FAKULTÄT FÜR !NFORMATIK
Faculty of Informatics

Exploring audience participation in live music with a mobile application

DIPLOMARBEIT

zur Erlangung des akademischen Grades

Diplom-Ingenieur

im Rahmen des Studiums

Business Informatics

eingereicht von

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Wien, 20. April 2016

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DIPLOMA THESIS

submitted in partial fulfillment of the requirements for the degree of

Diplom-Ingenieur

in

Business Informatics

by

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Erklärung zur Verfassung der Arbeit

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Wien, 20. April 2016

Christoph Bartmann

Acknowledgements

I would like to express my gratitude to my advisors, Peter Purgathofer, Oliver Hödl and Fares Kayali. Their guidance, experience and advice helped me during my research and writing of my thesis.

Besides my advisors, I would like to thank the other members of the expert team I was working with: Susanne Kirchmayr, Ulrich Kühn, Thomas Wagensommerer. Without them my thesis would not have been possible in that way. I appreciate their musical and sound-technical support as well as the time they offered during the last months.

I would like to thank my girlfriend Tanja for helping me with the mass of questionnaires I had to deal with during my evaluation.

Last but not least, I would like to thank my family and friends for their support during my thesis as well as the rest of my studies.

Kurzfassung

Smartphones dringen noch immer in verschiedenste Bereiche des Lebens vor. Es gibt jedoch Anwendungsgebiete in denen Smartphones entweder garnicht oder missbräuchlich verwendet werden. Eines dieser Anwendungsgebiete sind Konzerte. Dort werden Smartphones heutzutage vom Publikum entweder garnicht verwendet oder aber sie werden in einer Weise verwendet, die vom eigentlichen Konzert ablenkt. Dennoch haben Smartphones neue Arten der Publikumsinteraktion ermöglicht. Weitere Interaktionsmöglichkeiten müssen noch erforscht werden. Dabei sollte man beachten, dass schon vorhandene Interaktionsmöglichkeiten möglicherweise auf Smartphones umgelegt werden können.

In dieser Arbeit interviewen wir Konzertbesucher und Musiker, um neue Möglichkeiten der Publikumsinteraktion mittels Smartphones herauszufinden. Des Weiteren untersuchen wir eine bestimmte Publikumsinteraktion, welche hochfrequente Töne verwendet. Umgesetzt wird die Interaktion mithilfe einer Cross-Plattform Smartphone Applikation, welche im großen Rahmen getestet und anhand von Fragebögen und eines qualitativen Interviews mit einer Performerin evaluiert wird.

Abstract

Smartphones are still becoming more and more important in everyday life. Although there are areas of application where they are either not used or misused. One of these areas of application are live concerts. Nowadays, the audience either does not use their smartphones during concerts or they are distracted by using them. Nevertheless, smartphones have enabled new possibilities for the audience to participate and interact. New concepts still have to be explored. Traditional audience participation methods may possibly be transferred to the use of smartphones as well.

In this thesis we interview musicians as well as audience members to discover new ideas of audience participation using smartphones. Furthermore, we explore one specific audience participation concept using high frequency sounds with a cross-platform smartphone application. The application is tested in a large-scale setting and evaluated on the basis of questionnaires as well as a qualitative interview with a performer.

Contents

CHAPTER 1

Introduction

This chapter is used for pointing out our motivation and the problems we focused on during our work. We will define the aim of the thesis as well as the research questions we are trying to answer. Furthermore, we explain the methodological approach we used and give an overview of the thesis.

1.1 Motivation

Smartphones have overrun our everyday life. Almost everybody, especially the younger generation, uses a smartphone. Apps are being developed for various areas of application. They simplify processes, deliver the right information at the right time or entertain us. Activities that used to be been done on PCs are now done on smartphones. Even though most areas of application are well explored others are not. One of these areas is the area of audience participation. Developing new applications is not enough for exploring a new field. Applications are only useful if they are accepted by the users. Our motivation is the idea to integrate smartphones in live performances and to explore new areas of application via new smartphone apps. We also focus on the users' views which is crucial for improving our approaches.

1.2 Problem definition

Although audience participation is widespread in live concerts, smartphone interaction during live performances has become more important recently. Examples for available smartphone interactions are the smartphone application of a band called Tin Men And The Telephone [39] and the text message voting used by Metallica [48]. Metallica asks the audience which songs they would like via a voting.

During Tin Men And The Telephone concerts, questionnaires are used which can be completed via the audience's smartphones and the results are displayed on a screen on

the stage. The audience's phones are also used as additional speakers. A chatroom which is visible on a screen on the stage enables communication between the band and the audience as well as within the audience. [47]

A different approach, called massMobile [43], is an audience participation framework for smartphones which was developed for research reasons. It uses a web application to guarantee multi-platform support. User interfaces in massMobile are generic and contain sliders, text entries, votings and drawings. It is designed to be used in various areas of application. Nevertheless, the use of the web application and the multi-platform support lead to functionality restrictions (i.e. sensors, camera, speakers).

Economically, the implementation of multi-platform applications is more efficient than the implementation of single applications for each platform. We therefore identified two needs in the area of smartphone participation during live concerts. The first one emerged from the fact that the ways of participation with smartphones are not well explored. We therefore have to identify new ways of participation and figure out what audience members like and dislike. The second one is that we want to find a way which makes it possible to develop multi-platform applications without the restrictions of a web application.

The difficulty we have to deal with is that smartphones are often misused during live performances. People often start to take illegal pictures or film with their smartphones and other devices. From the performer's view it is nearly impossible to control how people are using their phones.

1.3 Aim of the thesis

The aim of the thesis is to

- figure out new ways of audience participation using smartphones.
- test one specific way of audience participation via a multi-platform mobile application.
- explore if the used concept is feasible and accepted by the audience and by the performer.
- identify positive as well as negative aspects of the chosen concept.
- find restrictions, possibilities and possible improvements of the presented concept.

1.4 Research questions

As mentioned in the sections above, we are focusing on one specific concept. The selection of the concept is done by a focus group which is influenced by preliminary interviews with both potential audience members as well as musicians. For more details we refer to

the next section which will point out the methodological approach. The methodology can be found in Chapter 3. At the start of this work we did not know which concept our focus would be on. We therefore formulated more general research questions. The initial questions were reformulated during the design process of the multi-platform application described in Chapter 5. The following research questions are the reformulated and specific ones which are crucial for the evaluation of our work:

- Is audience participation using high frequency sound ID recognition via a smartphone application accepted by the audience? Why is it accepted / not accepted?
- Is audience participation using high frequency sound ID recognition via a smartphone application accepted by the performer? Why is it accepted / not accepted?

Regardless of the answers, the following questions are crucial:

- What can be improved?
- What problems did occur?
- What are possible solutions for the problems?
- Can the app improve the concert / the experience of the concert?
- Will the audience use the app or prefer just listening to the concert?
- Will the audience stop using their phones for other things because of using the application?
- Are smartphone/non-smartphone users distracted by the app?

1.5 Methodological approach

The aim of the first part of the thesis is to discover new ideas and find new possibilities regarding audience participation using a smartphone application. To receive this knowledge we chose semi-structured interviews with both performers and people who attend concerts. As we were further interested in developing and testing new possibilities, the opinion of the most important kinds of participants became relevant. For this purpose interviews enabled a deeper insight than questionnaires. We therefore continued asking specific questions and pros and cons when we thought that we could learn more from the interviewed person.

The selection of the specific interaction we were implementing as well as the whole design process of the smartphone application was done with a focus group [40]. The advantage of this method is that a focus group can be an expert team where people from different fields come together to solve a problem or to explore a specific field.

After the developing process we tested our application in a lecture hall with more than 250 audience members. To evaluate the opinion of such a mass of people within reasonable time, the best solution was to hand out questionnaires which covered a few single choice questions as well as open questions. To cover a performer's view as well, we conducted a semi-structured interview with a performer who was a member of the focus group and responsible for musical support. The interviewed person experienced the live test as well as the design phase of the application. It was therefore helpful to identify problems, chances and possibilities from the stage side.

1.6 Structure of the thesis

Firstly, we will give an overview of important literature on audience participation in Chapter 2. We start with an introduction of audience participation and continue with audience participation without smartphones. We also give a few examples of audience participation where smartphones are used. The concepts mentioned in this chapter will not always be used in musical live performances but also in other events where an audience is present. Secondly, Chapter 3 describes the used methodology in detail. Thirdly, Chapter 4 and Chapter 5 describe the design process of the implemented smartphone application. Chapter 4 shows the interviews made before starting to develop the application within a focus group. Furthermore, an overview and an explanation of the results will be provided. Chapter 5 describes the design process as well as design decisions in detail. Fourthly, Chapter 6 describes the whole implementation of the final application. This chapter also includes important design decisions as well as advantages and disadvantages of the used technology. Fifthly, the live-test as well as the results of the questionnaires handed out can be found in Chapter 7. For evaluation purposes the chapter also includes a qualitative interview with a performer. The results and the research questions are discussed in Chapter 8. Lastly, the conclusion, as well as future work, can be found in Chapter 9.

CHAPTER 2

State-of-the-art

In this chapter we give an overview of important literature regarding audience participation at live performances. We start with an introduction of audience participation. We will continue showing relevant projects in the area of audience participation and technology-mediated audience participation. The projects cover participation methods without smartphones and methods for which smartphones are used. At this point we particularly point out high frequency sound recognition which is crucial for our work.

2.1 Audience participation: An introduction

This section explains how we understand the term "audience participation" since there is no clear definition of the term. Audience participation is not only used in musical live performances, it is also used at various events where a group of people, the audience, is participating in some way. The ways of participation as well as the direction of communication vary strongly. In some projects the the participation is unidirectional. This means that either the performer communicates with the audience or the audience communicates with the performer. In other projects bidirectional communication is used. Audience to audience communication is possible as well. A mix of the mentioned ways may be used at different times. Examples of the ways of communication will be given in this chapter as well. [32] Different types of audience participation are also discussed in echobo [26].

Although our work is focusing on a musical live performance, this chapter will introduce participation methods for musical performances as well as non-musical performances. Some of the introduced participation methods may also be transferred to other events.

2.2 Audience participation without smartphones

With the phrase "audience participation without smartphones" we cover audience participation methods and experiments where the audience does not need smartphones or PDAs. Typical concepts used in musical live performances are interactions like clapping, jumping, singing or other activities in a synchronised fashion. On stage the scene as a whole is important but also the gesticulation and facial expressions of the performers. Apart from these often used concepts people explored more complex and completely different approaches. This section is not only intended to provide an overview but more importantly, it also serves as an inspiration for the design phase since audience participation without smartphones may be rethought and transferred to smartphone-based audience participation. We therefore cover audience participation concepts where a large group can interact collaboratively. Moreover, concepts for which technical devices have to be used will be presented. These devices are handed out and do not belong to audience members like smartphones.

Talking about audience participation, two devices that can be discussed are the mixiTUI [34] and the Reactable [20]. Rather than being used by the audience these devices are used by the performer for creating music, illustrating how the music is created. Both devices may enable a deeper understanding how the performer is creating music on stage which may lead to better audience involvement.

For the following approaches different kinds of balls are used to playfully involve the whole audience collectively in an action. The approaches are all based on throwing a ball in the audience. A band called D'Cuckoo [4] invented a ball called "MIDIBall", which they used in their concerts. Every time the ball is hit by the audience, the ball plays music or displays computer visuals. Another approach is to throw a beach ball into the audience for playing an interactive game which is projected on a screen in the front. [30] The shadow of the beach ball is used as a cursor. Findings in this experiment include that the game is self-explanatory and that people react emotionally if the action is well chosen. A third ball game for audience participation, where the 3D positions of multiple helium-filled balloons are used is called Squidball [6].

A last presented ball based audience participation concept is called “Experimence” [16]. In Experimence the 3D position of the balloon in the room can control specific parameters of music. The balloon controls the sound of the piano during a live performance at specific parts of the currently played song.

Apart from large group ball games other collaborative large audience participation experiments were made by letting the audience play Pong, a video game developed by Atari, 1972, or by using laser pointers for pointing on a movie screen. The laser pointers were used for drawing, playing games or for answering questions which were shown on the screen. [30]

Maynes-Aminzade et al. defined a set of design principles regarding system design, game design and social factors. System design includes the following three design principles [30]:

- "Focus on the activity, not the technology."
- "You do not need to sense every audience member."
- "Make the control mechanism obvious."

Game design includes the following two design principles [30]:

- "Vary the pacing of the activity."
- "Ramp up the difficulty of the activity."

The social factors include the following two principles [30]:

- "Play to the emotional sensibilities of the crowd."
- "Facilitate cooperation between audience members."

For a more detailed explanation of the design principles we refer to "Techniques for interactive audience participation". [30]

Before changing to smartphone participation we will present three participation methods where technical devices are handed out in the audience. Moreover, these concepts were created for the use at music events. Glimmer [10] is a composition for a chamber orchestra. The audience in Glimmer has light sticks which can be turned on and off. Together with video cameras, computer software, multi-coloured stand lights and video projector animations these sticks are used to create a feedback loop which influences the composition directly. An interesting finding at Glimmer was that it is a problem if the audience is not working together in groups because the signals of turning on and off compensate each other in large audiences. Another interesting result was that people started waving their light sticks, because it was simply more fun for them than turning the light sticks on and off in spite of knowing that they did not affect the music as much.

For a further participation method wireless motion sensors are used by the audience. [9] The motion sensors capture the rhythm and activity information of the dancing audience which are sent by radio frequency waves. The signals are captured by multiple base stations which then send the information to a MIDI converter. After processing the information the audience gets feedback by changed music and light effects. The last presented technical devices are called Xylobands [46]. Xylobands are radio controlled LED wristbands, which for instance were used in the concerts by the band Coldplay [49]. By using Xylobands in live performances the audience becomes part of the show by shifting light effects from the stage into the audience area. The shifting of light effects into the audience is also done in some smartphone participation concepts which will be discussed in the next section.

2.3 Audience participation with smartphones

So far the audience participation methods and experiments mentioned were possible either without handing out technical devices in the audience or with technical devices handed out for the use at specific events. In this section we introduce significant work in the field of audience participation where the audience needs smartphones or PDAs to take part in the event. We will first show relevant related work in the field of smartphone audience participation and then mention bands which are using smartphone participation during their live performances. The presented concepts vary from concepts which are used for collaboratively creating or influencing sound, concepts which are made for audience to audience communication as well as concepts which are flexible enough to be used for various purposes.

Smartphone participation concepts which focus on sound

For some of the participation experiments the audience has to download an app, while other experiments are fully accessible via a web application or a website. An example for a live performance where none of these two possibilities is necessary is called Dialtones [27]. Dialtones has been one of the first experiments in the area of smartphone participation. Before the concert, the audience had to register their phone numbers, take a specific seat in the hall and download a specific ringtone. During the concert the performers dialed the audience's numbers to play the ringtones through the audience's phones. Dialtones is therefore an example of unidirectional communication. [32]

Oliver Hödl et al. also observed that smartphone participation can be an issue if the audience gets distracted because of the use of their smartphones. [17] In their studies the audience was able to control the stereo panorama of the lead guitar by moving their smartphone to the left or to the right. The collaborative value of the panorama was visualized by a point on a screen behind the stage. Main findings were that the musicians do not want to lose too much control of their music and that the audience wants to have proof that they exert influence with their actions. People get frustrated if they think that their actions are useless. Collaboratively controlling a value can become an issue because the average value does not change much by the change of a single value (and even less if more participants are present). In their interviews one of the participants mentioned that he missed a coordinator.

In CaMus^2 [35] users can use their phones' cameras and a piece of paper with a grid on it that is used to specify the parameters of music. The parameters are collected by a PC via Bluetooth where they are subsequently converted into MIDI format.

Echobo [26] is another smartphone application used for audience participation. In echobo the audience is able to download an app which is used for actively playing an instrument on the phone. A master musician is able to define possible tones which will be displayed on the audience's phones via a key instrument. The whole music is generated by the speakers of the mobile phones as well as a musician who is playing simultaneously.

A more complex way of communication is chosen in Madder Libs (2010) by Nick Kruge,

in Converge 2.0 (2010) by Jieun Oh and Ge Wang, and in Orkestra (2010) by Nicholas Bryan. [32] In these performances the communication is split up into three stages. In the first stage people are uploading content. The second stage is done by the performer, who processes the uploaded material and sends it back to the audience. In the third stage the audience communicates by starting social actions. [32]

Audience to audience communication

A different approach concerning the direction of communication is used by TweetDreams [7] and Heart (2010) by Jieun Oh. In these concepts the way of communication is audience to audience. For this purpose TweetDreams is using Twitter. During the live performance people in the audience were asked to tweet with specific search hash tags. When using these hash tags their tweets created melodies and were visualised unfiltered on a screen. Criticism was that actively tweeting people tried to find their tweet on the screen. This proved to be so difficult that they were not able to focus on the rest of the performance. Another one was the sounds of the tweets being too similar. [32, 7]

As far as the authors know, Heart is the first web application used for audience participation in a live performance setting. In Heart part of the audience was able to mark their place in the hall via a smilie on iPads. Furthermore the people were able to mark their heart rate on a 2-dimensional grid from calming to arousing and from negative to positive. The rest of the audience was able to see the results on a screen at the front of the hall. The process was repeated continuously. An interesting outcome of Heart was that not only the actively participating audience but also the audience just watching was interested in how the collaborative 2D-grid changed on the screen. [32]

A flexible framework for smartphone participation methods

An approach which was not developed for a specific audience participation or for specific events is called massMobile [43]. MassMobile was designed to be a flexible and scalable framework for audience participation. In massMobile the audience uses a web app therefore participation is not restricted to a specific platform. Each device with an internet connection via 3G, 4G or WiFi can be used to access the app via web browser. Used concepts in massMobile are text entries, votings, sliders, drawings and 2D-sliders. MassMobile is used for bi-directional communication. First the user interface (UI) elements are displayed on the screen and then the audience can interact with the given interface. MassMobile was tested in various projects. In one of these tests, for example, the audience was able to control the lighting configuration with a slider. In addition, a dancer changed his performance according to the light. An interesting outcome was that the audience started to work together to change the light collaboratively. Other experiments were made during sport events. In TeamWork the audience was able to change a sports team's fight song during a live performance of an athletic pep band by using 2D-sliders. The audience was able to choose from "slow" to "fast" and from "soft" to "loud". The collaborative voting was displayed on a big screen. According to the work of Oliver Hödl et al. [17] the same issue occurred in this scenario. Without a coordinator (in this case a mascot) the collaborative result is always somewhere in the middle because

the individual results cancel each other out if there are too many people in the audience. Another application of massMobile is Sketching. With Sketching the audience was able to collaboratively draw visual shapes. The application was used at two performances of the Georgia Tech jazz combo in spring 2013. [11] Each audience member was able to choose a shape and change the colour, the border, the size and the opacity. A shape represented an instrument while the other parameters represented articulation, volume and sustainability. After choosing the parameters the audience was able to position the shapes on a timeline on their screens which influenced the music. One problem was that too many people participated and the whole screen was full of shapes. This led to the fact that it was impossible for the musicians to interpret. Therefore, people were only able to place a limited amount of shapes at the next performance. Another known problem of massMobile is that mobile network reception often poses a problem at big venues. [43, 11]

High frequency sound recognition

Apart from conventional connections for transmitting data, a completely different technology is used in Sense of Space [14]. The authors built an iOS application which uses high frequency sound IDs to trigger sound and visuals on the iPhones and iPads in the audience. The IDs use frequencies between 18 kHz and 20 kHz and are recognized by the microphones of the mobile phones and tablets. An ID is specified as 2 simultaneously played frequencies. The authors defined 16 IDs. A problem was that the phones' speakers were not loud enough. The audience members then placed their phones near their ears which led to the fact that they could not see the visuals on their screens.

