of suspense and connecting to the audience when playing live. But they also reported that this was quite hard to accomplish, since they also had to listen to each other very closely for their improvisation while paying attention to the sounds the prototype triggered, which provided the tempo, rhythm and harmonies.

Original German quotation:

> "Ja schwierig war es auf jeden Fall, weil (...) es schon hätte sein sollen dass man sich auf beides gleichzeitig zu 100% konzentriert, und das ist gar nicht so leicht. Man hat sich auf den Backing-Track natürlich extrem

> konzentrieren müssen und damit man halt mitbekommt was kommt, was fällt weg. Gleichzeitg haben aber auch Meli und ich so extrem zusammenspielen müssen, weil das ja eigentlich hätte wie eins sein sollen. Und sich auf die zwei Sachen gleichzeitig so stark konzentrieren das war für mich schon schwierig"

English translation:

> "Yes, it was definitely difficult, since we should have focused on both simultaneously to 100% and that was not so easy. We had to concentrate very closely on the backing-track to know what would be added next and what would be removed. At the same time Meli and I had to play together accurately, since it had to seem as one thing. And to concentrate at both things equally accurate was very difficult for me."

They further reported that at the same time they felt the need to know what was going on on a technical level, fearing that parts of the equipment could fail during the concert. This attention to several, maybe too many, things at once made it difficult for the musicians to build a connection with the audience or to get into a positive flow during the concert. The suggestion to improve the technical setup by making it more reliable, which could again be found in both interviews, seemed to be the logical conclusion. During the development it seemed necessary to us to involve the musicians in the details of the implementation. However, to some extent this can be counter-productive, since it may result in distraction for the artist.

In 2.4 we discussed the model of Performer-System-Audience interaction of Bongers, which explains interaction in a way similar to information flows in signal processing. He points out that the human senses act as sensory modalities, using hearing, feeling and smelling as input channels [7]. When designing interactive systems based on such models the individual needs of human beings should not be disregarded, since every artist will have a limited and very unique capacity for processing additional cognitive inputs.

Overwhelming the audience

Throughout the interviews it was mentioned that the musicians hoped for a more lively feedback from the audience.

Original German quotation:

> "wenn man vor einer Wand steht und dann ist die Wand plötzlich weg stellt man sich das recht emotional vor wenn man dann die Leute sieht. Wenn man sieht wer ist da jetzt und so weiter. Und das war irgendwie von beiden Seiten halt nicht richtig da weil man das Gefühl hat wir waren ein bischen verwirrt und das Publikum war auch ein bischen verwirrt und da hat das einfach nicht so (...) geschafft halt. War nicht genug Ruhe da damit da eine Emotion hätte rüberkommen können."

English translation:

> "If you stand in front of a wall and all of a sudden the wall is gone, you expect it to be very emotional when you see the people. When you see who is there and so on. But that was not really the case on both sides, since we had the feeling that we were a little confused and the audience was a little confused too and it did not really work that way. There was not enough calmness for the emotions to get across."

In the design process we discussed the idea of providing the audience with more details on the performance, especially on how the performance can be influenced. We finally decided not to give any instructions and observe if the interaction would be recognized intuitively. Despite the fact that the actual interaction with the audience did not take place as imagined, the musicians still supported this decision. During the interviews it was made clear that basic explanation, e.g. in the form of a short text like it is used to describe installations, might be sufficient. Any additional means of description would however be an attempt to enforce a certain reaction from the audience, which would contrast important aspect of authenticity.

Original German quotation:

> "Aber ich glaube es liegt vielleicht schon auch am (...) ja (...) ich glaub das das mit dem Visuellen, ich glaube man müsste halt irgendwie machen dass die Leute das besser verstehen"

English translation:

> "But I think it may also rely on the visual, I think one should make it in a way that it is better understood by the people"

We drew the conclusion that the affordance of interactive elements in such a context has to be made clear to the audience, while at the same time it should not force a certain reaction. Since strengthening the connection between projection and audio was emphasized as an area of possible improvement, this could be a way to create a more transparent means of interaction.

Overall concept

Many of the technical aspects of the project were mentioned as areas of improvement, most of all the need for a better camera in order for the tracking to be more accurate and the need for a safer and more professional setup, which minimizes the artists fear that technology will act in an unpredictable way. However, when it comes to the concept itself the common ground seems to be that the overall mechanics should not be changed.

Original German quotation:

> "Also, dass sich die Leute sehen, sich bewegen (...) so gleichzeitig Einfluss auf die Musik haben und auf, dass sie das durchbrechen. Da würde ich im Großen und Ganzen nicht so viel daran verändern. Und ich glaube es hätte auch genau so funktioniert wenn es die Leute ein bischen mehr verstanden hätten"

English translation:

> "So, that people see themselves, move, influence the music and break through. All things considered, I would not change a lot about that. And I think it would have worked exactly like that, if the people would have understood it just little bit better"

Despite the mention of the complex multidisciplinary setup being perceived as error prone and complicated to handle, the musicians pointed out that tying the elements of the performance closer together would be their aim for improvements on a conceptual level. Burgheim points out the increasing importance of combining multiple artistic genres and technological approaches.

> "The avant-garde then proposed a convergence of the arts, an interdisciplinary approach in which all the arts (music, fine arts, cinema, theater, dance etc.) and their representatives would mix on stage. Richard Wagner, with his Gesamtkunstwerk ('total work of art'), would be a precursor of this trend." [11]

This theme of a "Gesamtkunstwerk" came up in several stages of the project and was also mentioned during the interviews, where we coded it as "overall concept". Both during the workshop 4.3 and the interviews the importance of a close connection between visual and auditive elements was emphasized.

Original German quotation:

> "glaube ich schon auch dass man mit solchen Projekten (...) ziemlich große Aussagekraft haben kann. Wenn man sich wirklich thematisch, wenn man das gut ineinander verzahnt hat man da eine Kraft dahinter die man halt in anderen, einfacheren Settings wahrscheinlich nie erreichen kann"

English translation:

> "I think that with such projects it is possible to have a fairly high expressiveness. If it is thematically interlocked well, then this can create a force that would most likely be not achievable in simpler settings."

Furthermore the musicians concluded that, despite the heavily underestimated workload prior to the performance and despite the high risk of failure, such experiments are worth the effort.

6.6.4 Summary

By analyzing the interviews that we conducted after the field test, we learned that the experimental character of the setup was valued by the musicians since it allowed them to try out a new approach towards playing live by stepping out of their comfort zone. However, the expectation that the performance would foster intense interaction with the audience through the influence on the music did not fulfill. Furthermore it was difficult for the musicians to focus on the interaction since the possibility of the technology failing did hinder them from getting into a state of flow. This emphasized that the human capacity to react to external stimulus is a limiting factor that has to be considered throughout the design process. In the same way the audience should not be overwhelmed by an installation, which makes it necessary to simplify interaction where it is possible. It was pointed out several times that the overall concept was very good, but might have been to ambitious since the resources of time and budget were simply not enough to cover all aspects adequately.

Finally the musicians stated that further improvement of the idea would most likely benefit from tying all elements of the performance closer together to create a "Gesamtkunstwerk" ('total work of art).

6.7 Reflective Perspective

In the phases of design and development we were acting as creators of the prototype that was used by the musicians. However, during the field test we also took an active role in the performance. To ensure the frictionless flow of events we monitored the prototype and adjusted its parameters throughout the performance. As part of the evaluation process the active role of the author will be discussed in this section by reflecting on the event. The leading questions for the reflection are based on Schöns reflection after a learning process [49].

6.7.1 Reflection

In retrospect how did it go?

Briefly summarized the event did go well, firstly because no severe technical complications occurred and the set was played mostly the way we planned it beforehand. Aside of that we had a large enough audience to test in a real life scenario and gathered a good amount of questionnaires. On a musical level it also went quite well, the musicians stated that there was room for improvement, but were generally satisfied with the outcome. Further the feedback of the audience was a positive one. However, the audience did not react as we anticipated. There was only little interaction with the installation. We assume that

this was mainly due to the vagueness of the influence on the performance. It seemed that the performance did not provide sufficient information on how the music could be influenced.

The biggest problem that occurred during the event was the low quality of the tracking. In some areas of the room the lighting was not good enough for the audiences movement to be recognized. During the performance no light technician was on site, so I left my post behind the stage, moved up to the balcony where the light was mounted and adjusted the spotlight.

What did I particularly value and why?

During the exhausting preparation phase all people who were involved were fully committed to the project. It was a very valuable experience to see what can be achieved with limited budget and time if all persons are motivated and willing to put their energy into a project.

During the performance itself all technical elements (sound, visual output, falling curtains) worked well. Although there are several things that could be improved, the aspect that no real technical difficulties came up during the performance is quite remarkable, taking into account that the setup consisted of many independent parts that could have easily failed.

Is there anything I would do differently before or during a similar event?

For a similar event it would be necessary to invest into a foolproof technical setup. Putting together a low-cost equipment for the stage comes with the constant fear of technology failing. In consequence this has a negative impact on the quality of the performance itself. Further the visual feedback for the audience needs to be improved. Many members of the audience claimed that they did not understand what was happening or understood it too late. A clear, visual representation of the audiences influence would be necessary to solve this problem.