Commercial smartphone participation

Not only researchers but also bands are discovering the area of smartphone participation because of increasing popularity. One example is the metal band Metallica [31] which started including smartphone voting in their concerts. The video [48] taken at the Rock Am Ring festival [29] 2014 in Germany shows that the audience is able to vote for three different songs. The voting results are displayed on a huge screen on stage. Another example of a band which uses smartphone participation is a dutch jazz band called Tin Men And The Telephone [39]. Concepts used in their interactive concerts contain real-time voting and live chatting on the stage's screen. A video [47] shows a full concert at the jazzahead! [44] 2014 in Bremen, Germany. To participate, the members of the audience had to download an app from the app store and use it during the performance.

Another simple but spontaneous smartphone or camera based type of audience participation was used by Robbie Williams. During his concert he asked the audience to use the flashlight of their cameras at the same time which led to a massive light effect within the audience. [50]

2.4 Interpretation

An issue all participation methods have to consider is scalability. Audience participation concepts without smartphones, like different kinds of ball games [4, 30, 6, 16] discussed above, are often scalable naturally. The use of smartphones complicates the situation however. Especially applications where an internet connection is needed may have latency problems. Concerning latency, radio controlled or audio controlled mechanisms may present a better solution. The lack of internet connection and mobile network reception at big events is an issue as well. Another concern various projects showed is feedback. Therefore, feedback loops as well as confirmation that user input has an influence may be important as well. Projects showed that if users' input is used collectively during the event, a coordinator should be used to guide the audience in a specific direction.

Audience participation concepts may not always be easily identifiable as such. For instance, it is not easy to say if the Reactable [20] can be used as an audience participation method. However, people may have the feeling that they can "touch the music" and know what is going on on stage. Even though this type of interaction is unidirectional it may heighten the audience's experience during the concert. Another important aspect is that on the one hand smartphones enable new ways of interaction but should only help to implement a specific activity. [30] The technology itself should be moved to the background. It is important to keep in mind that smartphone participation can also lead to distraction which is exactly what it should not be used for.

The projects presented strongly vary in the specific kind of interaction and participation. In some of these the audience has an active role while in others the audience participates passively. This may also be influenced by the way communication is possible.

One last issue to be mentioned is that the technology selection may also have an influence on the number of participating audience members. A web app may be used by more participants than an app which has to be downloaded.

CHAPTER 3

Methodology

This chapter explains which methods we used for our research. Chapter 2 covered relevant literature in the field of audience participation. The literature contains approaches without smartphones, approaches where smartphones have to be used as well as commercial approaches. Due to the fact that audience participation with smartphones is rarely used but is becoming more and more important nowadays, we will explore new concepts of audience participation within this work. Furthermore, one specific concept will be implemented and evaluated in detail. The research questions we are going to answer can be found in Section 1.4.

We therefore chose the following research methods which will be discussed subsequently:

1. Semi-structured interviews with potential audience members as well as musicians.
2. Designing an audience participation application for smartphones within a focus group [40].
3. Evaluating the concept and the smartphone application via
    - Questionnaires of a large-scale live test
    - A qualitative interview with a performer

Interviews with potential audience members and musicians

Our goal in the first place was to find new possibilities to use a smartphone for participation during a concert. Therefore, we chose semi-structured interviews with audience members as well as musicians who are smartphone users.

Another possibility would have been questionnaires which would have led to a larger number of participants. We chose interviews because our goal was not to receive all kind

of concepts that can be applied to audience participation applications but rather to get a basic feeling of what concepts people expect, want or even reject. Furthermore, the results of the interviews should only be used as input for the focus group. Within our time constraints more detailed research would not have been possible.

Designing an audience participation application for smartphones within a focus group

After ascertaining what audience members as well as musicians expect from an audience participation application an application was developed and further researched within a focus group. The focus group is an expert team consisting of a performer as well as four other experts located in the area of arts, music, sound engineering and informatics.

We chose the focus group because an interdisciplinary topic may be solved better by an interdisciplinary team.

Evaluating the concept and the smartphone application

The smartphone application was tested by a large-scale live test in which more than 250 participants tested the application via using it or watching the event. During the event a questionnaire was handed out.

Other possibilities would have been to test the application in a smaller setting or evaluate it via interviews. We chose our approach because of statistical meaningfulness. Furthermore, interviewing this number of people would have been too time consuming.

The second part of the evaluation was a qualitative interview with a performer who was also part of the expert team. The results of this method led us to the most relevant information we need for improving the application. Other approaches like interviews with more performers or even questionnaires would have gone beyond the scope of our project but are conceivable in future work.

CHAPTER 4

Preliminary Interviews

In this chapter we describe the interviews we conducted before designing the final smartphone participation application with the focus group. The aim of the interviews was to identify new audience participation concepts for which smartphones have to be used. We therefore interviewed potential audience members and musicians. Furthermore, the results of the interviews were used as input for the focus group.

This chapter first gives general information about the interviews and the interviewees. Then we present the results of the interviews. Finally, a brief interpretation of the results is given.

4.1 General information about the interviews

All in all we interviewed seven people. Four of the interviewees had the following characteristics:

- The person is a smartphone user.
- The person likes music and goes to concerts.
- The person went to concerts in the last months.

The other three interviewed persons are musicians and also smartphone users and are actively giving concerts. The combination of these two types of interviewees helped us understand the problem from both sides. Table 4.1 shows all interviewed people. The genre for the first four people is the preferred genre they are listening to, while the genre for the musicians specifies both the genre they prefer listening to as well as the genre they are currently playing. For musicians the instrument is also listed in the table. Due to the fact that the interviews were semi-structured, a list of important questions we

Person	Age	(Fe)male	Genre	Instrument/Singer
Person 1	30	female	Rock	-
Person 2	24	female	(Austro)Pop, Rock	-
Person 3	25	male	Rock, Electronic	-
Person 4	23	male	Drum and Bass, Electronic, RaggaTek	-
Musician 1	42	male	Jazz, Blues, Quartet	Drums
Musician 2	29	female	Rock, Jazz	Guitar, Singer
Musician 3	22	male	Punk rock	Bass

Table 4.1: Overview of interviewed audience members and musicians

tried to focus on can be found in Appendix A. It is only available in German though. The list contains a basic structure for the interviews with potential audience members as well as for interviews with musicians.

At the end of each interview the participants were shown a video of Metallica doing a live voting during a concert [48] and parts of a video where Tin Men And The Telephone is performing an interactive concert [47].

Before presenting the results in the next section it is important to highlight that the aim of the interviews was not to get a general knowledge about what people expect from such an audience participation application, but to identify undiscovered ways of participation and to get a basic feeling which concepts could or could not get accepted by the audience and the performer. Therefore, the interviews are not statistically relevant. Furthermore, we interviewed the participants in German, so the results were translated.

4.2 Results

This section summarizes identified concepts which were mentioned by the interviewees. Additionally, relevant information and comments regarding these concepts or the topic in general will be presented. The discussion of the meaning and relevance can be found in the section below. The interactions are grouped by the main function of the smartphone the respective concept is using.

4.2.1 Concepts for which the microphone is used

Table 4.2 shows concepts for which the microphones of the smartphones have to be used. Systems for song recognition already exist, which are able to recognize songs by singing, whistling or humming. [37] One person also mentioned that voice messages and measuring the volume via the microphone is not useful. It was discovered that singing was

not only perceived as a positive but also as a negative example of smartphone audience participation.

Concept	Description
Singing	People are singing into their smartphones. One person is randomly chosen by the system and his or her voice is increased over the public address (PA) system.
Song recognition	The application recognizes the performer and the title of the current song.

Table 4.2: Concepts where the microphones of the smartphones are used.

4.2.2 Concepts for which the speaker is used

Participation concepts where the focus is on the speakers of phones can be found in Table 4.3. A general criticism with using the speakers was that they are not loud enough during a live performance.

Concept	Description
Play sound	The smartphones are used for playing sounds collectively.
Metronome	A metronome specifies the correct speed for the current song.
Jump at sound	People are jumping collectively when a sound occurs within the smartphone application.

Table 4.3: Audience participation concepts where the speakers of the smartphones are used as the main function.

4.2.3 Concepts for which the GPS or the motion sensor is used

Table 4.4 gives an overview of concepts in which the GPS sensor delivers the information needed by the application. One mentioned the idea of finding the loudest place in the audience or finding the place's atmosphere as a combination of the GPS sensor and the microphone. This means that the microphones' input can be mapped to various positions within the audience's area. Motion sensor based applications can be found in Table 4.5.

4.2.4 Concepts for which the display is in focus

Concepts where no additional sensors are used and which basically only use the display to enter and show information can be found in Table 4.6. If the application is able to display a schedule, the idea of updating the schedule after people wished for songs, was mentioned. For the concept of communicating problems via the smartphone it is useful to take the number of people who reported the problem into account. Thereby, the relevance can be determined. Furthermore, it is also possible to make positive ratings. In this way the meaning of negative ratings can be qualified. Ratings were criticised because

Concept	Description
Finding friends	The application is used for finding lost friends during concerts.
Rating system	Within the application it is possible to rate the sound, the light show and the stage. The GPS location helps the evaluator to identify good or bad places in the audience.
Band location	The band can publish their current GPS location before the concert.
Record movements	The smartphones record the movement of the audience. For this purpose the motion sensors might be useful as well.
Display movement	The smartphones display the movement of all people who are using the application. Each person can be displayed as a point which is moving.

Table 4.4: Audience participation using the GPS of the smartphones.

Concept	Description
Recognize maximum movement	Show when the audience is moving the most or at which time most people were jumping.
Rating	The more the smartphone is shaken the better the rating is.

Table 4.5: Audience participation using the motion sensors of the smartphones.

most of them are useless. The following instance was mentioned: The band knows which songs their fans like because of chart lists.

4.2.5 Concepts for which the camera is used

Table 4.7 represents ideas where the cameras of the smartphones have to be used. At concerts it is often forbidden to take pictures and videos of the show. When people are allowed to take pictures and videos and in return share them with the band via the application, the band profits because of free media and the audience profits because they can download all the media created from other concert visitors. Camera focused concepts have been criticized because they may distract from the concert.

4.2.6 Concepts for which vibration is used

Fields of use where the vibration of the smartphones can be used are listed in Table 4.8. The metronome could be used on the stage to coordinate the musicians as well as the audience when audience members are asked to clap their hands. It was also mentioned that it could be a good effect in combination with the light show. Participation via vibration was criticized because people may not feel their smartphones vibrating during a concert.

Concept	Description
Live stream	Live streams of the concert can be seen in the application. Camera selection is possible.
Control camera	A person is able to control a camera during a concert. The camera's view can be seen on a video wall.
Display information	The smartphones are used to display current lyrics, a schedule, the current title and album, the total length and the current length of the concert, the volume, links to music stores, the songwriter, links to other songs, the current soloist, the beats per minute and other information.
Interpreting	Within the application it is possible to switch to another language between the songs. This can be done in real-time or after the show.
Light show	The application generates a light show similar to lighters or Xylobands [46].
Comment	Write and read comments within the app.
Rating	A rating system is provided in the app.
Communicate problems	Sound or light problems can be communicated to the band or technicians.
Wish a song	Songs can be voted on with the application.
Change lights	The lights can be changed collectively.
Yes/No voting	People can decide specific things with yes and no voting.
Messages to band	Messages can be used to tell the band that everything is OK.
Detailed sound adjustment	The application can be used for telling the band which instruments are too loud or too quiet.
Donate for a good cause	People can for example auction a specific light show. The proceeds will be donated for a good cause.

Table 4.6: Audience participation using mainly the smartphones' displays.

4.2.7 Further results

A general problem mentioned during the interviews is that the mobile reception is often very bad at concerts. Another one is that it could be hard for musicians to actively take part in an audience participation concept with smartphones. It was mentioned that they need to focus on their performance. When showing the Metallica voting video, five out of seven people liked the concept. It was criticised that the charm of Metallica gets lost during the voting and that there are better voting methods like asking the audience for shouting for their favourite song. Moreover, the interviewees liked the Tin Men And The Telephone voting that appeared in the video but it was mentioned that it is not possible with every kind of music and that the band needs good musicians for such a concept. People also liked the chatroom Tin Men And The Telephone showed on the screen on stage. One mentioned that this form of chat is too permissive because of anonymous

Concept	Description
Posting selfies	People are using their smartphones for taking selfies during the concert. The selfies are displayed on a video wall in sequence or randomly.
Stage picture	The band takes stage pictures and distributes them through the smartphone application.
Record concert	People record the concert within the app. The videos will then be collected and cut for a concert review.
Face recognition	People get information about the band members by taking a picture of them.
Reuse videos and pictures	The videos and pictures of the audience will be reused and provided on a website.
Use video wall	While the people are filming the concert a smartphone will be chosen at random and its current filming process can be seen on the video wall.

Table 4.7: Audience participation using the cameras of the smartphones.

Concept	Description
Jump at vibration	The people jump when their smartphones are vibrating.
Metronome	A metronome is specifying the correct speed for the current song.
Jump at sound	People are jumping collectively when a sound occurs within the smartphone application.

Table 4.8: Audience participation using the vibration function of the smartphones.

postings which led to insults and nonsense.

4.3 Interpretation

For the audience an audience participation application has to be designed in a way that the experience during the concert does not suffer. Even more importantly, the application has to enhance the user's experience or give him or her the feeling to be part of the concert. The experience for audience members without a smartphone also has to be considered when developing such an application.

Musicians on the one hand have the same needs, like wanting the application to improve the experience for the audience and on the other hand they also may not want to loose too much control during their concerts. Oliver Hödl et al. also figured out that "*musicians seem to be cautious about giving up control*" [17] in their audience participation concept using smartphones to control stereo sound. Furthermore, it has to be considered that the performers may be busy during their performance. Therefore, either the performance

is designed for being used together with the application or the application has to be designed in a way that it does not directly affect the performer or specific actions of the performer have to be simplified.

All obtained concepts regard live concerts. Some of them more from the audience's view, others from the musicians' view. It is important to ask ourselves which of these concepts are audience participation concepts and which of them are not. Concepts like "Finding friends" may be useful for concerts but are not part of an audience participation system. In the following chapters we focus on audience participation, therefore, such concepts will be disregarded.

A general problem with most of the applications is that the internet connection at big concerts is an issue. At festivals where a lot of people cannot charge their phones for days, smartphone participation is difficult or almost impossible. A possible solution to the first problem is to use an application that does not need a hook up when in use. Unfortunately, most of the mentioned concepts are not possible in this case. As mentioned before the results of the interviews will be used as input for the workshops within the focus group.

CHAPTER 5

Workshops

In this chapter we present the way in which we obtained the final smartphone application for audience participation called "Poème Numérique" which was tested in a live test setting. At the beginning of the implementation it was not clear what the application should look like. We rather asked ourselves the question "What can a smartphone application look like that is made for audience participation during live concerts?". The starting point was given by relevant literature and the results of the interviews conducted with potential audience members and musicians, as described in Chapter 4. An iterative process was used to achieve the final implementation of the application. For this purpose, prototypes were built between the workshops. Based on the prototypes we discussed possible improvements, like what had to be discarded and what could be added to improve the application as well as the experience of the audience and performers.

First of all we give an overview of all five workshops. A more detailed description of the focus group can be found in Section 5.2. Afterwards, a detailed description of each workshop is presented. The descriptions include preconditions, proceedings and results.

5.1 Overview

Before describing all workshops in detail an overall view is provided in this section. For this purpose all workshops are listed in Table 5.1. The table includes major topics, all application prototypes and major problems we had to deal with.

During the first workshops we focused on technology and discussed which application will be interesting for both the audience and performers. Notwithstanding, our own interest also influenced our decisions. Later on we iteratively refined the application's appearance. The aim of the last workshop was to test the final concept of the application as well as developing suitable sounds which can be used for playback with the difficulty of distributed sound sources in the entire room.

Furthermore, the table points out that we experimented with a lot of interactions and functionalities that are not available in the final application. There are two reasons why we removed interactions and functionality. The first reason is that we did not achieve a stable version either because it was technically not possible or it was not possible within our time frame. Functions often worked on Android or iOS but not on both. Sometimes functionality was given on specific Android devices but not on others. The second reason is that we collectively decided that the user experience would be better without specific features or interactions.

Workshop	**Topics**	**App functionality**	**Problems**
Workshop 1	App technology Interaction technology	No app	Framework selection
Workshop 2	ID Recognition	ID recognition Colour blinking Play sounds	ID recognition in motion Unpredictable ID triggering
Workshop 3	Interaction brainstorming	Play sounds Loop sounds Random delay loop Flashlight blinking Shake gesture	Too short sound files
Workshop 4	Interaction selection	Play sounds Show buttons Show pictures Picture sequences Show colour Colour blinking	-
Workshop 5	Sound experiments	Play sounds Loop sounds Play random sounds	-

Table 5.1: A summary of all topics, developed prototypes and main problems during our workshops.