However, the most important enhancement would be a better tracking solution. Either by using a better regular camera under better lighting conditions or by using a different technological approach, e.g. by integrating a Kinect module.

What are the insights from the event?

We worked together with the musicians very closely the days before the performance. This process showed us how much effort it takes to put such a complex prototype to use. For a prototype test in this context the human factors and the organizational factors are equally important as the technical aspects. When delivering software it is usually possible to test it in a sandbox environment to make sure nothing breaks the system on rollout. In a live situation with interaction there is no way to do a full test in advance and it is not possible to pause at any point. If a crucial component fails it can either be fixed right

away or the performance is over. This puts a lot of pressure on every person involved. Furthermore we learned that the time and effort necessary to create a prototype for the stage is easily underestimated, especially if this relies on the combination of various technologies. Finally we learned that interaction can not be planned. It is possible to give the audience the possibility to interact, but there is no way of knowing what will happen.

6.8 Summary

We decided to conduct our field test as a full scale event in the venue mo.ë. By partnering with local artists we were able to draw enough attention to the event and tested with more than 50 participants. We built our stage in the main hall of the former factory hall. The pillars in the hall of the venue were used as a crossbeam for our stage setup. We came up with a well prepared room concept, however we underestimated the workload necessary to prepare the room accordingly.

For the actual performance we provided no instructions to the audience on how to interact with the prototype. Both the video analysis and the questionnaires revealed that many of the participants did not know how they might influence the performance. By analyzing video footage we further found out that only a few key events created visible impact on the audiences behavior. Due to the complicated lighting situation the tracking of people's movements did not work as well as expected. This added vagueness to the interaction method we designed and made it difficult for the participants to engage. We compared the log files created for the audio output with the video and were able to see that adjusting the spotlights during the performance made the tracking to work better.

Taking a closer look into the questionnaires we found out that, despite the fact that there were problems with the interaction, most participants gave a very positive feedback on the concept of the event. Many participants claimed that it was a unique and unusual performance and that they had enjoyed being part of it. To get a better understanding for the perspective of the musicians we cooperated with we conducted two interviews. In these interviews we found that the musicians valued the experimental character of the setup since it allowed them to try out a new way of playing live. Since expectations were high it was difficult to create a fully satisfying setup. By focusing on technological aspects of the setup we did however not consider the constraints of human sensing sufficiently. For the musicians it was difficult to concentrate on several sources of information (visual, sound, audience, curtains) at once while playing together.

For future works we learned that a clear and simple interaction metaphor for the audience, a solid technical setup and the aim to create a total work of art ('Gesamtkunstwerk') are among the most important factors to be considered.

CHAPTER 7

Discussion

7.1 Introduction

When we began working on this thesis we started out simply with the idea to create a piece of software that would allow us to connect audience and performers of a live concert in a unique and experimental way. Our research question was if this would add value to the experience of a live concert. We refined this question by splitting it into the perspective of the audience and the perspective of the performers.

Through taking a closer look at classifications of live performances that incorporate technology, we aimed towards a better understanding of performing arts in general and specifically how to integrate technology into performances. By field testing our prototype we gathered evidence on positive and negative impact of technology mediation in live performances. Finally, we wanted to find parameters that would act as guidelines for the design of software in the context of live performances. In this chapter we will review our findings by discussing the results depicted in the Evaluation chapter.

7.2 Design and Development

7.2.1 Does the performance fit into the classifications and categorizations we found?

When we reviewed the state of the art in performances with audience participation we found and discussed different approaches on how to categorize performing arts in general 2.2 and more specific technology mediated performances 2.4. As our fieldtest consisted of a mixture of live music, computer generated music, visuals and interactive elements we conclude that this mixed media approach ranges in the "Multimedia and other performances" category [12]. In the same category we find "Happenings", a type of performing arts that we also discussed in the course of this thesis. Despite the fact

that our prototype gives control over several aspects of the performance to the audience, we learned that our concept is clearly demarcated from the idea of Karpows Happening. This is because the performance we prepared had a strong deterministic element, since the audience could only influence the outcome in a predefined possiblity space.

Burgheim analyzed the context of performances with audience participation in more detail and also tried to find an approximate classification on the types of performances. Regarding her overview the following description fits many of the aspects of our performance:

> "Digital performances combining computer graphics, 3D images, as well as cinematic techniques, Pepper's Ghost, tulle or cyclorama, in some cases interactive – in real time or recorded – via technical manipulation from outside of the stage. The images are part of the stage design" [11]

However, the aspect of interacting by using game mechanics and the idea of a dynamic flow of events is not depicted in this description. Burgheim further mentions Trans-media performing arts and describes it as:

> "Trans-media storytelling is a technique coming from cinema and gaming; in principle it doesn't concern the live performing arts" [11]

A description for our performance is most likely a combination of the two descriptions above. Even so, we would need to extended this by the game-like character of our proposed interaction. Since our performance concept allows the audience to influence certain events and therefore change the way the arrangement unfolds, we would draw a parallel between our concept and computer games.