5.2 Focus group members

The design process of the application was supported by an expert team within a focus group. A performer was called in who shared her views on how the application could be used during a concert from a performer's perspective. Furthermore, four other experts were called in to support the design process in an artistic, sound-technological, design-technical as well as software-technical way. This section will cover a brief introduction of the experts' references as well as previous knowledge. Not all experts participated in all workshops. The performer was absent in the first and the third workshop.

Performer

Susanne Kirchmayr, better known as Electric Indigo [8], is an Austrian composer and musician. Surround sound as well as temporal placements of elaborate electronic sounds are important elements in her music. 2012 she received the "outstanding artist award Musik 2012" in the category of electronic music and computer music. 2013 she got the "Staatsstipendium für Komposition 2013" by the Austrian art department.[1]

Expert 1

The first expert is a lecturer for Experimental Media at the University Of Applied Sciences Sankt Pölten as well as a member of research and artistic staff at the University of Applied Arts in Vienna. Furthermore, he is an artist, musician and theoretician. [41]

Expert 2

The second expert is a senior lecturer at the University Of Applied Arts Vienna. Moreover, he is a sculptor, media artist, musician and teacher. An overview of his artistic as well as scientific work can be found on his website. [24]

Expert 3

The third expert works as a researcher and lecturer at the Vienna University of Technology as well as the University of Vienna. His research interest is, among other things, audience participation, interaction, as well as developing new instruments and interfaces. [15]

Expert 4

The last expert works as a researcher and lecturer at the Vienna University of Technology as well as the University Of Applied Arts Vienna. He works in the field of game design, game art, music, media and human computer interaction. [21]

5.3 Workshop 1 - Team building and technology

The aim of the first workshop was to present the starting point for developing the smartphone application. Therefore, our agenda included the following points:

- Presentation of the interview results.
- Which of the smartphone interactions, mentioned in interviews, are we interested in and which are feasible?
- Do we have other ideas than the ideas mentioned during the interviews?
- Selection of a mobile application technology: Which one fits best, if we want to support a cross-platform application for at least iOS and Android?

[1] Information received via e-mail by Susanne Kirchmayr (March, 21^{st} 2016)

Preconditions

Before the first workshop we worked on the preliminary interviews described in Chapter 4. Furthermore, literature review and research about cross-platform development, its advantages and limitations was done. A detailed description of the cross-platform selection can be found in Section 6.2.3.

Results

As a result we decided to try if it is possible to use high frequency sound IDs [14] to trigger specific actions on the smartphone. In Sense of Space [14] the authors used iPhones and iPads to capture high frequency sound IDs.

The cross-platform technology we agreed upon that time was PhoneGap [2]. The reason for our choice was that PhoneGap had been well-known and well-tested as a cross-platform framework. [13, 33] PhoneGap applications are hybrid applications which use HTML5, CSS3 and JavaScript. Hybrid [36] means that they are a mixture of a web-based application and a native application. These applications are basically apps which contain a browser. The platform-specific browser shows the content of the application.

5.4 Workshop 2 - High frequency recognition

The aim of the second workshop was to discuss the first prototype within the whole team, as this was the first workshop where the performer joined the group.

Preconditions

During work on the application between the first and the second workshop we found out that we were not able to use high frequency sound recognition with PhoneGap. The problem was that we were only able to record audio with PhoneGap but could not process the received audio stream in real-time. As an alternative we chose a cross-platform framework called Xamarin [45]. Xamarin was developed to create iOS, Android and Windows Phone applications with a single code basis. Furthermore, the developed applications run as native applications on each platform. Due to time constraints we decided to focus on the iOS and Android application. A Windows Phone application can be added in a further version of the application.

We developed a prototype with Xamarin for iOS and Android. The application was able to recognize high frequency sound IDs and was tested on a Sony Xperia Z1 Compact and an iPad mini first generation. Moreover, it was possible to play sound within the application. When the app recognized a specific frequency via the phone's microphone, the display started blinking as long as the sound continued.

Results

The presented prototype had three problems:

1. The smartphones were not able to recognize high frequency sound IDs if the person who was holding the phone was moving or shaking the phone.
2. With the standard sound libraries for iOS and Android which were available for Xamarin it was not possible to record and play sound at the same time.
3. Sometimes the phones received a high frequency sound ID even if the speaker did not play an ID.

For the next workshop our target was to solve these problems. In addition, we wanted to find out if it is possible to play sounds in a loop and to play specific parts of a sound file after receiving a high frequency sound ID. Furthermore, we wanted to find out if it is possible to create a granular synthesis [23] with the audience's smartphones as sound sources. The granular synthesis is a particular technique for creating sounds out of very short sound files called grains.

5.5 Workshop 3 - Finding possible interactions

The aim of this workshop was to find possible interactions with the already given technology. The starting point was an application that was able to recognize high frequency sound IDs and react to them via playing sounds and changing the display colour.

Preconditions

Before the third workshop we found out that the problem of the second workshop was the Doppler effect. Due to the Doppler effect a phone received a higher frequency if it was moving in the direction of the speaker. It also received a lower frequency if it was moving in the opposite direction This resulted in the application being unable to recognize a high frequency sound ID. Therefore, we extended the range of acceptance for each expected high frequency sound. For more details about the Doppler effect we refer to Section 6.3.4. Moreover, we solved the problem of recording and playing audio at the same time. The solution was to turn off recording, play the sound and start recording again, after the playback had finished. Lastly, the problem that the application recognized non existent Sound IDs was solved by redefining what a high frequency sound ID looks like. The reason for false positive triggering was background noise. For a detailed description what our final high frequency sound ID looks like we refer to Section 6.3.3.

Unfortunately, the functionality needed to create a granular synthesis is not given using the standard sound libraries. They do not support features like custom fade-in, custom fade-out and Hanning window [23]. A fade-in is used to gradually increase the volume at the beginning of a sound while a fade-out is used to gradually decrease the volume

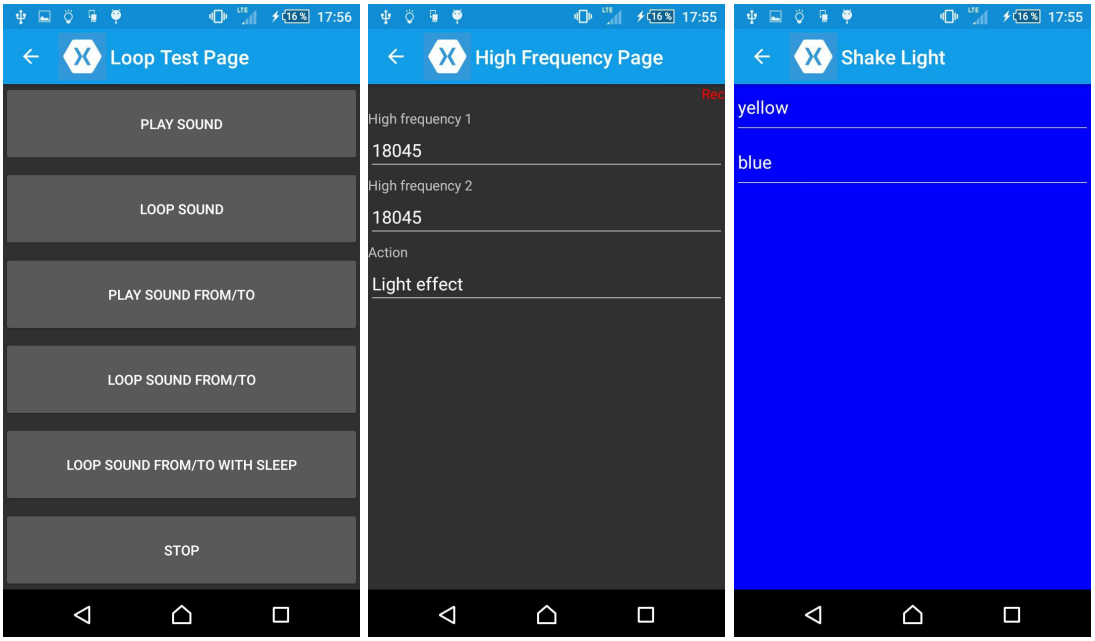
at the end of a sound. A Hanning window is a so called window function which would also have been important for the granular synthesis we wanted to create. While it might have been possible to create a granular synthesis it was not feasible within the given time frame and resources. Nevertheless, we got the following reactions to work before the third workshop:

- Play a specific part of an audio file
- Loop an audio file
- Loop a specific part of an audio file
- Loop with a random delay between the loops

It is important to mention that the loops are not synchronous between the phones, and even if they are coincidentally synchronous at the beginning, they start to differ with the beginning of the first loop.

Figure 5.1 shows three screenshots of the prototype presented at the third workshop. In Figure 5.1a a menu of different sound tests can be seen. The prototype in Figure 5.1b was used for recognizing two simultaneously played high frequencies. The user was able to choose the frequencies as well as the triggered event. The screen in Figure 5.1c was used for testing shaking gestures. The user could choose two colours. The screen changed colour whenever the smartphone was shaken.

We also had the idea to specify the direction of the high frequency sounds. Thereby we would have been able to send high frequency sound IDs to specific parts of the room. To do that we had two possibilities. The first one was to use a satellite dish in front of the speakers used for the high frequency sound IDs. Our idea was to place the speaker in the focus point so that the sound waves were sent back in parallel by the satellite dish. We tested this approach for a short time, but figured out that the sounds spread too much so that the satellite dish was useless. The second approach was to use directional sound but we did not find a product which is able to reach frequencies from 18 Kilohertz to 21 Kilohertz so far. Even if we had found directional sound speakers which met our requirements, we would have had to test this approach. Our main concern with this possibility was that we do not know if the directional sound would be reflected too much by the walls. This would result in the sound being loud enough to be heard within the whole room which is not what we intended. Nevertheless, this can be considered in further research.



(a) Test-screen for playing and looping sounds.

(b) High frequency recognition test-screen.

(c) A test-screen that changes the colour after shaking.

Figure 5.1: Screenshots of the prototype developed between the second and the third workshop.

Results

The new prototype was tested on the following smartphones and tablets:

- Sony Xperia Z1 Compact (Android 5.1.1)
- Samsung Galaxy Note 3 (Android 4.4.2)
- Samsung Galaxy Nexus (Android 4.2.1)
- Samsung Nexus S (Android 4.1.2)
- iPad mini 1. Generation (iOS 9)

We asked ourselves, "What can be done after receiving a high frequency sound ID and what kind of interactions are interesting for the audience?" The results of the third workshop can be split up in visual and auditory feedback. An overview of the defined reactions can be found in Table 5.2. The welcome and the pause screen can either be a picture or text, which can be displayed as long as the ID can be recognized by the smartphone. Furthermore, sequences of pictures or user interfaces can be triggered. The interface can invite the user to select a role or a colour by clicking one among a selection

Visual feedback	Auditory feedback
-) Displaying a welcome or pause screen -) Change the user interface -) Displaying colours, pictures, sequences of pictures or videos	-) Call-response scenario -) Play a random sound -) Play a sound matching the users role

Table 5.2: Possible feedback of the application after receiving a high frequency sound ID.

of buttons, shaking the phone or by just tapping on a random button. The selection can then be used to play a different sound for a specific role or to display a specific colour after receiving another high frequency sound ID. In the call-response scenario the source of the concert's sound changes from the main speakers to the smartphones.

Apart from this, we thought about spatial possibilities to support our concept. One possibility was to strengthen the smartphones' sound by providing funnels in the room. Audience members can place their phone in the funnel to strengthen their speakers. Another option was to create a feedback loop by filming the audience from above and displaying it by beamer on stage. A third one was to strengthen the light effects by providing mirrors and acrylic glass objects.

5.6 Workshop 4 - Determining the interactions

The aim of the fourth workshop was to present the results of the interactions we determined in the third workshop, which we also tested on the smartphones and tablets mentioned in the previous section. A detailed description of these interactions can be found in Section 5.5. As the third workshop took place with only part of the group, this workshop was also used to present the results to the performer as well as external people, who were interested in music.

Preconditions and proceedings

Before the fourth workshop we once again created a prototype. We discarded playing videos at this early stage because of limited storage and technical issues in a cross platform environment.

Figure 5.2 shows the testing devices displaying a sequence of pictures. While four devices show the fourth picture, one device shows the third one. This occurs because not all smartphones recognize the high frequency sound IDs at exactly the same speed. Figure 5.3 shows the same smartphones showing a green or blue colour on the display. For this state two high frequency sound IDs were used. The first one triggered a user interface where the user was able to select whether the display should change to blue or green. In our example we chose blue on three devices and green on two devices. The second ID was used to change the display colour for a few seconds.

On basis of all mentioned interactions we discussed which interactions would be most interesting for our final test.

Figure 5.2: Smartphones reacting on a high frequency sound ID via a sequence of pictures.

Figure 5.3: Smartphones reacting on a high frequency sound ID changing the display colour.

Results

As a result of the fourth workshop we decided that we did not want the users to be distracted by user interfaces which meant that the users always had to check their screens. We therefore decided to focus on sound feedback like call-response scenarios and random sound playback.

5.7 Workshop 5 - Sound test

The fifth workshop was meant to help us figure out which sounds are interesting and which ones are not.

Preconditions and proceedings

We developed and tested 15 combinations of sounds, which means that we defined 15 high frequency sound IDs, each one triggering a combination of sounds. A combination in this sense means that it is possible that not all smartphones play the same sound. Each smartphone generates a number which specifies which sound file is played. If one combination has four sound files for instance, each smartphone generates a number between one and four to determine the file played. For each sound file we also specified how often it will be looped.

The tested sound files included sine waves with a frequency from 220 Hertz to 3529 Hertz, files which essentially loop short sounds (also called grains) and longer audio files which should generate impressive sound if they are played through multiple speakers. When testing the sine waves, we used combinations where the frequencies were close to each other, the reason being that these sound files start to interfere with each other. That makes it possible to hear the sound more like waves and not as a straight tone.

For instance: A combination of 8 sound files was used, with frequencies between 439.6 Hertz and 441.5 Hertz.

Results

We basically had three main findings during this workshop. The first one is that sine waves, especially above 439 Hertz are annoying or painful for the listener. We did not further test using only sine waves below 400 Hertz, because the result of sine waves in general did not convince us. The second finding concerns the shifting of looped sound files. If we fire a high frequency sound ID, the phones never detect the ID at the same exact time, which means that they do not start to play the sound at the same time. More interesting at this point is that they also do not loop sound files with the same speed. The delay between the loops is short but seems a bit random and does not always happen exactly at the same time. Our guess is that the standard sound libraries are basically not developed for looping sound files which are only a few seconds or shorter. We therefore had to work with these random delays. The third finding regards the looping in Xamarin for Android. The standard sound library does have a loop functionality but does not have a loop counter. So we have two possibilities if we want to loop a sound file a few

times. The first one is to activate the loop and stop it after a specified time. The second one is that we implement the looping process on our own. Both of them worked but sound different because the delay between the loops differ from each other.

The conclusion of the workshop was that the performer got a feel on how to develop the sounds for the live test. We also decided to add a colour for each sound, which will be displayed on the screen. We would decide at a later point if the colour should just appear or blink. The final app should also be able to display text. Lastly, we collectively defined a name for the app, which is "Poème Numérique".

5.8 Interpretation

In this chapter the design process of the application was provided. The workshops as well as the development of the application were not a straight-forward process. While new ideas came up we had to disregard others. Moreover, since not all group members sat in on all workshops, the combination of group members always led to slightly changed directions. Especially during the third workshop interactions were designed and prototyped. Because of the performer's influence as well as two external musicians and researchers, we disregarded most of the interactions, simplified the application and focused more on music and sound instead of interacting via pictures and buttons on the smartphone's screen. The whole process and the design of the final application highly depended on the mixture of experts and interests we had. Other research groups may come to a completely different solution with the same input.

It is equally important to mention that the application was specifically designed for running on iOS and Android. This led us to various design decisions as well as simplifications of the application. In a cross-platform environment the availability of frameworks is limited due to the fact that they have to be available for both platforms or at least a similar framework has to be available for the other platform. More sophisticated functionality within the application may be part of future work.

CHAPTER 6

Smartphone Application Development

So far we talked about the interviews we conducted for getting insights from potential audience members as well as musicians. Furthermore, we presented the design process of creating an audience participation application for smartphones. This chapter focuses on the implementation of the application itself. Therefore, we start with an introduction and explanation of our goals. Moreover, the technical setup and relevant design decisions are provided in Section 6.2. The final implementation of the application Poème Numérique is provided in Section 6.3. Last but not least, technical insights will be pointed out in Section 6.4.

6.1 Introduction

Before starting the design-phase of the application we defined a few goals we wanted to focus on when implementing the application. Firstly, we wanted to provide an application that is simple to use and allowed everyone in the audience to use the application. Secondly, maintainability as well as extensibility were important not only for future work but also for minor adjustments. Thirdly, we on the one hand wanted an application that is available for as many people as possible, on the other hand we wanted to provide access to as many sensors as possible. To provide many platforms, sensor access, maintainability as well as extensibility, we decided to create a cross-platform application. The selection of the cross-platform framework and the reason why a cross-platform seemed to be the best solution for us, can be found in Section 6.2.3.

Table 6.1 gives an overview of the smartphones we used for testing the application from Workshop 5 on. The version of the respective operating system and the number of the respective smartphones is provided as well.

Smartphone	OS version	Amount
iPad mini 1st generation	iOS 9.2.1	1
iPhone 5S	iOS 9.3	1
Motorola Moto G (second generation)	Android 5.0.2	10
Google Nexus S (Samsung)	Android 4.1.2	1
Google Nexus 5 (LG)	Android 6.0.1	1
Samsung Galaxy Nexus	Android 4.2.1	5
Samsung Galaxy Nexus	Android 4.3	3
Samsung Galaxy Note 3	Android 4.4.2	1
Sony Xperia Z1 compact	Android 5.1.1	1

Table 6.1: Smartphones used for testing purposes.

6.2 Technical setup

This section is used for presenting the setup we used in the final application. Moreover, an explanation of important design decisions based on our goals is provided.

6.2.1 Used setup

After the first prototype we changed the used framework from PhoneGap to Xamarin. When using Xamarin we used the following versions:

- Xamarin.Forms Version: 1.3.5
- Xamarin.Android Version: 6.0.1.10 (Business Edition)
- Xamarin.iOS Version: 9.1.0.31 (Business Edition)

The minimum Android version the application supports is Android 4.1 (API Level 16). For iOS the minimum supported version is iOS 8.0. The fragmentation of iOS and Android as well as the statistics about market shares showed that supporting these two operating systems with these minimum versions was sufficient for our purpose. More information about market shares and fragmentation can be found in the following section.