Although we know that not all aspects of this concept were easily grasped by the audience, the protoype allowed the audience to interact by triggering previously defined events (starting loops, stopping loops, opening curtains). The order and timing of these events is open to modification. Furthermore, the interaction is based on a set of rules. By moving in a certain area the audience can increase the activity level of this area, which then results in tiles being added to the projection and sounds being played. After the maximum amount of tiles has been opened in a certain area the corresponding canvas segment falls to the ground. This interaction concept is based on the idea of levels and game mechanics in computer games. The player acts as a dynamic element by influencing the level, hence co-creatating by participation.

Therefore we propose the following definition:

Game-based concert: Musical performance with technology mediation, where the interaction between musicians and audience relies, at least in part, on the use of game mechanics and the course of events is dynamic, allowing the audience to co-create with the artists.

7.2.2 Did the setup fulfill the requriements we described with our design questions (Devices, Displacement, Distraction, Distance)?

As a conclusion on the state of the art we defined four design questions that need to be addressed when creating technology mediated audience participation 2.5.6. We answered these questions before implementing the prototype and review our decisions in this section.

We decided to use optical tracking as the only means of interaction, hence our **device** was deliberately not a physical artifact. Furthermore, we assumed that this would create the least distraction and allows the audience to fully concentrate on the performance. Based on our video analysis 6.3 we assume that we met this requirement. The majority of the audience was focussed on the performance and was not distracted from the center of attention. Nevertheless, we conclude that optical tracking is not ideal for interaction with more than ten people. From our questionnaire we learned that the interaction concept was not understood by all participants, which can also be observed in the video footage. We think that it is hard for an individual in a crowd to distinguish the impact his or her movements have on the tracking. Therefore we conclude that the use of optical tracking was, at least in our specific context and implementation, not the right choice.

Our interaction only happened on site and in real-time, so the spatio-temporal **displacement** was very little. Still a slight temporal displacement was created since we used a quantization of four bars before a new music loop was introduced. At a tempo of 120 beats per minute this could create up to 8 seconds of delay before an event occurs.

Although this quantization is essential in order to create a solid musical structure for the musicians, we assume it can be confusing for the audience. For that reason we think it is necessary to make temporal displacement transparent to the audience and therefore recommend to use a visual representation for this otherwise invisible feature. In this specific case a visual represenation could be a simple progress bar that fills up every four bars and thereby shows the otherwise hidden feature of quantization.

The aspect of **distraction** was partly answered by the use of optical tracking, which we assessed to be less distracting than physical devices, at least in our setup. Distraction by the prototype from a musician perspective will be answered in detail below 7.3.1.

Finally we wanted to create a setting that allowed the audience choose their level of influence by the **distance** they keep from the stage. Our approach was to facilitate collective action on one hand, while on the other hand leaving enough space for bystanders who don't want to approach. From our video analysis we found that the collective action did only happen on a few occasions. The problem we encountered was more that most of the audience remained in a passive position, looking at what was happening without interfering, hence remaining in a save distance. We observed that most interaction was focussed on a few key moments. When we designed the interaction we followed, to some extent, the ideas of Bongers audience participation study [8] that was built around an interactive installation in a museum. Bongers emphasizes that "successful interactive

artwork or system is about facilitating and creating opportunities" [8]. Furthermore, in his study he observed levels of involvement as unaware, aware, approach and interact.

We think that the approach in Bongers study is only partially suiteable for a concert setting. Firstly, we assume that in a concert most of the audience is already aware, therefore we think that for our specific setup a distinction between active and passive members of the audience would be sufficient.

We further reckon that fostering participation would benefit from the use of triggers. As interaction mainly happened around key moment, we suggest to create such key moments on purpose and thereby allow the audience to switch from a passive to an active role. Therefore we assume in our context "creating opportunities" could also be modified to creating key moments that initiate interaction. These key moments should allow individuals to break the ice and should be designed in a playful way which encourages the audience to participate.

7.3 Musicians perspective

7.3.1 How much interaction can be added to a performance from the artists perspective?

In the design phase we roughly classified four levels of influence on a musical performance (Non-musical, Timbre, Music, Mixed) 4.6.3. This classification proved to be a good guideline for the early conceptual phase and we recommend using it to get an overview on how modificational parameters and the interaction can be matched. Through our workshop 4.3 and the prototype iterations with the cooperating musicians 4.6 we were able to map out several parameters for influencing live music. For pop music in a broad sense we assume the following parameters are the most crucial ones when it comes to influencing the musical aspects of a live performance:

- Tempo
- Cadence
- Harmony

Parameters that modify the timbre of a musical performance can hardly be listed, since every instrument, synthesizer and effect chain offers a multitude of parameters. During the development phase of the prototype we found that our simple classification did not consider changes on the structure of events, hence the arrangement. Therefore, when working with loop based music and a dynamic arrangement we assume that the following parameters should further be considered:

- Quantization

- Loop length
- Loop duration
- Loop frequency (how often can one loop be started)
- Amount of simultaneous tracks (minimum, maximum)

In our prototype design we set fixed values to all of these parameters except loop duration, loop frequency and the amount of simultaneous tracks. From our rehearsals we learned that if more than half of these parameters are dynamic and can be edited by the audience, the musical structure of a performance is likely to collapse. However, this is a result specific to our field test and can therefore not be generalized.

When we researched theoretical models that describe the role of technology in audience participation we found the Performer-System-Audience model of Bongers to be a suiteable high-level representation [7]. As discussed in the state of the art section 2.4 we found that in this model the system is placed between audience and performer, listening to input on sensors, calculating reactions in a memory and cognition module and finally providing output on actuators. From our evaluation we found that it is not ideal to reduce the human actor, in this case musicians and audience, to a deterministic element of a system. Both musicians and members of the audience where to some extent overwhelmed by the interaction. We therefore advise to consider the constraint of human perception, especially the amount of events happening in parallel, from the very beginning when designing a prototype.

7.3.2 Did the prototype improve the performance from an artists perspective? Was the technology accepted by the musicians?

In our workshop participants listed authenticity, spontaneity and having a special experience as elements of good performances 4.3.1, all of which are highly dependent on individual perception. Similarly, our interviews with the cooperating musicians revealed that they also valued these qualities. From this we learned that there are ephemeral aspects of a performance, which are hard to describe and most likely can not be planned in advance. However, the musicians also mentioned that when it comes to playing live they like to expand their horizon by stepping out of their comfort zone 6.6.3. For that reason we assume it can be beneficial for musicians to play in experimental environments like our field test. This allows musicians to step outside their frame of expectations, explore the live situation and by doing so further develop their stage presence.

Auslander described modern live performances as oscillating between the poles of the live and the recorded and concluded that this changes the understanding of liveness as a transient experience, since it can be recorded and reviewed all the time [4]. We think that by incorporating game elements and interaction into a performance it is possible to create a setting where each performance will be different. Our field test, due to the movement of the crowd which can hardly be anticipated, will create a unique musical arrangement

for each performance. Subsequently, we assume that participation through technology can help to regain liveness in performances by adding an unpredictable element.

From the perspective of innovation in performing arts we reckon the prototype and its fieldtest were successful as a case study that shows how audience participation could look like. These findings showed us that the prototype had a positive impact on the musicians work in that specific case.

Although the prototype was accepted in the context of the field test, we conclude that the setup is not relieable enough in its current form. To gain a general acceptance from musicians the prototype would need to work near-faultless while offering a greater range of customization options.

7.4 Audience's perspective

7.4.1 How far can interaction in a performance go from the audience's perspective?

From our findings we conclude that creating interactive performances is a tradeoff between hosting a game and performing a concert. A game would in most cases have attributes as rules, challenges, goals or rewards. If many of these attributes are integrated into the interaction concept it is increasingly difficult to maintain the arc of suspense since random events will overshadow the planned events.

We assume that the more the audience can co-create, the less it will be possible to accurately plan the dramaturgy. Therefore audience participation is primarily dependent on the artists, their willingness to work with uncertainty and their expections.

7.4.2 Did the prototype improve the performance from the audiences perspective? Was the technology accepted by the audience?

One of our goals was to foster interaction in between members of the audience as well as between musicians and the audience. The video analysis clearly showed that interaction was sparse and the audience was hesitant to act, possibly even more than at regular concerts. Beside the fact that the interaction was unclear to several participants, we infer that many participants were also afraid to be embarrassed by acting in the wrong way. Therefore we conclude that the participation was not intensified.

However, the questionnaire revealed that the audience was highly interested because it was a unique and exciting setup and that the audience wanted to explore. Therefore, after the audience acclimated, they did mostly accept the unusual utilization of technology and took advantage of the explorative character of the performance. For our field test we assess the technology was mostly accepted.

Nevertheless, as the field test was promoted as an experiment, it is not adviseable to draw general conclusions out of this. We suppose that the use of this prototype in a

normal concert might not be accepted by the audience since the audiences expectations would be very different.