6.2.2 Mobile operating systems

The decision which platforms should be supported by our application was based on market shares.

Android had a worldwide market share of over 81 % in 2015. A forecast also shows that it will grow to more than 84 % in 2020. iOS had a worldwide market share of more than 15 % in 2015 and it seems that it will have a market share of 14 % in 2020. [38] Together they have a market share of more than 95 %. Due to these high numbers, we focused on Android and iOS when selecting the framework we wanted to work with. The statistics

also show the third interesting platform to be Windows Phone. Therefore, we considered Windows Phone as the third platform we wanted to support. Nevertheless, due to the market share of Android and iOS, Windows Phone was only secondary to us.

According to the Android Developers website 95 % of the android devices run Android 4.1 or a later version. [12] According to Apple 79 % of the iOS devices are running iOS 9 while 16 % are running iOS 8. [3] All in all we are reaching more than 91 % of the market share by providing an application that runs on Android with minimum version 4.1 and iOS with minimum version 8.

6.2.3 Technology selection

When choosing the right technology we aligned the selection with the goals mentioned in the introduction as well as cost efficiency. Many cross-platform development frameworks are quite cost-intensive because of yearly usage costs.

There are basically four possibilities available when considering to develop an application for more than one platform [36]:

- Native apps
- Generic mobile apps
- Dedicated web apps
- Hybrid apps

In native app development, applications are developed for each platform separately. Because of maintainability, extensibility and time commitment we did not consider this option. Generic mobile apps are websites that fit the screen size of phones and tablets. In this setting the main problem is sensor access, which is very limited. Dedicated web apps have the same issue as well as the problem that they are built for a specific platform.

Based on literature [13, 33] as well as online research, we went for PhoneGap [2] in the first place, which generates hybrid applications. The referenced literature is from 2012 which is quite old for new technologies. Through additional online research, we figured out that PhoneGap is still one of the State-Of-The-Art frameworks and therefore a good choice.

PhoneGap applications are basically websites which are embedded in a native application. Furthermore, they support Android, iOS, Windows Phone and other platforms. It is possible to access the hardware of the respective smartphone. The main technologies used by PhoneGap are HTML5, CSS3 and JavaScript. After developing the first prototype we figured out that PhoneGap does not provide reading the audio stream in real-time. We therefore searched for another solution which led us to Xamarin [45]. Xamarin works differently. The applications are compiled into native applications for each platform.

Graphical control elements used in the code are translated into specific controls for each platform. The applications are written in C#.

Even though Xamarin was a good choice there are also disadvantages compared to native applications. For instance integrating native libraries is not that straight-forward as in native development. The online community for Xamarin compared to the community for native iOS and Android development is also quite small. Another disadvantage is that Xamarin is relatively new and therefore minor bugs still occur when developing with Xamarin and Xamarin Studio.

6.2.4 High frequency recognition

The application we developed uses frequencies above 18 kilohertz for communication. As far as we know, high frequency recognition is first used in Sense of Space [14] for these kinds of applications. There are two main reasons why we have chosen high frequency communication instead of an internet connection via 3G, 4G and WiFi. The first one is data transfer. Via high frequencies better transfer speeds are achievable and recognition by the smartphones is more or less simultaneous. This does not mean that every smartphone gets the signal exactly at the same time, but at least the time difference between recognition by different devices is very low compared to 3G, 4G and WiFi. The second reason is scalability. As long as the smartphones are able to recognize the signal it does not matter how many smartphones are used in the audience.

A known problem at concerts is that the mobile network is not available due to the high number of people. Furthermore, inside buildings the phone reception can be limited. Locally provided WiFis often do not work because of overload.

Another advantage is no additional hardware other than a computer and two separate speakers being necessary. The following section shows the structure of the whole system.

6.3 Implementation of Poème Numérique

This section covers the final implementation of the whole system, which was used for the live-test described in Section 7.1. Firstly, we give an overview of the functionality as well as the system. Secondly, we describe all parts of the system in detail. As discussed in Chapter 5, the implementation of the system changed from one workshop to the next due to the iterative design approach.

6.3.1 Functionality

The application contains 17 events that can be triggered by the performer. All events consist of sounds, colours and text. Before an event can be recognized by the audience's smartphones the application has to be opened by the user. iOS users have to confirm that the application needs microphone access. When an event is triggered the smartphones start to display the text of the respective ID, start playing a sound and start displaying

Figure 6.1: Screenshot of an iPhone playing ID 1.

the respective colour. The colour can either be permanent or blinking as long as the sound is played back. Due to the fact that the only data connection used is sound, the smartphones can be in flight-mode. All kinds of necessary data, including the sound files, are already delivered within the downloaded application.

Some IDs do not trigger the same sound and the same colour for all smartphones. For these IDs all phones generate a random number which specifies the colour and the sound file to play. At the live-test the highest amount of random numbers we used was four which led to four different colours and sound files played simultaneously by all present smartphones.

Figure 6.1 shows an iPhone after receiving ID number 1. The text in the middle displays "ID 1: Electric Beat". The duration of the event depends only on the length of the sound file as well as how often the sound file is looped. The number of loops is predetermined for each ID as well.

When closing or pausing the application the event stops. If the application is reopened and other smartphones are currently participating in an event, the actual event can not be triggered because the high frequency signal only occurs at the beginning of an event. Nevertheless, the next event can be recognized as usual.

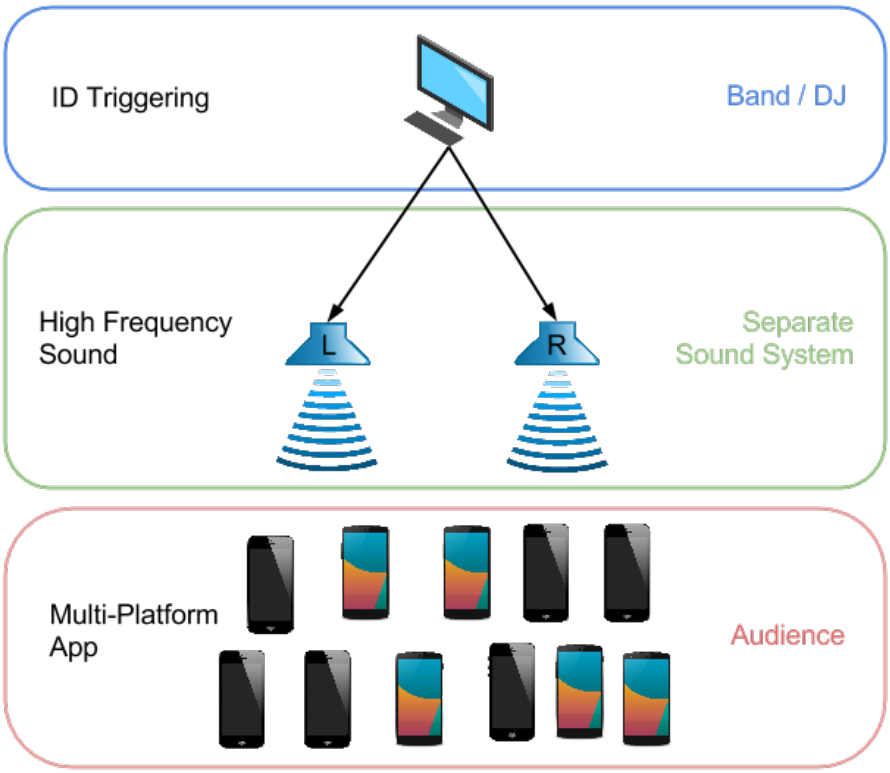


Figure 6.2: Basic structure of the entire system.

6.3.2 System overview

Figure 6.2 shows the basic structure of the whole system. For our live-test we used PureData [19] to produce high frequency sound IDs. These IDs consist of sine waves. However, it does not matter how the performer generates these sine waves. An ID always uses two separate sine waves at one time. These two sine waves have to be rendered by two separate speakers otherwise interferences could occur and the smartphones would either trigger the wrong high frequency sound ID or would not trigger a sound ID at all. After triggering the ID, smartphones which have opened the application will recognize the ID and trigger the respective event. The system only works if the speakers support frequencies until at least 20.7 kilohertz. In our case we used active Genelec 8020A speakers.

More details about what the ID triggering process looks like is provided in the following.

6.3.3 ID triggering

As mentioned before a high frequency sound ID consists of two simultaneously played sine waves with a frequency between 18 kHz and 20,7 kHz. Although IDs are recognized pretty fast they are played back for three seconds to allow smartphones that have not recognized the ID yet, to react delayed instead of not reacting at all.

To reduce the chance of false positives we additionally use one ID for synchronization. We call this ID "Sync-ID". Only after receiving a Sync-ID a smartphone can react on another ID for 9 seconds. Furthermore, we use one ID, called "Change-ID", for increasing the number of events that are triggerable. A Change-ID is used between a Sync-ID and the respective ID which was meant to trigger an event.

Table 6.2 shows all 15 combinations of frequencies that are possible with our built system. ID 10 is used as Sync-ID, while ID 11 is used as Change-ID. Without using the Change-ID we can trigger 13 events. By using the Change-ID the number of events is 26 because each of the 13 IDs can be used twice.

L/R	**18045**	**18562**	**19078**	**19595**	**20112**	**20629**
18045	-	ID 1	ID 2	ID 3	ID 4	ID 5
18562	ID 1	-	ID 6	ID 7	ID 8	ID 9
19078	ID 2	ID 6	-	Sync-ID	Change-ID	ID 12
19595	ID 3	ID 7	Sync-ID	-	ID 13	ID 14
20112	ID 4	ID 8	Change-ID	ID 13	-	ID 15
20629	ID 5	ID 9	ID 12	ID 14	ID 15	-

Table 6.2: Combinations of frequencies that can trigger an ID.

Figure 6.3 shows the PureData interface we use for triggering. ID 16 to ID 19 can be triggered by using the Change-ID before triggering ID 12, ID 13, ID 14 or ID 15. This led us to 17 events that can be triggered. There are two ways the interface can trigger an ID:

- The Sync-ID is played for 2.5 seconds. After pausing half a second the respective ID is played for 3 seconds.
- The Sync-ID is played for 2.5 seconds. After pausing half a second the Change-ID is played for 2.5 seconds. After another pause of half a second the respective ID is played for 3 seconds.

In the first case the smartphones react after about 3.1 seconds while in the second case they need about 6.1 seconds to react. The sequence of the Sync-ID, the Change-ID and another ID also works much faster but for safety reasons and due to the fact that we do not need a faster recognition we give the phones more time to react.

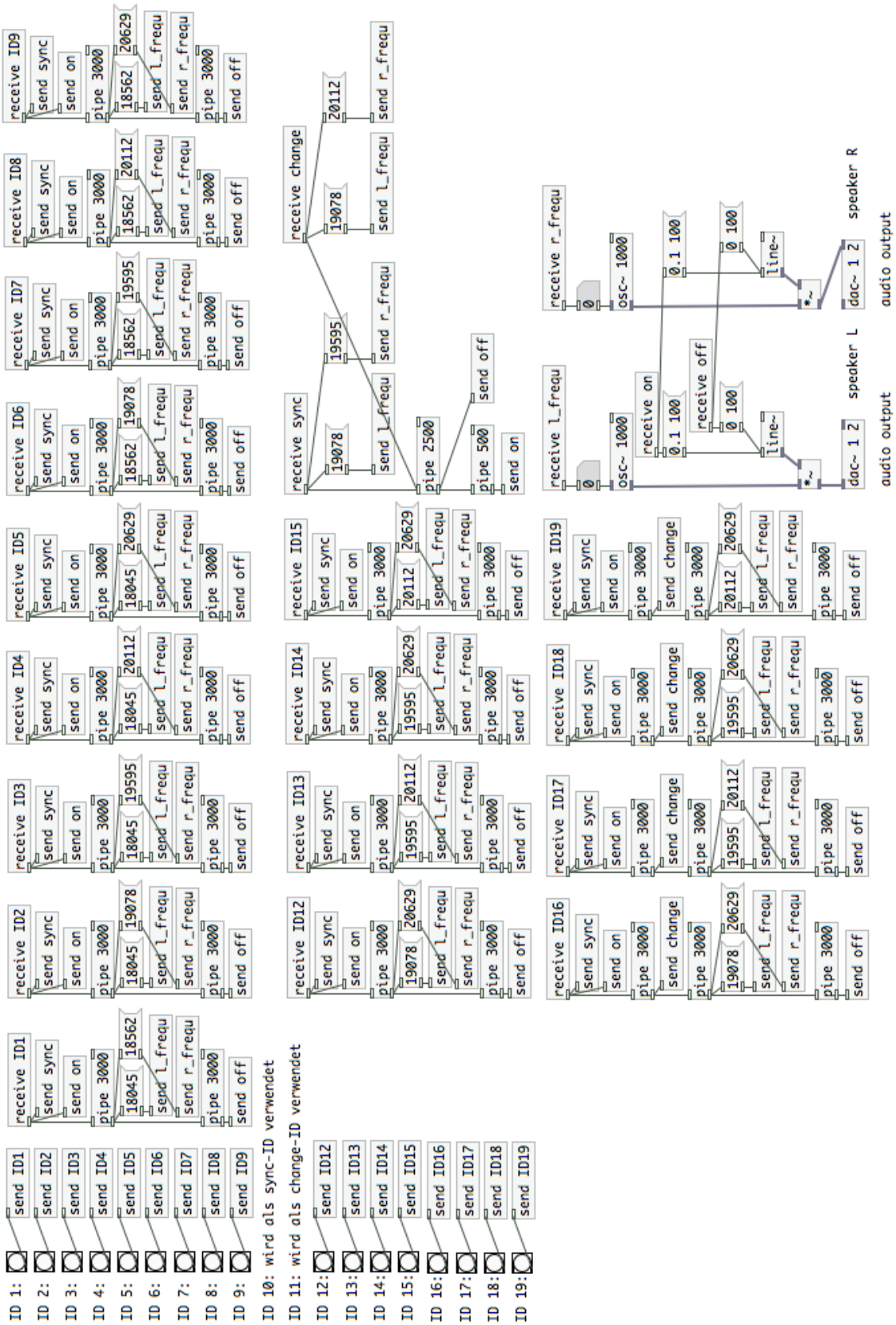


Figure 6.3: Triggering high frequency sound IDs with PureData.

6.3.4 The Xamarin application

The Xamarin project consists of three different projects. One common project, one for Android and one for iOS. Figure 6.4 represents a class diagram of the common project. The diagram does not include the entry points of the Android and the iOS application that are used for instantiating the App class. Each platform includes an implementation of the IPlayer as well as the IRecorder interface. Because of clarity private variables and methods are not included. Furthermore, minor important variables and methods are not included either. The FFTAdapter uses Exocortex.DSP [18] internally for the Fast Fourier Transformation (FFT). The classes of the library are also not provided in the diagram. The cardinalities represent the actual used cardinalities.

In the following we describe all classes shown in the figure. The recognition of high frequency sound IDs and the underlying technology, the FFT is explained as well.

Description of the classes

App: This class is the starting point of the common application and receives events when the app is started, paused or resumed.

ApplicationPage: The ApplicationPage is instantiated by an App object and represents the whole user interface. The recording process is started in the constructor. Moreover, this class is responsible for recognizing an ID as well as updating the user interface.

IPlayer: The IPlayer interface is used for playing back a sound file.

IRecorder: The IRecorder interface is used for recording sound via the microphone.

For both the IPlayer as well as the IRecorder interface the implementation of the interface is done in the iOS and Android project.

Properties: The Properties class is a static class and only used for providing relevant information for the FFT and ID recognition.

FFTAdapter: An FFTAdapter object is used for simplification in using the Exocortex.DSP library. The ApplicationPage object only accesses the library through the FFTAdapter object.

SoundIDManager: This class is used for managing the high frequency sound IDs.

Fast Fourier Transformation

To recognize if a signal has a specific frequency the time-based audio stream values have to be converted into frequency-based values. In our application we use an open-source library called Exocortex.DSP [18] for the FFT. The more time values we provide the higher the precision the frequency-based values offer. In our case we use the frequency spectrum of 22050 Hz and divide it into 256 pieces. Each piece consists of a frequency spectrum of 86.13 Hz. To do this 512 time-based values have to be used. The information provided by the array of frequency-base values is crucial for recognizing the intensity of a specific frequency interval and therefore crucial for identifying high frequency sound IDs.

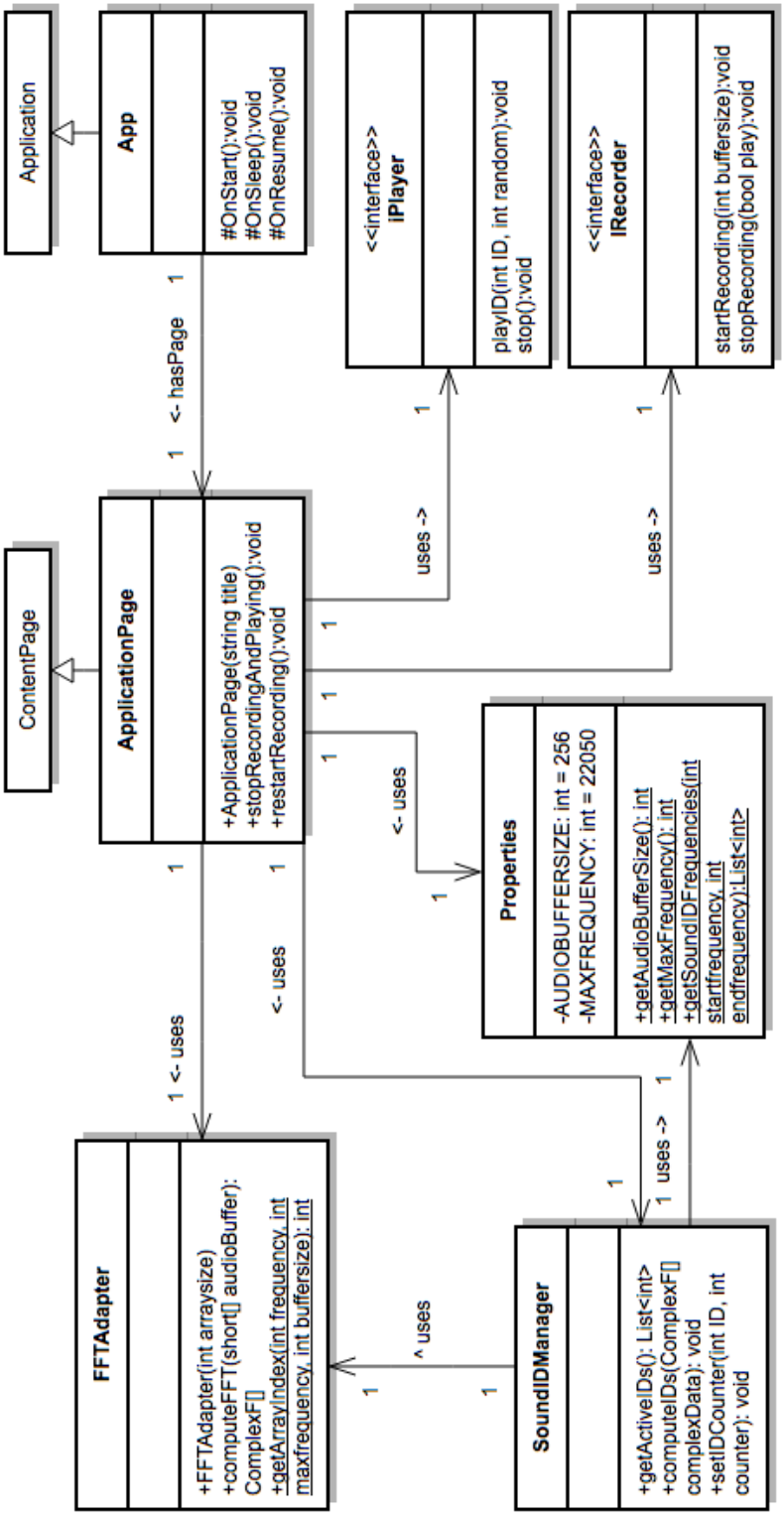


Figure 6.4: Class diagram of the common used classes of the Android and the iOS application.