7.4.3 Did the audience co-create with the musicians?

For us the Humanquarium Project was an important source of inspiration, since one of their goals was to "explicitly explore the dialogical relationship between artist and audience" [46], which was also an important aspect for our work. In this work Taylor points out the importance of transitions between the roles of "audience, participant, interactant and collaborator"[46]. Unfortunately, when we analysed the video footage, we could not find any indication that the audience encountered a deliberate shift in their role. We infer that the audience did not see clearly enough how their actions would change the course of events, and therefore did also not perceive their role as potential co-creators.

A somewhat similar outcome has been described by Freeman in the graph theory based collaborative composition:

> "However, it was difficult for participants to follow how their own decisions related to those made by other users or to scores performed in concert. Instead, they focused on the individual product they created, and they often wished they could generate audio files or scores based only on their personal paths through the composition." [21]

Our assumption on co-creation is that it is necessary for a collaborative creative act to make the individual contributions visible. Although the graph based composition works on a far more abstract level than the Humanquarium or our prototype, participants should ideally see what they added to the big picture and how they influence the course of action. Moreover, we assume that this is a relevant factor for collaborative work in general.

CHAPTER 8

Conclusion

8.1 Introduction

The motivation for this thesis was to design and develop technology that deliberately deconstructs the artificial barriers in live performances that were created by technology in the first place. We identified the lack of possiblities for the audience to participate in the concert as an issue that we wanted to investigate.

Our primary resarch question was if it was possible to intensify the experience of a live concert, for both musicians and audience, by adding game-based elements for participation. Based on this question we further wanted to explore the context of audience participation in performing arts and find parameters for successful technology mediated audience participation.

8.2 Summary

We want to briefly summarize our contributions during each phase of the thesis.

8.2.1 Design

We began work on this thesis by describing the stakeholders that were to be considered in the context of a concert. In conclusion to our stakeholder analysis we held a workshop with participants that represented the stakeholder groups we identified. During this workshop we created extensive mappings that represent the domain specific knowledge of the participants. After creating seperate maps for performances, interaction and games we discussed possible fusions of these topics. As a result a combined knowledge map for game-based interaction was created during the workshop.

With the knowledge we gathered in the workshop we drafted several design ideas that we discussed with experts of the field. In this process we were able to refine our ideas and found several limiting constraints for the design of such prototypes.

We were then able to build a lasting cooperation with local musicians that allowed us to discuss and test our ideas with the actual users. This allowed us to add details to our idea while at the same time showed us early in the process which ideas were unfeasible. We iteratively built our design by doing so. In the course of the design process we subsumed our most important design questions to the simple and generalized form of "Devices, Displacement, Distraction, Distance".

8.2.2 Development

During the development process we evaluated different envirionments for software development. We documented this process in detail by explaining which tools, libraries and overall software architecture we used. Furthermore, we described each aspect of the software we developed by its features, explained in detail which third party libraries were used and assessed if the choice was beneficial for the purpose. Moreover we outlined how our tracking was implemented on the Java/OpenCV level, described how a sequencer like Ableton Live can be connected to a Processing application and explained the hardware aspects for our stage design.

By discussing in detail which pitfalls we encountered and which design decisions were a disadvantage we hope to prevent similar projects from making the same mistakes.

8.2.3 Evaluation

Through our extensive field test we gathered data on several levels. The video analysis in combination with the log file output of our prototype gave us a good overview on the activity throughout the performance. We learned that our interaction concept was not intuitive enough for the participants to work immediately. Furthermore, we found that interaction was mainly triggered by a few incidents, which we then defined as key moments. Moreover, we could find indications that during most of the performance the audience was overwhelmed by the situation and therefore reluctant in their action.

By evaluating the questionnaires, which we handed over to the audience after the field test, we found that many members of the audience were in fact doubtful at first since the idea behind the performance did not reveal itself immediately. Nevertheless, we registerd an overall positive feedback through these questionnaires and learned that the unusual character of the performance was also valued by the audience.

Additionally, we conducted semi structured interviews with both musicians that played during the field test. We found that the unusual setup was also valued by the musicians since it allowed them to experiment with liveness from a different perspective. Furthermore, we could describe the challenges that arise when allowing the audience to modify

the flow of events in a live performance and described the issue of overwhelming the musicians by providing too much information.

By considering all these sources of gathered data we leaned that our prototype was accepted in the scenario of the field test both by the audience and the musician. Moreover, we learned that the field test was appreciated by the musicians and by the majority of the audience. However, we also assessed that the prototype would have to be improved on several levels to be accepted in the context of a regular concert.

8.3 Critical Reflection

Throghout the process of this thesis we made decisions based on the knowledge and resources we had at hand. We are aware of the fact that many of these decisions are a source of potential bias for our oveall conclusion. We want to discuss these sources of potential bias in this section and thereby allow considering these aspects in future works.