High Frequency ID Recognition

Two frequencies are recognized as an ID if both of them are recognized in at least eight out of the ten last FFTs. That means that for both frequencies a peak has to be recognized eight out of ten times.

For a peak to be recognized the following two conditions have to be fulfilled:

- The value in the respective array entry has to be higher than a threshold which is platform and frequency specific.
- The value in the respective array entry has to be higher than the surrounding array entries.

Doppler effect

The doppler effect occurs when a smartphone is moved towards or away from the speakers. This effect leads to the fact that the frequency recognized by the respective smartphone is higher or lower than the frequencies played by the speakers. The ID is therefore not recognized.

To minimize the chance of a doppler effect disturbing the recognition process, the frequency interval used for recognition is chosen very generously. This means that the defined frequencies in Table 6.2 will also be recognized if they are 129 Hz higher or lower. This number is given by the fact that the value of the array entry below and above is accepted as well.

Example: An array entry contains a frequency interval of 86 Hz which is given by 22050 Hz divided by 256. The first frequency in Table 6.2 is 18045 Hz. The array entry in which 18045 Hz is contained, contains all frequencies in the interval [18002Hz,18088Hz]. The entry below contains the interval [17916Hz,18002Hz]. The entry above contains [18088Hz,18174Hz]. The actual frequency can therefore be in the interval [17916Hz,18174Hz] which results in a frequency span of 258 Hz.

6.4 Insights

The main issue during the development of the application was the recognition of the high frequency sound IDs. The values of the audio input stream varied between different kinds of smartphones. The higher the frequencies got, the worse the recognition got which is the reason why the highest frequency we used is below 21 kHz. On the one hand the target was to minimize false positives. On the other hand the target was to reach as many smartphones as possible. During the development we tried to find an efficient trade-off. We therefore kept the threshold value low but additionally defined the Sync-ID. Though, we could only test the application with the smartphones given in Table 6.1. A further problem which may occur is, that a phone recognizes a wrong ID after the Sync-ID is sent.

During our tests especially the Samsung Galaxy Nexus phones had problems with recognizing higher frequencies. Other phones were able to recognize frequencies up to 22 kHz.

Another important concern is the size of the application the audience has to download. Theoretically we could use 26 events when using the Change-ID. We only used 17 events during the live-test. The Android application already had more than 70 Megabytes in the app store. The more events we use the bigger the application gets primarily because of the size of the audio files. We expect that audience members may start to refuse the application because of the app size.

Amount of Change-IDs	**Maximum amount of events**
0	14
1	26
2	36
3	44
4	50
5	54
6	56
7	56
8	54
9	50
10	44
11	36
12	26
13	14
14	0

Table 6.3: Theoretical maximum amount of events that can be triggered when using a specific amount of Change-IDs.

Nevertheless, Table 6.3 shows the amount of events that are theoretically possible with multiple Change-IDs. The values are based on the assumption that only one Change-ID is used before the respective ID that triggers an event. The maximum can be reached by using six or seven Change-IDs. Another possibility which we did not consider in detail is to use sequences of Change-IDs. However, a potential problem is the triggering of a wrong ID. The longer the sequence gets and the more Change-IDs are used the higher the chance that an ID is either not recognized or recognized wrongly.

After rejecting PhoneGap as the framework to use, we also thought about developing two separate applications for iOS and Android. The main considerations to discard cross-platform development and go for native development are better hardware access,

well-engineered integrated development environments (IDEs), a larger community, more libraries and easier integration. Maintainability and extensibility would become harder in that case. However, we decided to try Xamarin as a last alternative also because of compilation to native code.

An issue when developing an app that can also be applied to this application is that it is impossible to test all devices, especially with all possible OS versions. For applications without hardware access, emulators can help to increase the number of testing devices. In our case, as we need microphone access, emulators are useless when testing high frequency recognition. Unfortunately, this is the most critical part of the application. The live-test is therefore also used for figuring out which devices or OS versions do not work or generate problems.

CHAPTER 7

Evaluation

This chapter provides detailed information about the whole evaluation process. Furthermore, evaluation results are presented which are crucial for answering the research questions. Section 7.1 handles the preparation of the large-scale live test, its setup as well as insights. Afterwards, the results of the questionnaires handed out will be presented, discussed and reviewed. Section 7.2 treats the qualitative interview with a performer. A discussion can be found in Section 7.3.

7.1 Large-scale live test

The Live Test was important for several reasons. Firstly, it was a good chance for us to test our technical concept and system with a lot more people. Secondly, we wanted to find out which problems would occur and what could be improved. Thirdly, we needed an impression of how the sound behaves if we have a crowded hall compared to just a few phones in a small room. This chapter is split into four sections. The first one will give a short overview of preparations we had to make before actually running the live-test. Furthermore, final adaptions of the application will be summarized. The second section will describe the setup of the live test. The complete evaluation of the questionnaires which we handed out during the Live Test is given in Section 7.1.3. Lastly, we reflect on the live-test as well as the results of the questionnaires.

7.1.1 Preparation

To check the basic conditions during the live-test we arranged two sample sessions within the same room. We basically wanted to answer the following questions in the first session:

- Are two speakers at the front of the room enough?
- Do all our test smartphones trigger the IDs when they should?
- Do all our test smartphones not trigger the IDs when they should not?
- How do the sample sounds behave in a big room compared to a small one?
- Are there any other difficulties we have to deal with?

When we realized there were app crashes during the first session we arranged the second session. Furthermore, unanswered questions, the new sounds as well as the sequence of all IDs were tested during the second try. For both testing sessions the smartphones in Table 6.1 were used. In the first session the Google Nexus 5 was missing. We therefore used 23 and 24 phones.

Results of the first session

Within the first session we found out that two of our speakers were enough for triggering smartphones at the back of the room, but we noted that the volume had to be louder than we initially thought. Furthermore, we found out that not all of our smartphones triggered all IDs. Especially the Google Galaxy Nexus had a problem with triggering IDs above 20 kHz. It happened just once that a wrong ID was triggered and only at a moment where an ID was sent and all the other phones triggered the correct ID. We also figured out that some sample sounds were too long and specific sound files were not loud enough when a combination of sound files was triggered. Last, we still had a software bug within the Android media player which resulted in app crashes after the application was paused and reopened.

Results of the second session

Before the second session we solved the issue with the Android phones and included the new sounds in the application. The aim of the test was to find out if all the phones were working for the whole performance.

All smartphones worked for the whole session. Only a few smartphones did not trigger all IDs but continued with the next ID without restarting the application. Compared to the first session we placed a smartphone in the front corner of the room which ended in a wrongly triggered ID on that phone. Our guess is that through multiple diversion of the high frequency sound IDs the smartphone in the corner was no longer able to get the correct ID. Nevertheless, we decided that the front corners were not important for the live-test. Hardly anyone would enjoy the live-test from there.

Figure 7.1: The Audimax photographed from the front table.

7.1.2 Setting

The live-test took place in the Audimax of the Vienna University of Technology which has exactly 500 seats. We managed to perform the test directly after a briefing of a lecture. This was one of the only chances we had to reach such a great number of students. Figure 7.1 shows the Audimax from the front desk looking into the audience. The first half of the room is flat whereas the second half rises towards the back.

Unfortunately, the Apple review process for iOS applications did not review our application fast enough so we were only able to test the Android application in such a big setup. The running of the test included the following points:

- An explanation where the students could download the application.
- A short introduction of the concept.
- Triggering of specific IDs.
- In the meantime, handing out questionnaires.

As we could not see the displays from the front we invited the audience to hold their smartphones in the air. Figure 7.2 shows the audience after a high frequency sound ID was triggered. Regrettably, the audience's attention dwindled after a few IDs had been triggered and they had realized how the concept worked. We therefore handed out the questionnaires earlier than planned.

Although the app was developed for concerts we did not perform a real concert but tested the sounds and the functionality of the app in a large-scale setting in the Audimax.

Figure 7.2: The audience holding their colourful displays in the air.

7.1.3 Evaluation of the questionnaires

Before presenting the results of the questionnaires an explanation is made on how we evaluated them. What a questionnaire looked like can be found in Appendix B, it is only available in German though. We therefore translated the questions into English for this section.

Evaluation approach

We asked the participants for their age, their sex and eight single choice questions. Three of the questions asked for an extra explanation or an extra single choice question if the answer was "Yes". One of them asked for an explanation no matter if the answer was "Yes" or "No". Additionally to these questions, we asked three open questions.

If answers were missing we still classified the questionnaire as valid. The reason for this is that it is possible to evaluate the single choice questions independently from each other. For the open questions, no answer is also valid. The only questionnaires we counted as invalid were questionnaires where half of the questions or more were unanswered and where we had the feeling that the person did not understand the questions asked.

Basic information

221 people filled in the questionnaires of which two questionnaires were counted as invalid. 18.7 % of the participants were female whereas 1.8 % did not declare their sex. 85.4 % of the participants were between 18 and 25 years old. 2.7 % did not declare their age. 11.9 % were between 26 and 40 years.

Results of the single choice-questions

The answers of the single-choice questions can be found in Table 7.1. To the last question an additional question was asked, if the person was able to hear the high frequency sounds. The additional question was "If 'Yes': Were they distracting?". 45.3 % of the people who heard them answered that they were. 50.0 % answered with "No". 4.7 % were invalid. Table 7.2 offers a classification based on this information, including the participants who did not answer "Yes" on the question "Were you able to hear the high frequency tones?" Figure 7.3 offers a graphic view of the first seven single choice questions as well as the classification in Table 7.2.

Question	**Yes**	**No**	**Invalid**
Did you install and use the app on your own smartphone?	72.1 %	27.4 %	0.5 %
Did you like the concept?	92.7 %	7.3 %	0.0 %
Can you imagine using the app in a concert?	67.6 %	31.5 %	0.9 %
Do you think that the app is distracting during concerts?	34.7 %	63.0 %	2.3 %
Do you think that the app can improve the concert experience?	71.7 %	26.5 %	1.8 %
Do you think that it is annoying that you cannot use your smartphone for other activities during the concert (photos, filming, communication, ...)?	46.1 %	52.5 %	1.4 %
Did you wish for (more) possibilities for interacting?	37.0 %	60.3 %	2.7 %
Were you able to hear the high frequency tones?	39.3 %	60.7 %	0.0 %

Table 7.1: Answers to the single choice questions.

Class	**%**
Participants who did not hear the high frequency tones.	60.7 %
Participants who heard the high frequency tones but did not find them distracting.	19.7 %
Participants who heard the high frequency tones and found them distracting.	17.8 %
Participants who heard the high frequency tones but did not say whether they found them distracting.	1.8 %

Table 7.2: Perception of high frequency tones.

Results of the open questions

The questionnaire all in all contained six open questions. In the following we will present the results for each of them. To analyse the questions we used thematic analysis [5, 1]. If we put a number in brackets in this section, the number specifies the amount of answers. We indicate that the amount of people who answered the question is not the same amount of valid answers per question. The reason is that some people wrote more than one answer, some people wrote useless or incomprehensible answers and some answers were categorized in more than one category.

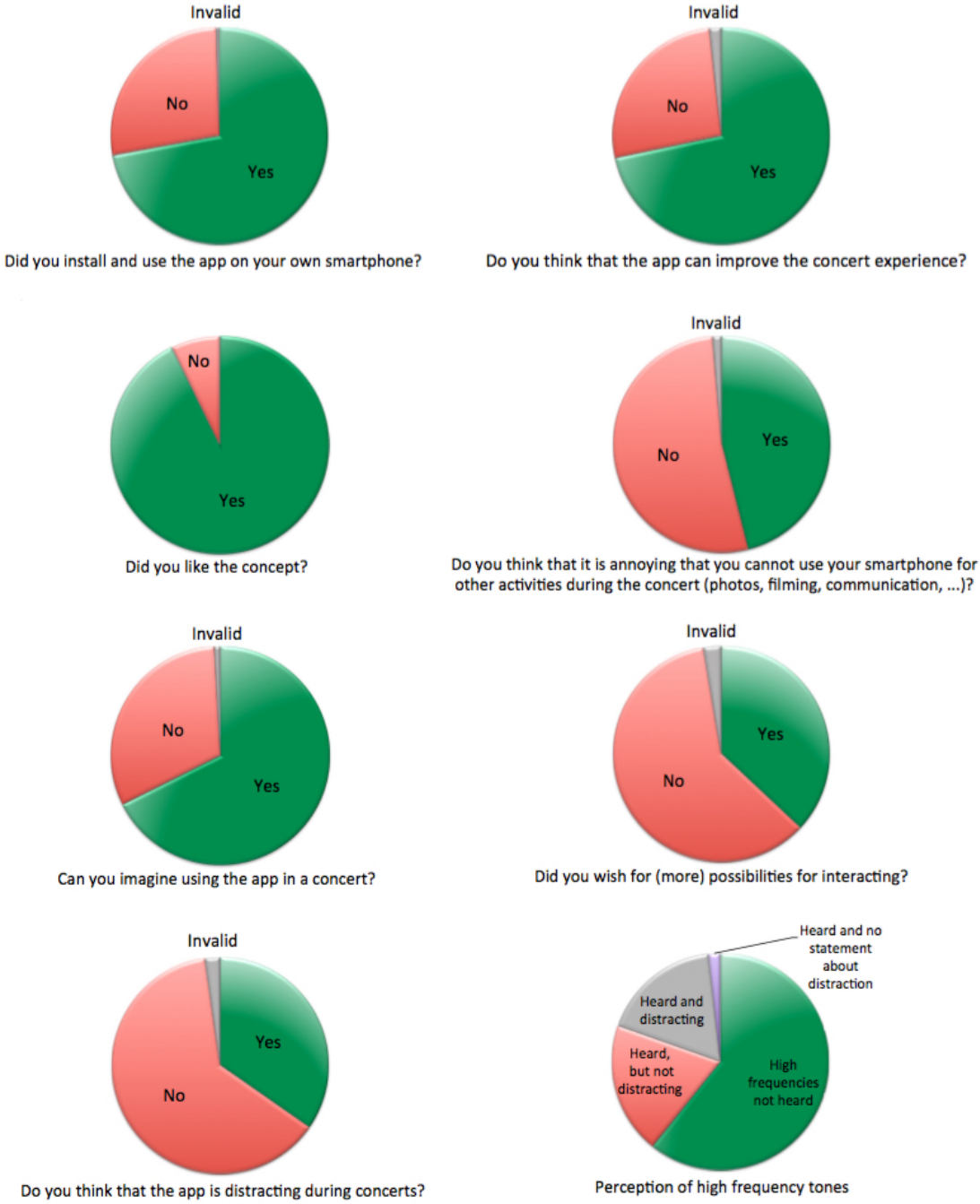


Figure 7.3: A graphical representation of the first seven single choice questions as well as a classification on participants hearing high frequencies.

Single answers or answers that did not fit in the defined categories of each question were put in a separate category because of marginal statistical importance. Furthermore, for questions with a lot of categories, tables are provided.

Open question 1: Why do you think that the app is distracting during concerts?

The participants only had to answer this question if they answered the question "Do you think that the app is distracting during concerts?" with "Yes".

79 people answered the follow-up question. The most frequent answer was that the use of the app was distracting (21). The reason for some of them was that smartphones would be distracting during concerts (8). The second common answer was that the respective person did either not like the sounds or the person was worried how the sounds harmonize with the music from the stage (11). A few mentioned that the sounds were asynchronous (9) and that it would depend on the concert and the genre if the app would be distracting (9). Others answered that keeping the hands in the air the whole time was annoying (8) and that it would depend on the integration and the duration of usage (6). For a few, the sense of the application was unclear (6). Other, less often mentioned answers included the blinking or the colourful display being distracting, the battery decreasing, the sound quality of smartphones being bad and that the person was able to hear the high frequency sound. Less important answers were categorized into "other answers" (9).

Open question 2: Why do you think that the app can (not) improve the experience of a concert?

This question was asked as an additional question to the single choice question "Do you think that the app can improve the experience of a concert?". Everybody was asked this question disregarding whether the person answered "Yes" or "No".

146 people answered the question. We distinguished between positive and negative answers. However, for some people the purpose of the app was not clear (16). Others mentioned that it would depend on the concerts or how the application would be used exactly (10). A few also mentioned that it would only improve the concert if everything is synchronized (4).

Table 7.3 gives an overview of the most frequent positive answers sorted by the amount of people who were assigned to the respective answer category. In Table 7.4 negative answers are provided.

Furthermore, some answers did not have a constructive meaning (11), while others were mentioned only once (6).

Open question 3: Which additional interactions would you wish for?

This question only had to be answered by people who answered the question "Did you wish for (more) possibilities for interacting?" with "Yes".