Workshop

When we invited participants to our first workshop we did this based on our stakeholder analysis. We defined the stakeholders not based on persons, but on roles representing potential stakeholders. If this analysis was done by different researchers it is possible that these roles would have been defined slightly different. Furthermore we invited participants to the workshop that fit the description of our roles. This group had an age distribution of 20 to 35 years, all participants were male and living in Vienna. A more representative setup would have been to conduct several workshops, aim to get an equal distribution of gender and age in each group and compare the results of these groups.

Cooperation with musician

The cooperation with musicians largely influenced our conceptual work. We tailored the stage setup and the prototype in several aspects to fit the needs of the musicians. By cooperating with different musicians the outcome would most likely also differ in many aspects. Since each genre, style and instrument offers a specific range of parameters for potential influence, this cooperation was shaping the direction of our research. In the case of a different cooperation we assume that the interaction with the audience would also have been designed in a different way.

Field Test and Evaluation

We suspect that the way we promoted our field test as well as the venue we chose for this field test also influenced the outcome. Most members of the audience were young and open to experimental performances. A survey that is done under such conditions is of course only partially representative and the context of the survey has to be considered when drawing conclusions.

Limitation of our own knowledge

Finally, we researched and developed with the knowledge, resources and set of skills we had at this time. In case we would have considered other sources in the state of the art section, the course of this thesis would also have changed. The same applies to the our technological set of skills. We chose to develop our software as a Processing project with Java. Using C++, C# or Python to approach the task would also be feasible and by doing so different aspects of the software could have moved in the center of attention.

8.4 Future Work

Based on our findings we see two main paths for future research and development. The first approach would be to use the basic concept with different means of interaction. The semi structured live set that allows musicians to improvise on could be the foundation of such developments. However, the interaction that was done by tracking movement in this thesis could be implemented differently. For example, it could be displaced on the spatio-temporal level by allowing the audience to define the influence on the music in advance. Such research could use a similar approach as Freeman in the graph theory based dynamic composition [21], but could emphasize the focus on the musicians perspective. On the contrary, the interaction could still happen live, but by using other sensory equipment, e.g. ultrasound sensors, the aspect of optical tracking could be substituted.

The second path we see for future research would be to use parts of the prototype as an interactive installation. This would move the research questions away from the context of live performances and would allow for research on interaction and involvement in public places as we described in section 2.5.3 Social Interaction in Public Places . By following this path the software and the work of the design process could be largely reused to research the dynamics of participation with publicly installed interactive installations.

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Appendix A

Questionnaire

Survey Border.games

About this survey:

The purpose of this survey is to capture your experience as a part of the audience in the performance „Border.games“. Your feedback will enable us to evaluate and further develop our concept.
Thank you for your time!

Consent

By proceeding you agree, that you

- participate in a study of the Technical University of Vienna
- have read and understood the survey description
- know this survey is anonymous
- are older than 16
- know that there is no wrong or right answer, only your personal opinion counts

that your data is being treated confidentialy and will not be shared with thrid parties

Contact

Lukas Gartlehner
l.gartlehner@gmx.at

Naida Comaga
naida.comaga@gmail.com

Please circle the correct answers:

Male / Female / no Answer

Age group
16-19 / 20-24 / 25-29 / 30-39 / 40-49 / 50-59/ 60+

Highest level of education:
Compulsory School/ Apprenticeship/ Higher School Certificate/ University

Do you play an instrument or have musical background?
Yes / No

How often do you play games:
Daily/ Weekly/ Monthy/ Never

Which of the following statements about live concerts do you agree with (multiple choice possible)

☐ I like to be a part o an audience
☐ I like to meet other people at concerts
☐ I like the artist to know my appreciation and excitement at a concert actively
☐ I want to hear the songs as I know them from records
☐ I want to experience a unique and special concert
☐ I want to have fun and make a party
☐ I like to live a music experience instead of just listening to the music
☐ I like to be involved in a show
☐ I want to hear new songs which are not (yet) available on the records
☐ I like to focus on the music without being distracted
☐ I like to see a show instead of just listening and watching them play

Regarding the performance border.games, which of the following statements do you agree with:

☐ The performance differs from the previous ones I visited
☐ I could participate in the performance
☐ I interacted with other audience members
☐ I could influence the music with my interaction
☐ I understood the concept of game elements
☐ The concert provided an additional value to the interaction
☐ I had a feeling I could interact with the performers
☐ I didn't interact with other members
☐ I couldn't participate in the performance
☐ I didn't think I was influencing anything
☐ I didn't understand the concept of the performance
☐ I understood the curtains purpose at the performance
☐ I understood the projection on the curtains
☐ I didn't know what the curtains purpose was
☐ I didn't know what the projection was about

Please write your personal opinion about the performance:

Please state your opinion about interactions that took place at the performance?

Appendix B

Interview Guideline

This appendix contains the guideline questions for the semi-structured interview of Chapter 6 in the original German version as well as an english translation that was created afterwards.

Leitfaden

I) Zur eigenen Musik

1. Wie lange machst du bereits Musik?
2. Wie würdest deinen musikalischen Stil beschreiben?
3. Kannst du einen typischen Auftritt beschreiben (Vorbereitung, Show, danach) ?
4. Wann läuft ein Konzert für dich als Musikerin optimal?

II) Allgemeines zum Thema Musik

5. Was macht für dich, aus Publikumssicht, ein gutes Konzert aus?
6. Wann ist ein Konzertbesuch für dich schlecht?

III) Konzept

7. Du hast den Prozess der Entwicklung des Prototypen von der Konzeption an begleitet.
8. Wie ist die Konzeptphase für dich verlaufen?
9. Gibt es dabei Dinge die besonders interessant für dich waren?

IV) Vorbereitung & Aufbau

10. Wie ist es dir bei der Vorbereitung ergangen?
11. Was waren die Herausforderungen?

V) Während der Veranstaltung

12. Wie ist es dir auf der musikalischen Ebene währenddessen ergangen?
13. Gab es Probleme, und wenn ja, auf welcher Ebene (technisch, konzeptionell, andere Gründe)?
14. Wie ist es dir mit der Interaktion ergangen?
15. Wie könnte man das bestehende Konzept erweitern oder verbessern?

Guideline

I) About your own music

1. Since when do you make music?
2. How would you describe your own style?
3. Can you describe a typical live gig?
4. What is necessary for you as a musician to have an ideal gig?

II) Music in general

5. From an audiences point of view, what makes a concert great for you?
6. From an audiences point of view, what makes a concert experience bad for you?

III) Concept

7. You have been part of the process of the prototype development from an early stage.
8. How did this concept phase proceed for you personally?
9. Did you encounter especially interesting aspects during this phase?

IV) Preperation and Setup

10. How did you perceive the preperation phase?
11. What do you think were the main challenges during this phase?

V) During the performance

12. How did the performance go for you on a musical level?
13. Were there any problems, and if so, can you define on which level (technical, conceptual or other) ?
14. How did you perceive the interaction with the audience
15. How could the concept be improved or extended?

Informationsblatt & Einverständniserklärung

Einleitung

In diesem freien Interview geht es um Ihre persönlichen Erfahrungen mit dem Prototypen zur Publikumsinteraktion welcher im Zuge der Veranstaltung „border.games“ getestet wurde. Als Student der Technischen Universität Wien bin ich für Ihre offene und ehrliche Meinung sehr dankbar.

Informationen zur Einverständniserklärung

Es ist bei Forschungsinterviews üblich, dass Sie vor Beginn Ihr Einverständnis zur Teilnahme geben. Im Folgenden möchten wir Sie über die wichtigsten Punkte des Interviews und über unsere Arbeitsweise aufklären:

- Sie können in diesem Interview nichts falsch machen, Ihre ehrliche Meinung ist uns wichtig.
- Sie können während des Interviews vollkommen frei agieren und sprechen.
- Der Verlauf des Interviews wird aufgezeichnet. Die gewonnenen Daten werden vertraulich ausgewertet und nicht an Dritte weitergegeben.
- Wir können das Interview jederzeit unterbrechen falls Sie eine Pause wünschen.
- Sie können das Interview jederzeit ohne Erklärung und folgenlos abbrechen.
- Sollten Sie uns nach dem Interview etwas mitteilen wollen, können Sie uns gerne telefonisch, per E-Mail oder postalisch kontaktieren.

Für die Durchführung des Interviews und allfällige weitere Fragen steht folgende Person zur Verfügung:

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1030 Wien

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Einverständniserklärung

Name (in Blockbuchstaben): _____

Ich habe alle Punkte gelesen, verstanden und stimme dem Interview zu.

☐ Ja ☐ Nein

Ich stimme zu, dass das Interview mit einem Audioaufnahmegerät aufgezeichnet wird.

☐ Ja ☐ Nein

Ich stimme zu, dass Zitate namentlich / anonymisiert (nichtzutreffendes streichen) aus diesem Interview in wissenschaftlichen Publikationen verwendet werden dürfen.

☐ Ja ☐ Nein

Ich stimme zu, dass ich keine Bezahlung für die Teilnahme an diesem Interview erhalte.

☐ Ja ☐ Nein

_____ _____

Ort, Datum Unterschrift des Interviewleitenden

_____

Unterschrift des Interviewpartners