Answer category	Amount
Everyone is part of the concert. / The app generates group-feeling. / The app promotes audience participation and audience interaction.	33
The app is new and interesting.	20
The app improves the acoustics, the sound-effects or the surround feeling.	18
The light effects are cool.	10
The application offers new possibilities.	4
The effects are cool.	3

Table 7.3: Positive participants' answers to the question "Why do you think that the app can (not) improve the experience of a concert?" sorted by the amount of answers.

Answer category	Amount
Either the visuals, the sounds or the app is annoying.	9
Smartphones are not loud enough.	7
One's focus should be centered on the stage and the music of the performer.	6
The quality of smartphone speakers is insufficient.	5
The use is unwieldy.	5
The sounds are not synchronized.	3

Table 7.4: Negative participants' answers to the question "Why do you think that the app can (not) improve the experience of a concert?" sorted by the amount of answers.

64 people answered the question. The most frequent answer was that the person wanted to choose the displayed visuals (19), followed by choosing the sounds (17). A few people also would like to produce the sound in some way (5) or vote for something (4). Others wanted to have some kind of input possibility, a menu or options (4). Also media support (filming, photos, messaging), feedback for the performer, additional information, shake functionality and wave-like spreading of sounds or visuals were among the answers. Single answers again were categorized separately (9).

Open question 4: What did you like about the app?

181 people answered the question. By far, the most common answer was that the person liked the idea or the concept of the application (75). The next most common answers were that the person liked the colours or the light-show (27) and that the person liked the technology used within the application (25). Some mentioned they liked that the application or the handling of the app was simple (16), they liked either the group-feeling or the interaction by using the app (14) and they liked the surround sound or surround light feeling (13).

Other less common answers were that the person liked the sounds (9), the person did not like anything, that the person liked that not each smartphone reacted in the same

way and that the application did not need a lot of access rights on Android. Again, a few answers did not have a constructive meaning (3).

Open question 5: What could be improved in the app?

Table 7.5 gives an overview of the most frequent answers for this question.

Answer category	**Amount**
The application should be compatible with more devices or the application should be more stable.	16
More interactions should be added or interactions should be improved.	15
More information should be provided. (i.e. on the start-screen or between the IDs)	14
Other operating systems should be supported.	13
The colours should be selectable. More colours and multicoloured screens should be provided.	13
More functionality should be added.	10
To enable other functionality during usage of the app, the app should also be able to run in the background.	10
The used sounds should be changed or improved.	8
Health should be considered more (i.e.: epilepsy warning)	8
The user interface should be improved.	8
The download size of the application was too big.	7
The sounds or lights should be more synchronized.	6

Table 7.5: Participants' answers to the question "What could be improved in the app?" sorted by the amount of answers.

Less frequent answers were that the high frequencies should be inaudible, that the volume and the brightness should be adjusted automatically or adjustable by the user or that the flashlight should be used in some way. Other less frequent answers were that the application should be able to continue with the current ID when restarting the application or that their smartphone should interact with the smartphones around them in some way. A couple of people also mentioned their worry about the decrease of the battery.

Unfortunately, a few people misunderstood our explanation that they could change to flight mode. This was meant to demonstrate that the application does not need another connection type other than sound. The application also works without changing to flight mode.

Quite a lot of people also answered that they did not know what to improve, that nothing had to be improved or the answer was incomprehensible. (28) Also a lot of single answers were given (14).

Open question 6: Did you have problems with the app? If "Yes": Which problems and which smartphone (and operating system + version) do you have?

We only evaluated answers from people who had installed the application on their own smartphone. Therefore, the question "Have you installed and used the app on your own smartphone?" had to be answered with "Yes". 158 did so.

The most frequent answer was that there was no problem (79). Some people answered that their phone never reacted on the IDs (37) or that their phone was not reacting at the beginning (14). Some also mentioned that their phone only reacted sometimes (12). In some cases it was not clear whether the person had a problem (8). Others mentioned that there was a problem but did not specify it (6). Less frequent answers were that the app crashed (3) or that the app only reacted when the person was holding his or her phone in the air (3).

A problem we realized during the evaluation was that we could not determine whether a specific operating system or smartphone did not work because we only asked for the smartphone and operating system if something did not work. However, it is conspicuous that ten people answered that they had a OnePlus One and seven of them never reacted on the IDs. Furthermore, people who mentioned that they were using a OnePlus 2 together with OxygenOS never received an ID. But without further information we cannot assume that all OnePlus 2 phones with OxygenOS did not work properly.

Another assumption is that there was a general problem with CyanogenMod. Nine CyanogenMod phones mentioned at this question, never reacted on the IDs. One mentioned that there was a problem with the Privacy Guard of CyanogenMod and that the application worked after deactivation of the privacy guard. However, we do not know how many CyanogenMod phones worked properly.

Other smartphones which might have had a general problem are smartphones from HTC. Five out of six never recognized an ID.

7.1.4 Insights

The aim of the test was on the one hand to find technical issues, possible improvements as well as accepted and non-accepted aspects about the application. On the other hand the test was important for the performer to see how the sounds work in a large-scale setting.

Since the lecture during which we tested the app was for the second semester of the informatics studies, most audience members were studying informatics. The limiting factors are that all participants were students, most of them were male and all of them were studying informatics. Therefore, we assume that the number of operating systems like CyanogenMod was higher in this setting than in a setting with more varying participations. Moreover, the technical interest was also higher than in general. This can

also be seen as an advantage because of the technical evaluation. However, this was the only chance to test our application with such a high number of people.

Another important concern is that lecture rooms may suppress noises from the audience. We do not know if this was the case, but there was definitely a problem with the maximum volume.

As we worked through the questionnaires we had the feeling that the quality of the answers was quite good. When designing the questionnaire we paid attention not to ask too many questions in general and open questions specifically. However, we cannot exclude that some of the participants answered single choice questions in a way that they did not have to answer the associated open question. This could have been done by answering "No" if the associated question was only for people who answered with "Yes".

One aspect that did not influence the quality of the questionnaires but the impression of the performer is that we were not able to test all IDs and therefore all included sound files. Due to the fact that there was no compulsory attendance and the fact that we did not have a real concert, the attention of the students faded after they understood the general concept. Hence, students started to talk or leave the room. The noise level got too high to continue testing other sound files.

7.2 Interview with a performer

As an addition to the results of the questionnaires the opinion of the performer who was involved during the whole design process of the application is crucial for evaluating the performer side.

The performer was interviewed after the large-scale live test. This time was chosen because of the fact that we could talk about the design process, the project as a whole as well as the live test itself. The whole transcript of the interview can be found in Appendix C. Due to the fact that the interview was held in German the transcript is only available in German as well. Original citations in this section are in German as well but an English description is provided. All quotations in this section belong to Susanne Kirchmayr alias Electric Indigo and can be found in the transcript as well.

Before the beginning of the project she thought about which kind of participation could be relevant for her as a musician. She thought that banal participation like holding the phones in the air and waving were not very exciting. Interesting for her was to use the hands as instruments. She considered not only an aural but also a visual layer which was exactly what we had tested.

Original German quotation:

> Es hat mich eigentlich in erster Linie interessiert die Hände als Instrumente zu verwenden.

Translated English version:

> I was primarily interested in using the hands as instruments.

She described her role within the project as the person who provided professional input concerning music and live performance. Moreover, the application could have moved in many directions whereas she set the agenda where to move to. She tried different kinds of sounds for the application. The sounds were not produced specifically for a smartphone-oriented concert. After the first tests she added additional sounds that sounded different and sounds which could sound better with the limited frequency range of smartphones' speakers.

She also mentioned problems that occurred during the live test:

Original German quotation:

> [...] worauf ich hinaus will ist, dass ich den Eindruck hatte, dass die 25 Handys beim ersten Versuch im Audimax ein klareres und prägnanteres akustisches Bild geliefert haben als die ungefähr 200 Handys mit 300 Leuten beim zweiten Test [...]

Translated English version:

> What I want to point out is that I had the feeling that 25 smartphones at the first test in the Audimax delivered an acoustic image which was more clear and concise than the approximately 200 smartphones with 300 people in the second test.

As a possible reason she mentioned the acoustics of the lecture room which may be built to suppress sound from the audiences' area, although we had tested the application in the same room. As another possibility she mentioned that many asynchronously starting sounds may become more blurred than just a few and the mass of people could have additionally suppressed the sound.

To the fact that people who filled out the questionnaire sometimes did not get the sense of the application she responded:

Original German quotation:

> Ja, ich mein das überrascht mich auch nicht, wenn die Leute irgendwie den Sinn nicht verstehen von der App, [...] weil uns der Sinn glaub ich selber noch nicht [...] 100 %-ig klar ist. Oder wie das dann genau in ein Konzert eingebaut wird [...].

Translated English version:

> Yes, that does not surprise me, if people do not get the idea of the app since we do not understand it 100 %, either. Or how it could be integrated into a concert [...].

Due to the fact that the live test had a problem with the sound level she stated that she does not know yet how to use the application musically and whether the whole project adds value is not yet clear either.

Based on this she identified sound level as key factor.

Original German quotation:

> Aber wir können ja nicht die Handys lauter machen. Außer wir fangen an irgendwie komisch herum zu tricksen, indem wir Signale oder eben die Samples die das Handy abspielt auch noch zusätzlich über die Anlage abspielen.

Translated English version:

> But we can not increase the volume of the smartphones, unless we start enhancing signals or even samples that are played on the phones via the PA.

Supplementary, there are two directions she wants to test further. The first one is to use the sounds more sparsely to minimize the effect of blurring. The second one is to use the sounds of the smartphones additionally to the main music. For instance she mentioned layers, drones and rustling noises. She also mentioned that she does not know if the experience is improved in comparison to an electro-acoustic concert or an experimental concert. As a more massive improvement she mentioned all kinds of controls like volume control, a stop function, an equalizer and basic audio interaction. Normally, she uses other speakers if the sound does not satisfy her needs. The challenge with the application is the multiplication of sound waves. She does not see the application as a restriction because she would specifically create the music for it. The system is not very flexible though.

Original German quotation:

> Man muss irgendwas musikalisch sinnvolles damit machen. [...] mit diesen Spezifika muss man halt arbeiten und nicht [...] versuchen, [...] gegen die Natur der Telefone irgendwas zu machen, was nicht gut geht.

Translated English version:

> One has to use it for something musically meaningful. One has to work with the specifics and not try to work against the nature of smartphones, which does not work.

At this point she also mentioned that the use with visuals may be easier.

Another improvement regards the fact that the application is useless outside of the specific concert. A solution can be that the sound files are usable outside of the concert.

7.3 Interpretation

Due to the fact that we only had one interview with the performer, who was involved in the project, the result of the interview is subjective. The interview was rather important because the performer influenced and guided the design of the app into a specific direction. The interview helped us to obtain relevant insights as well as to identify problems.

From the performer's side, we identified the limited volume of smartphone speakers as the major problem. In the audience on the other hand only a few people mentioned the sounds not being loud enough. As mentioned before we do no know if the lecture room suppresses sounds from the audience. However, this would be a possible reason for a different perception in the front of the lecture room. A solution to this problem is crucial for gaining acceptance by the performer.

An issue for both the audience and the performer mentioned, is the purpose. For some of the participants either the purpose of the app was not clear or the acceptance was dependent on the exact use of the app. This means that it would depend on the concert and the use during a concert. After the live-test the performer also had to rethink how to possibly use the app. For each performance in which the app is used, it must be considered how it should be used. Moreover, the app has to be embedded in the performance. The challenge for the performer is to think about how a given system can be used or adjusted to fit in a show. The respective show most likely would have to be announced as a show with smartphone participation or an experimental concert.

From the audience's side the concept is highly accepted. Two-thirds could imagine using the app during a concert. However, we identified the following major issues:

- Support for more operating systems and better device support
- Reliability of the high frequency sound ID recognition
- Minimum frequency in the high frequency IDs
- Selectable sounds and visuals
- More information
- Background-mode

Unfortunately, we could not test the iOS application in the setting, otherwise the first point would be less essential. The mentioned points should help as an input for future work.

CHAPTER 8

Discussion

The smartphone application we presented arose of literature review, interviews as well as cooperation with a focus group. However, the idea of using high frequency sound IDs was first used in Sense of Space [14]. Limitations in Sense of Space are that the application only worked on iOS devices and that the amount of IDs is limited to 16. Furthermore, in Sense of Space the authors observed that the volume of the smartphones was an issue. The authors also mentioned that the audience seemed confused how to deal with sound and visuals in the app:

> We needed to listen to the music from the iPhone by placing it near our ear, so we could not see the visuals on the application. Audience members also seemed confused about how to enjoy the application. [14]

The presented smartphone application enhanced the use of high frequency sound IDs. Firstly, the application was built for cross-platform support using Xamarin Forms for iOS and Android. This leads to the possibility that Windows Phone can be added in future work. Moreover, the amount of possible IDs in the final application is 26. The theoretical amount of possible IDs with the used technology is 56. In comparison to Sense of Space we use a Change-ID to enhance the amount of IDs. 56 IDs can be reached if seven Change-IDs are used. To decrease the chance of false positive ID recognition, we also defined an ID for synchronisation, which we called Sync-ID. To solve the issue that the combination of sound and visuals may be confusing, the used visuals are limited to colourful screens which do either not change or just blink. This should lead audience members to look at the whole room instead of staring at their own screen. Further user interactions and triggering pictures were tested during our workshops but were removed because of the distraction.

We tried to solve the problem of limited volume of smartphone speakers by limiting the audio output to the phones instead of using a combination with a PA. In a real concert

a possible solution is to alternate between the PA and the smartphones or, as figured out during the interview, to enhance the smartphones' sounds with the PA. However, we determined the same problem as the authors of Sense of Space in spite of having tested the application in a large-scale setting. Surprisingly, our impression was that the volume during the large-scale test did not feel louder than the volume with only a few phones in the same lecture room.

We furthermore not only tested the technology but also asked the participants' opinions on the concept, the technology, issues and improvements. The research questions answered below are focused on the acceptance as well as major findings by analysing the questionnaires as well as the interview with the performer.

One issue we paid attention to during our work, and which was also mentioned by a few participants, is health. The volume of the high frequency sounds also has to be considered. The main problem with the volume is that we can not hear if the respective sound is too loud. For that reason we always checked the same volume with lower frequencies where we could hear how loud the sounds were. Moreover, a few participants mentioned that an epilepsy warning would be good because of the blinking lights. Others mentioned that people may get a headache.

The answers to the research questions in this chapter are summaries. For more detailed information about the complete evaluation, we refer to Chapter 7.

Is audience participation using high frequency sound ID recognition via a smartphone application accepted by the audience? Why is it accepted / not accepted?

Based on the facts that 92.7 % of the participants liked the concept, 67.6 % could imagine using the app in a concert and 71.7 % thought that the app could improve the experience of a concert, high frequency sound ID recognition was highly accepted in our specific case. However, acceptance strongly varies on the exact use of the respective application.

Main reasons given for acceptance can be found in the open question "What did you like about the app?" as well as "Why do you think that the app can (not) improve the experience of a concert?" Most received answers were in regard to audience participation, the group-feeling, the idea, the concept, novelty value, the light-show as well as the improvement of the acoustics and surround feeling. High frequency recognition and the simplicity of the application were also praised.

Is audience participation using high frequency sound ID recognition via a smartphone application accepted by the performer? Why is it accepted / not accepted?

The interview with the performer indicates that high frequency sound ID recognition may be accepted. It is important to mention that this answer is based on a specific opinion. The application in its current implementation is definitely not accepted though. The main issue is the limited volume of smartphone speakers which makes the application not

suitable during a real performance. Further research has to be done to find out possible solutions.

What can be improved?

Main improvements to gain acceptance by the performer is to improve the lack of maximum volume when using smartphones as speakers. A possible solution for this issue is to enhance the smartphones' limited volume by the additional use of a PA. This could also lead to a suffering of the surround feeling and therefore has to be tested in future work.

The acceptance of the audience can further be improved by better device support, operating system support as well as enhancing the reliability of high frequency sound IDs. The minimum frequency used in the high frequency sounds may be reconsidered.

Further possibilities to enhance the acceptance are to make sounds and visuals selectable, to provide more information as well as implementing a background-mode.

What problems did occur?

The most extensive problems that occurred during the live-test are the reliability of ID recognition, missing device support for specific Android phones as well as the lack of volume of smartphone speakers.

What are possible solutions for the problems?

The reliability of the ID recognition can be improved by improving the recognition algorithm used in the app. The arrangement of speakers used for high frequency sound IDs influences the recognition as well. Additional speakers may help to accomplish better recognition. Furthermore, spatial and local conditions have to be considered each time high frequency sound IDs are used.

To detect the precise problem of the Android devices that did not react on the high frequency sound IDs further tests have to be conducted. A possible solution is to adjust the recognition algorithm.

Can the app improve the concert / the experience of the concert?

71.7 % of the participants thought that the app could improve the experience of a concert. The exact use of the app as well as the integration and the context is highly relevant for improving the experience.

Will the audience use the app or prefer just listening to the concert?

In our test most of the audience members tried to participate. 67.6 % answered that they could imagine using the app in a concert. 71.7 % thought that it could improve the concert but 34.7 % thought that the app would be distracting during concerts.

On the basis of our test about two-thirds would use the app whereas about one third would prefer just listening the concert.

Will the audience stop using their phones for other things because of using the application?

46.1 % of the participants thought that it would be annoying that they could not use their smartphone for other activities like photos, filming or communication. Moreover, the wish for background support for enabling other functionality was expressed by a few people.

We do not think that people will stop using their phones for other activities. We have to consider that the live-test lasted less than thirty minutes. As concerts in general take longer, people would get distracted more easily.

Are smartphone/non-smartphone users distracted by the app?

34.7 % of the participants answered that the app would be distracting during concerts. However, concerts with smartphone audience participation may be announced as these, therefore people would be forewarned.

Limitations

The acceptance of a smartphone application for audience participation via high frequency sound ID recognition is not only dependent on the technology but also highly on the specific content of the application. Furthermore, the participants of the live-test are not representative of all people who like to go to concerts.

The answers to the research questions can therefore not be applied to high frequency sound recognition in general. However, the answers and the received data may help in further developments in the area of high frequency sound recognition or smartphone participation.

Implications

Although the provided application has its problems and can be improved in several places, the concept was highly accepted by the audience. When implementing an audience participation system one has to consider if high frequency sound recognition is the right choice due to problems concerning recognition. Different applications have to be tested and evaluated. Furthermore, other technologies which could deliver the same or a similar result have to be considered.

Further literature

During the evaluation of our live-test, further interesting audience participation concepts were presented at the Web Audio Conference WAC-2016, April 4-6, 2016, Atlanta, USA. Although these papers contain interesting approaches as well as interesting findings we could not consider them in our work. However, a short overview as well as implications for our work are provided. In Musique Concrète Choir [42] the audience is able to use their smartphones for creating music via a web app. The smartphones' speakers are used for audio playback whereas the audio mix, created by the audience, is guided by a coordinator. Furthermore, a principal performer is able to add additional sounds. An

interesting design decision is that the sound files used on the smartphones are downloaded at the beginning, which prevents the users from possible reloading.

In Constellation [28] the audience uses a web app for interaction. Different kinds of relations between performers and audience are explored in four scenarios. Because of latency of cellular and WiFi connections, the sounds played back by the smartphones' speakers are chosen with consideration on asynchrony.

Both Constellation and Musique Concrète Choir mention that the volume of smartphones' speakers is limited, which confirms our findings.

Another recently introduced web app is called Crowd in C[loud] [25]. In this work the audience creates simple sound sequences on their phones which are later on collectively played back by a performer. Before submitting the created sounds, the users have to combine their sounds with another user's sounds.

CHAPTER 9

Conclusion And Future Work

In the following we provide a summary of the thesis. Furthermore, a critical reflection as well as an outlook is given. The outlook includes improvements of the presented concept as well as possible extensions and further ideas.

9.1 Summary

We presented new smartphone application ideas for audience participation. Furthermore, the ideas were used as input for a focus group consisting of experts and a performer who helped in iteratively developing an iOS and Android cross-platform application for audience participation called "Poème Numérique". The application reacts on high frequency sound IDs whereas an ID always consists of two simultaneously played sine waves between 18 Kilohertz and 20.7 Kilohertz. In the final release IDs trigger sounds, colours and text. A Sync-ID and a Change-ID help to minimize false positives and expand the amount of triggerable events.

The application was tested with more than 250 students during a live test setting. Main findings are that the application is highly accepted by the audience but not accepted in the current state by the performer due to the limited volume of smartphone speakers.

9.2 Critical reflection

As we focused on a specific concept and did not define general statements about audience participation using smartphones, our work is influenced by subjective views. The preliminary studies could have had different results when interviewing other people. The same applies to the focus group we worked with. Especially choosing a different performer would probably lead to a completely different way of interaction.

For our purposes the results of the questionnaires are absolutely sufficient. The meaningfulness is also restricted because of the fact that the participants all were IT students who live in or near Vienna. Furthermore, the scattering of the age and the surplus of male participants are also limiting factors.

One last thing to mention is the interview with the performer. Our aim was to get insights from a person who already knows what the application can be used for as well as someone who could share insights concerning the application. We therefore do not know how the application would be accepted by performers in general. Gathering more information from the performers' side can be a topic for future work.

9.3 Outlook

In future work we primarily have to rethink the use of smartphone speakers, improve the ID recognition algorithm as well as enhance device support. Furthermore, a Windows Phone application could be added. A test with all three platforms at a single event would be useful. Regarding the wish for more interaction methods, further tests with interactions that were disregarded during our workshops, may be done.

Moreover, we are still interested in directional sound and its field of use in combination with high frequency sound IDs. For this purpose we also thought about using normal or directional speakers, mounted on a quadro- or octocopter. Thereby, specific parts of the audience get the high frequency sound IDs where others do not. The difference between these two approaches is that without the flying object the Sound IDs will be recognized in the line of the speaker, whereas using a flying object the IDs will be recognized in a circle directly under the flying object.

Since the sound files, the texts and the displayed colours are hard-coded to date, another interesting enhancement opportunity is, for the user to be able to update the reaction of the phone before a concert. During the concert an internet connection should never be necessary. As we were only able to test the application in a test setup but not at a real concert, this would be an interesting continuation as well.

A demonstration of the developed system will be presented at the 8th International Conference on Intelligent Technologies for Interactive Entertainment, June 28-30 2016, Utrecht, NL. [22]

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Appendix A

Interviewfragen für das Publikum

1. Alter?

2. Geschlecht?

3. Anzahl der Konzertbesuche pro Jahr?

4. Welche Art von Interaktion zwischen Band und Publikum ist dir/Ihnen bekannt?

   Anders formuliert falls die Person sich darunter nichts vorstellen kann:

   Wie motivieren Bands ihr Publikum? Wie macht das Publikum bei Konzerten mit?

5. Fallen dir/Ihnen konkrete Bands ein die dies besonders gut können? Welche Art von Interaktion ist bei dieser Band besonders gut?

6. Smartphone-Benutzer?

7. Kannst du dir/Können Sie sich eine Interaktion mittels Smartphone zwischen Band und Publikum vorstellen?

   Zusatzfrage: Wie könnte diese aussehen (egal ob störend oder witzig/gut/motivierend)? Was kannst du dir/können Sie sich vorstellen mit dem Smartphone zu machen?

8. Denkanstoß: Denke auch daran/Denken Sie auch daran, dass das Smartphone verschiedenste Sensoren und Funktionen hat (Mikrofon, Lautsprecher, Lagesensor, Bewegungssensor, Display, Kamera, Vibration, …)

   Fallen dir dazu Interaktionen ein? (event. jede Funktion/jeden Sensor noch einmal einzeln aufzählen und auf eine Antwort warten)

9. event zusätzlich noch: Glaubst du/Glauben Sie, dass Smartphone-Interaktion bei Konzerten sinnvoll ist?

Interviewfragen für Musiker

1. Alter?

2. Geschlecht?

3. Instrument/Gesang/DJ?

4. Anzahl der Konzerte/Jahr?

5. Interagiert ihr/Interagieren Sie während euren/Ihren Konzerten mit dem Publikum (außer reden und Songs ankündigen)?

   Anders formuliert: Motiviert ihr/Motivieren Sie das Publikum zusätzlich in irgendeiner Weise mitzumachen?

6. Fallen dir/Ihnen Bands ein, die sehr gut mit dem Publikum interagieren? Welche Art von Interaktion ist das?

7. Smartphone-Benutzer?

8. Könntest du/Könnten Sie sich vorstellen, dass das Publikum mit dem Smartphone mit der Band kommuniziert?

   Zusatzfrage: Wie könnte diese Interaktion aussehen? Welche Informationen könnten für die Band interessant sein? Was sollen die Zuhörer mit dem Smartphone machen können?

9. Denkanstoß: Denke auch daran/denken Sie auch daran, dass das Smartphone verschiedenste Sensoren und Funktionen hat (Mikrofon, Lautsprecher, Lagesensor, Bewegungssensor, Display, Kamera, Vibration, …)

   Fallen dir dazu Interaktionen ein? (event. jede Funktion/jeden Sensor noch einmal einzeln aufzählen und auf eine Antwort warten)

10. event zusätzlich noch: Glaubst du/Glauben Sie, dass Smartphone-Interaktion bei Konzerten sinnvoll ist?

Appendix B

Fragebogen zu Poème Numérique

Alter: __ Geschlecht: O weiblich O männlich

Hast du die App auf deinem eigenen Smartphone installiert und verwendet?
O Ja O Nein

Hat dir das Konzept gefallen?
O Ja O Nein

Könntest du dir vorstellen, dass du die App auf einem Konzert verwendest?
O Ja O Nein

Glaubst du, dass die App bei Konzerten störend ist?
O Ja O Nein

Falls „Ja“: Warum?

Glaubst du, dass die App das Erlebnis eines Konzertes verbessern kann?
O Ja O Nein

Warum bzw. warum nicht?

Stört es dich, dass du dein Smartphone dann nicht für etwas anderes verwenden kannst? (Fotos, Filmen, Kommunikation, …)
O Ja O Nein

Hättest du dir (mehr) Möglichkeiten zur Interaktion gewünscht?
O Ja O Nein

Falls „Ja“: Welche?

Hast du die hochfrequenten Töne gehört?
O Ja O Nein

Falls „Ja“. Waren sie störend?
O Ja O Nein

Was hat dir an der App gefallen?

Was könnte man an der App verbessern?

Hat es Probleme mit der App gegeben? Falls ja: Welche und welches Smartphone (und Betriebssystem + Version) hast du?

Vielen Dank für deine Mithilfe!!!

Appendix C

Transcript of the interview with the performer

Interviewer (C): Christoph Bartmann
Interviewee (S): Susanne Kirchmayr (Electric Indigo)
Date: March 15th 2016
Duration: 35 minutes

S: Test,Test

C: Ja, funktioniert. Ok. Ich möchte nur mal kurz im Vorhinein sagen, dass du ruhig ehrlich sein kannst und dass Kritik wirklich auch erwünscht ist und auch die negativen Aspekte sagen kannst jeweils.

S: Ok. Ja, gut.

C: Kannst du mir kurz nochmal erklären was du als Musikerin bis jetzt gemacht hast? (Pause) Also vor dem Projekt jetzt.

S: Was hab ich gemacht? Naja, ich hab mir grundsätzlich Gedanken gemacht was für mich als Musikerin interessant sein könnte an Art der Partizipation und was ich jetzt irgendwie nicht so spannend fände, weil weil (zögert) wahrscheinlich ichs ein bisschen banal finde, also das sind so Sachen, ich mein nicht, dass wir das machen ja, aber so naheliegende Dinge die es auch schon gibt soweit ich weiß, dass Leute halt irgendwie das Handy verwenden können im Publikum um ihr Fan-tun auf so ner Rock-Business üblichen Ebene kundzutun und solche Sachen wie ja, irgendwie Handy in die Höhe halten und winken oder so Zeug find ich halt ja nicht besonders interessant und es hat mich eigentlich in erster Linie interessiert die Hände als Instrumente zu verwenden. Also möglicherweise nicht nur auf Audioebene sondern auch auf einer visuellen Ebene und ja, das ist ja auch die Richtung die wir getestet haben bis jetzt. Und nachdem ich mir eben so eine Vielzahl von Handys als Instrument nicht so gut vorstellen kann haben wir eben die Tests gemacht und zu dem Zweck hab ich einfach Sounds ausprobiert, verschiedener Art. Die Sounds die ich genommen hab, hab ich jetzt nicht für ein bestimmtes, schon aufs Handy ausgerichtete Konzert neu kreiert oder zum Großteil nicht, sondern hab Sounds einfach genommen die ich schon parat hatte und hab nach einem allerersten Test in kleiner Runde noch ein paar zusätzliche Sounds gemacht die einfach ein bisschen anders klingen, weil ich mir gedacht hab das könnte über die beschränkte Frequenzbreite vom Handylautsprecher vielleicht besser klingen und ja, mir waren die, meine eigenen ersten Sounds, alle auch ein bisschen zu ähnlich, weil ich sie halt auf eine ähnliche Weise generier also so, ah es is halt eine typische Klangcharakteristik von mir und ich wollt was klareres, bisschen was anderes, haben bisschen was tonaleres und in der Richtung möcht ich auch noch das weiter ausbauen. Ahm, ja. Das heißt ich hab unterschiedliche Sachen vorbereitet, die um zu ergründen irgendwie wie was wirkt und wie was vielleicht was besser kommt oder was nicht so gut kommt und insofern wars auch recht aufschlussreich, dass im Audimax, also in einem großen Raum, sowohl mit ganz wenigen Leuten als mich mit den vielen Leuten zu probieren, weils doch interessant war wie unterschiedlich die Akustik war. Also das wenige Han(unterbricht) Also ich mein vielleicht wars auch wirklich eine Täuschung und wir haben nicht den Hintergrundpegel gemessen oder mit einem absolut eingestellten Aufnahmegerät den Gesamtpegel aufgenommen in der einer Version und in der anderen Version, nämlich mit den wenig Leuten und mit den vielen Leuten, deswegen kann ich jetzt schwer so ein gültiges Urteil treffen, aber worauf ich hinaus will ist, dass ich den Eindruck hatte, dass die 25 Handys beim ersten Versuch im Audimax ein klareres und prägnanteres akustisches Bild geliefert haben als die ungefähr 200 Handys (lacht) mit 300 Leuten beim zweiten Test und das ist, ja ähm, das ist eine Information wo ich jetzt, die eigentlich mehr Fragezeichen (lacht) generiert als (zögert) sozusagen Wegweiser liefert. Ja.

C: Ja, das hat uns glaub ich alle ein bisschen verwundert. (beide lachen)

S: Ja ja, ich mein es spielt sicher die Akustik des Raumes auch eine Rolle, aber wenn wir das zu einem anderen Zeitpunkt im Semperdepot versuchen wird das sicher anders klingen. Es könnte auch einfach sein, dass viel Signale die eben nicht synchron abgefeuert werden können, also

Audiosignale, die nicht synchron starten, dass die halt das Ganze einfach verschwommen machen und wenns dann richtig viele sind die mitspielen, ist es vielleicht noch verschwommener, aber was sicher auch zutreffend ist, ist dass wenn viele Leute in einem Raum sind, dass die einfach auch sehr viel Schall schlucken. Ja.

C: Mhm (zustimmend), jaja das glaub ich auch, dass (unterbricht)

S: Und Audimax natürlich, ahh (zögert), obwohl wir hams ja im gleichen Raum probiert, und wenn wir jetzt sagen würden, dass Audimax so gebaut ist, dass Schall der aus dem Zuhörer/innen-Bereich kommt tendenziell eher unterdrückt wird, muss man sagen, hat nicht den Eindruck gemacht, dass wenige Leute drinnen waren. Ja, aber es is ja immer so, dass Leute Geräusche machen, also auch wenn sie still sitzen. Sie müssen ja atmen und vielleicht machens doch irgendeine Bewegung und es gibt irgendein rascheln oder sonstiges. Das heißt so ein Grundpegel ist einfach da und der muss ja auch bei einem Konzert da sein, wenn die Leute nicht tot sind (lacht) die das Konzert besuchen.

C: Es wird sicher eher noch lauter.

S: Es wird eher noch lauter und vorallem (wird unterbrochen)

C: Weil die Leute ja auch, während die Musik laut ist, auch lauter reden, damit sie sich gegenseitig verstehen.

S: Genau, ja und wenn wir auch noch wollen, dass die Leute herumgehen, einfach weil das unterhaltsam ist das zu erforschen wie das von einem anderen Standpunkt aus klingt, dann wird's noch viel lauter. Na, dann hat man die ganzen Gehgeräusche und sonstiges auch dazu. Also ich bin im Moment eigentlich nicht so, auf keinen grünen Zweig, dass ich weiß wies musikalisch jetzt wirklich gut einsetzen kann.

C: OK.

S: Mhm. (zustimmend)

C: Hmm (denkt nach) Wie würdest du das, weil du eben schon gesagt hast, dass du jetzt nicht weißt wie dus einsetzt. Was fehlt dir oder wie würdest dus verändern dass du sagst, so könntest dus jetzt einsetzen?

S: (zögert lange) Schwer zu sagen. (zögert) Naja, ich mein Lautstärke ist schon ein Schlüsselfaktor, na.

C: Mhm (zustimmend)

S:Aber wir können ja nicht die Handys lauter machen. Außer wir fangen an irgendwie komisch herum zu tricksen, indem wir Signale oder eben die Samples die das Handy abspielt auch noch zusätzlich über die Anlage abspielen.

C: Mhm.

S: Könnte eine Möglichkeit sein. (zögert) Ich glaub tatsächlich, dass (zögert) ich weiß es ehrlich gesagt nicht. Es gibt 2 Richtungen in die ich weiter gerne Tests machen würde. Das eine ist Signale noch spärlicher zu sehen, das führt halt zu Pausen, aber das könnte diesen Verschwimmungseffekt bisschen minimieren.

C: Mhm.

S: Und die gegensätzliche Richtung, dass ich eben jetzt keine besonderen musikalischen Strukturen damit reproduzieren will, sondern eher halt so layers und drones. Halt rauschartige

Sachen. Das lässt sich ganz sicher recht einfach damit realisieren. Wie gesagt, bei beiden ist mir noch nicht ganz klar irgendwie was das Ganze jetzt bringen soll und was es spannender oder besser macht im Gegensatz zu einem guten anderen (lacht) electro-akustischen Konzert oder experimentellen Konzert.

C: Ja

S: Ja, ich mein, wenn die, wenn wenigstens die Leute irgendwie einen Spaß damit hätten, dann müssten sie aber auch mehr interagieren können. Also der Mehrwert von dem ganzen Projekt ist mir noch nicht ganz klar.

C: Mhm. Ja das werma dann eh, wenn die Fragebögen ganz ausgewertet sind (lacht), eh sehen.

S: Mhm (zustimmend)

C: (…) Ich mein ich hab eh schon einen Teil ausgewertet. Das zeig ich dir auch nachher, aber ich würd vorher gern nochmal wollen, dass du einmal unvorhereingenommen ein bissl (…) weitermachen.

S: Ja, jaja.

C: Ähm, wie würdestn, sag ma mal du hättest jetzt alle Wünsche offen und es is nicht so eingeschränkt jetzt oder es gibt quasi nicht diese Vorgeschichte vom Projekt, dass du jetzt ganz genau weißt schon auf was du, auf was wir jetzt hinaus wollen.

S: Mhm

C: Was würdest da denn dann wünschen oder wie würdest es dann im größeren Stil verändern wollen? Hättest da eine Idee oder (wartet) Ich mein wir sind jetzt schon (bricht ab) wir haben jetzt technologisch schon eine bestimmte Richtung gewählt.

S: Jaja, klar. Na ich könnt mir jetzt, das einzige was mir einfällt, aber das is ja, hat ja dann auch nichts mit Handys zu tun, wenn (bricht ab). So wie ich jetzt an die Sache rangegangen bin, hab ich für mobile Lautsprecher etwas bereit gestellt und mir sozusagen versucht etwas zu finden das über viele mobile Lautsprecher irgendwie interessant, musikalisch interessant, wird. Wenn das jetzt klanglich nicht zufriedenstellend ist, dann müsst ich natürlich sagen, ok ich brauch andere Lautsprecher (lacht),

C: Ja

S: (setzt fort) Aber dann haben wir keine Handys mehr.

C: Ja

S: (setzt fort) Also insofern brauch ich da jetzt nicht weiter spekulieren. Ahm, aber was tatsächlich interessant sein könnte jetzt für so, für so eine Testanordnung, ich weiß nicht ob mans dann braucht bei einem Konzert, ja, aber für eine Testanordnung wären alle möglichen Kontrollen interessant wie ich sie beim Musikmachen auch hab, also zum Beispiel Lautstärkenkontrolle, Kontrolle darüber was wo läuft. Wenns uninteressant ist, dass man dann nicht irgendwie das Ende des Experiments abwarten muss, sondern dass ich sofort sagen kann stop, also basic audio interaction, lauter, leiser, vielleicht sogar einen EQ, also einen Equalizer, aber ja, ob das technisch machbar ist, bezweifle ich (lacht). Sicher nicht so einfach, dass ich quasi ein live Signal irgendwie,über die, auf die Handys schickt und live eingreifen kann in das was da, also das wäre ja ein komplett anderes Setup, ja.

C: Ja

S: Ja, (zögert) aber das ist natürlich etwas was ich irgendwie, was mir in den Fingern juckt, wenn hör OK da sind zu viele Mitten, dann würd ich gern die Mitten absenken wollen während es läuft oder OK jetzt weiß ich schon: Das ist nicht so leiwand. Dann würd ich gern auf Stop drücken wollen. (lacht)

C: Das wäre eh auch meine nächste Frage gewesen. Inwiefern dich das jetzt, also wenn dus wirklich anwenden würdest, inwiefern dich das einschränkt und inwiefern es dir dann wirklich neue Möglichkeiten bietet?!

S: (zögert) Naja, es ah. (unterbricht)

C: Oder generell auch: Wie dus einsetzen würdest?!

S: Naja, wenn ichs einsetzen würde, dann würde ich dafür ein Stück komponieren. So wie ich auch ein Stück zum Beispiel für 8 Lautsprecher komponiere und das in der Komposition und in der Vorbereitung von der Aufführung einfach schon von vorn herein Bestandteil der Überlegungen ist.

C: Mhm

S: Ahm, (zögert), das heißt, wenn ich dann weiß wies klingen soll oder wies eingesetzt werden soll in einem bestimmten Kontext, dann brauch ich nicht mehr so viel Kontrolle, aber um das herausfinden zu können, müsst ich in dem Fall, weils mir immer noch nicht ganz klar ist was jetzt leiwand kommt und was nicht leiwand kommt, müsst ich in dem Fall irgendwie, wahrscheinlich noch ein bisschen mehr testen und noch ein paar Versuche haben um andere Sounds auszuprobieren oder um irgendwie ja, ums prägnanter zu machen oder musikalisch ein bisschen sinnvoller.

C: Ja, du hast ja eh schon mal gesagt, dass das für dich, mehr oder weniger, ja quasi ein neues Instrument ist, dass du kennenlernen musst.

S: Ja,genau. Genau so ist es. Aber die Frage ob es mich einschränkt oder nicht, kann ich eigentlich so nicht beantworten, weil ich genau dafür etwas machen würde und insofern ist es keine Einschränkung, aber es ist halt (unterbricht) Also mit anderen Worten: Es fällt mir keine besonders flexible Anwendung dafür jetzt ein. Ich glaub, dass das mit visuellen Geschichten irgendwie ein bisschen einfacher ist, aber dann wahrscheinlich sehr schnell auch, wenns nur was visuelles ist auf ein bisschen banalen Gimmick, den man wahrscheinlich auch schon gesehen hat hinausläuft.

C: Mhm

S: (setzt fort) Was eben ein buntes flackern oder so. Also nichts was jetzt wirklich irgendwie zwingend ist. Aber ich mein da müsste man auch die bildenden Künstler fragen die involviert sind ins Projekt.

C: Mhm, ja stimmt

S: Ja, (zögert) aber vom musikalischen Standpunkt her wie gesagt, ist das, diese Multiplikation der Schallwellen halt eine Herausforderung und kann schon interessant sein, wenn ichs schaff da irgendwas reinzuschicken was dann auch leiwand rauskommt. (lacht)

C: Mhm. Gut. Darf ich dich noch kurz mal fragen wie du überhaupt zu dem Projekt gekommen bist, also (unterbricht)

S: Der Fares hat mich gefragt. Warum weiß ich nicht.

C: Also direkt, ok.

S: Ja

C: Mhm, wie (unterbricht) Ich mein du warst jetzt während der kompletten Design-Phase quasi bei der App dabei. Wie würdest du selber deine Rolle im Projekt beschreiben? Oder welche, ja, welche, in welcher Rolle siehst du dich selbst?

S: Ja, so als fachliche Inputgeberin. Die Musik betreffend und die Aufführung auch betreffend. Und ich glaub auch, dass, ich mein es hätte ja am Anfang viele Richtungen nehmen können und ich war ja auch recht dezidiert indem wie ichs, wie ich mir eine Anwendung hab vorstellen können und ich denke, dass ich da auch maßgeblich irgendwie so eine erste Richtung vorgegeben hab, aber wie, wo jetzt hin, also wo die Entwicklungskräfte eingesetzt werden. Es hätt ja auch irgendwas anderes sein können. Irgendein Wechselspiel oder weiß ich nicht.

C: Ja eh, deswegen hamma ja (bricht ab)

S: Rein theoretisch,

C: Ja

S: (setzt fort) hätte es ja sein können dass die Leute im Publikum sagen jetzt spiel das und dann kommt irgendwie eine ganz andere Quelle.

C: Mhm.

S: Also, ja.

C: Ja eh, das ist ja auch der Grund warum wir diese Design-Phase quasi gehabt haben.

S: Genau.

C: Damit wir selber schauen was dabei rauskommt. Hat für dich die Zusammenarbeit während der Design-Phase gut funktioniert oder

S: (Zwischenruf) Ja, sehr.

C: (setzt fort) was positive und negative Aspekte?

S: Na ich find. Also ich mein Thomas kenn ich sowieso gut und mit dem arbeit ich immer gern zusammen. Uli kenn ich flüchtig. Jetzt ein bisschen besser. Find ich auch total super. Mit dir hab ich dir eh schon geschrieben, dass ichs toll find wie aufmerksam du bist und es hat auch wunderbar funktioniert. (zögert) Also so das Team quasi find ich sehr gut. Ja

C: Mhm. (zögert) Passt (zögert) Ich schau nur kurz noch ob ich noch irgendwas vergessen hab. (schaut auf den Laptop) Nein, also ich bin generell einmal durch. Ich les dir jetzt nur mal ein paar Auszüge der Auswertung vor die ich bis jetzt gemacht habe. Also es ist, die, ich hab 95 Fragebögen ausgewertet bis jetzt, wobei die offenen Fragen, da kann ich dir nur Auszüge einfach vorlesen. Das hat jetzt statistisch gesehen noch überhaupt keine Relevanz. Das ist einfach damit du mal ein Gefühl hast was die Leute teilweise geantwortet haben.
82 % der Befragten waren zwischen 18 und 24. Das war eh naheliegend. (beide lachen) Nur 14,7 % waren weiblich, (zögert) was irgendwie auch naheliegend war auf der TU. (lacht)

S: Ja, ja

C: 71,6 % haben die App am Smartphone installiert.

S: Mhm

C: 91,6 % hat das Konzept gefallen.

S: Mhm

C: Aber nur 72,6 % können sich vorstellen, dass sie die App auch auf einem Konzert verwenden.

S: Mhm

C: Umgekehrt aber auch (zögert)

S: Eh viel eigentlich. Stell dir vor eine Partei würde in Österreich 72 % (lacht) bekommen.

C: Stimmt, ja.

S: Wär ja der absolute Killer. (lacht)

C: Ja. Aber es deckt sich auch mit der nächsten (--) ganz gut, weil 32,6 % haben gefunden, dass die App bei einem Konzert störend ist. Also es is quasi (bricht ab)

S: Ja

C: Dann Antworten warum sie störend ist waren: Weil die Wiedergabe asynchron ist

S: Mhm

C: (setzt fort) oder, dass es auf die Musikrichtung drauf ankommt obs störend ist oder nicht.

S: Ganz genau. Aber das ist im, das deckt sich eh mit dem was ich gesagt hab. Man muss irgendwas musikalisch sinnvolles damit machen.

C: Ja

S: Also eigentlich mit diesen speziellen, mit diesen Spezifika muss man halt arbeiten und nicht dagegen versuchen, also gegen die Natur der Telefone irgendwas zu machen was nicht gut geht.

C: Genau, ja.

S: Weil, das wird dann nicht (--).

C: Mhm. Ja, manche habens störend gefunden, weil sie die Geräusche komisch gefunden haben. Also ich glaub schon auch teilweise, dass sie, dadurch dass wir kein Konzert gehabt haben, sich nicht wirklich was drunter vorstellen haben können, was, wies dann in Wirklichkeit ist.

S: Ja

C: Ja und einige Leute haben auch gesagt, also das ist jetzt auf die 32 % dies generell störend gefunden haben

S: Mhm

C: Dass sies einfach generell störend finden, wenn sie ein Smartphone während einem Konzert verwenden.

S: Mhm, mhm.

C: Dann 75 % glauben, dass die App das Erlebnis eines Konzertes verbessern kann. Da hab ich dann auch gefragt, warum oder warum nicht.

S: Mhm.

C: Vielen hat das gefallen, dass es halt audience-participation ist oder dass jeder quasi ein Teil des Konzerts ist.

S: Ja

C: Vielen hats gefallen, dass der Ton im ganzen Raum verteilt ist.

S: Mhm

C: Und bei den Lichteffekten ist es so ein bisschen geteilte Meinung. Viele habens cool gefunden. Manche haben aber auch gesagt, dass das Display zu hell leuchtet oder dass es einfach zu viel ist. (lacht) Ja, dann haben auch einige gesagt, dass es, ja gut ist, dass es neu ist oder dass es lustig ist oder dass es cool ist oder solche Sachen.

S: Ja, ja

C: Negativ war, dass die Klangqualität der Lautsprecher schlecht ist.

S: Mhm

C: (setzt fort) oder, ja dass der Sinn der App irgendwie unklar ist. Also manche haben glaub ich relativ schlecht verstanden wozu wir sie überhaupt einsetzen wollen. Oder was man damit machen kann, machen soll während einem Konzert. Ja manche haben auch gesagt, dass es generell störend ist, aber das ist, ja (bricht ab)

S: Mhm

C: 48 % störts, dass sie das Smartphone nicht für was anderes verwenden können. Also jetzt Fotos, Filmen oder SMS schreiben oder so.

S: Mhm, ganz schön viele ja

C: Ja das ist fast die Hälfte ja. 38,9 % hätten sich mehr Interaktionen gewünscht.

S: Mhm

C: Zum Beispiel: Die Farbe aussuchen oder den Sound oder das Instrument aussuchen. Also ich glaub manche haben auch geglaubt, dass das, dass der jeweilige Sound ein Instrument darstellen soll. Oder, dass man das blinken irgendwie steuern kann.

S: Mhm

C: 35 % haben die hochfrequenten Töne gehört. Aber von diesen 35 % haben nur 41 % die Töne als störend empfunden.

S: Ah, ok.

C: Also das sind von der Gesamtmenge dann ca. 15 %.

S: Ja

C: Was ich jetzt nicht so besonders viel find oder. Vor allem da haben wir noch gestern darüber geredet. Wir sind uns nicht sicher, ob sichs die Leute nur teilweise eingebildet haben, weil viele geglaubt haben, dass der (unterbricht) die permanent waren.

S: Einer hat zumindest geglaubt, dass die ganze Zeit waren.

C: Ja. Und dann ich hab jetzt dann noch am Schluss gefragt was den Leuten an der App gefallen hat, was man verbessern kann und welche Probleme, dass es gegeben hat. Gefallen haben, also was ihnen gefallen hat, ham sehr viele gesagt, dass ihnen die Idee oder das Konzept gefällt.

S: Mhm

C: Und sonst, dass man kein Internet braucht, dass die Art der Datenübertragung cool ist, dass es klanglich halt was neues ist, dass man so eine, so ein Gruppen-Feeling hat.

S: Mhm

C: Und, dass es generell einfach zu bedienen ist.

S: Mhm

C: Was man verbessern kann ist, dass es eben noch nicht auf iOS funktioniert hat. Dann, ich glaub manche haben nicht verstanden, dass wir die MP3s mit der App mitliefern, weil viele geschrieben haben, dass, wozu braucht man 77 MB oder wozu braucht man 70 MB. (lacht) beim runterladen

S: Ok, das heißt das könnte man ja dazu sagen, ja?

C: Ja, irgendwie dass mans irgendwie kommuniziert, dass sies verstehen.

S: Damit die Leute das verstehen, ja, dass sies mit Soundfiles kriegen.

C: Manche Leute haben sich irgendwas mit einer Kamera gewunschen, wobei da eigentlich nicht viel mehr dabei gestanden ist muss ich auch dazu sagen.

S: Vielleicht haben sie auch gemeint, dass eben das was wir selber auch eh schon irgendwie die ganze Zeit immer wieder andenken, dass es entweder einen Spiegel gibt oder eine Kamera, sodass sich die Leute selber sehen können oder dass sie das Gesamtbild von den Screens oder so sehen können.

C: Das kann auch sein, dass das Stichwort „Kamera“ in dem Sinne eher gemeint ist, von vorn eine Kamera, dass man die Gesamtmasse sieht und nicht die Kamera selber, aber wie gesagt, dass muss ich dann noch auswerten.

S: Mhm

C: Und auch da ist wieder erwähnt worden, dass mehr Interaktionen oder mehr Funktionen cool wären.

S: Mhm

C: Und was auch nicht so unwesentlich ist: Viele waren irritiert dadurch, dass zwischen den IDs der Bildschirm schwarz ist.

S: Mhm

C: Und es ham jetzt, Sie haben teilweise nicht gewusst, was passiert jetzt, ist die App abgestürzt

S: Ja

C (setzt fort) oder, also da ist auch dabeigestanden manchmal, dass sie in irgendeiner Weise

Information gerne hätten und nicht einfach nur ein schwarzes Display.

S: Versteh ich.

C: Ja

S: Ja

C: Ok, und dann ob es Probleme gegeben hat. Da ist es jetzt schon so, dass (bricht ab) Also ungefähr ich sag mal ungefähr die Hälfte hat gesagt, es hat keine Probleme gegeben. Aber bei der restlichen Hälfte wars doch so, dass es (bricht ab) Also, dass manche gesagt haben, dass ein paar IDs garnicht erkannt worden sind oder dass die App überhaupt nicht funktioniert hat.

S: Mhm

C: Das war vor allem auch, es ist oft dabeigestanden, dass sie als Betriebssystem Cyanogen Mod verwendet haben.

S: Ok, das kenn ich nicht.

C: Das ist einfach eine andere Android Version, mehr oder weniger, auf die wir die App natürlich nicht, für die wir die App nicht getestet haben und deswegen ham wir auch nicht (bricht ab) Ich mein, ich muss auch dazu sagen, ich glaub das gerade in dem Setting was wir dort gehabt haben extrem viele Leute das haben, einfach weil es alles Informatiker sind.

S: Weil es so geeky ist das OS oder wie?

C: Ja, also ich glaub nicht, dass wenn man es in einem anderen Setting testen würde, dann hätten viel, prozentmäßig viel weniger Leute das Betriebssystem.

S: Ja, wahrscheinlich, ja.

C: Ja

S: Was ist das für ein Betriebssystem?

C: Das ist einfach (wird unterbrochen)

S: Wo kommt das her?

C: Wo es herkommt weiß ich nicht, aber man ist nicht mehr so abhängig von Google. Man kann auch Apps von anderen Stores installieren und ist nicht, hat nicht nur diesen Google Play Store.

S: Mhm, mhm

C: Das Betriebssystem ist generell ein bisschen offener auch oder komplett offen quasi.

S: Mhm, ja

C: Ja, hat dich irgendwas besonders überrascht jetzt bei dem Ergebnis oder fallt dir noch irgendwas noch dazu ein?

S: Na, hab ich eh schon gesagt, also dass es mit so vielen, also 10 mal mehr Telefonen so viel leiser gewirkt hat. Das hat mich schon sehr überrascht.

C: Mhm.

S: Ja, aber (zögert) na, sonst hab ich schon alles (lacht) gesagt.

C: OK.

S: Also jetzt bei den Ergebnissen vom Fragebogen hat mich eigentlich gar nichts überrascht. Ich find das deckt sich ganz gut, bis auf die Sachen die ich halt nicht einsehen kann wie ob eine App funktioniert oder nicht auf einem bestimmten Handy oder einem bestimmten Betriebssystem.

C: Ja

S: Ja, ich mein das überrascht mich auch nicht, wenn die Leute irgendwie den Sinn nicht verstehen (lacht) von der App, wenn das, weil uns der Sinn glaub ich selber noch nicht, also mir wie gesagt auch nicht 100 %-ig klar ist. Oder wie das dann genau in ein Konzert eingebaut wird und

C: Ja

S: (setzt fort) insofern überrascht mich das auch nicht.

C: Ich glaub auch, dass (bricht ab)

S: Weil du kannst auch die App nicht, wenn du alleine zuhause bist, was machst du mit der App? Kannst ja auch nix machen.

C: Ja, das stimmt. Ich glaub auch, dass generell die Leute wenn sie, also ich könnt mir das so erklären, wenn sie die erste oder die ersten 2 IDs aus irgendeinem Grund nicht bekommen haben, weil sie zum Beispiel ganz hinten gesessen sind, dass sie dann generell einfach die App zugemacht haben und hingeschrieben haben: Es funktioniert nicht. Wobei sie in Wirklichkeit vielleicht die dritte ID eh bekommen hätten

S: Ja, (--)

C: Aber das können wir ja nicht sagen,derzeit. Ich hab auch während dem Konzert, oder während dem Test quasi, nachdem ich selber hinten, nach ganz hinten gegangen bin und gesehen hab, ok hinten funktionierts doch noch relativ schlecht, bin ich wieder vor und hab noch ein Stückl mehr aufdreht und ich glaub dann hats schon besser funktioniert.

S: Mhm

C: Aber das ist halt jetzt schwierig herauszufinden, schlussendlich.

S: Ich mein das wär vielleicht noch eine Geschichte. Wenn jetzt schon Leute die App haben, was sie dann machen, wenn sie nicht am Konzert sind damit. Also was, können die reinschauen, können sich die zum Beispiel die Soundfiles anhören, können die sehen, dass da Soundfiles drinnen sind. Also das wär noch eine Überlegung für dich als Entwickler.

C: Mhm, dass man generell einfach ein bisschen mehr aus der App macht und nicht sagt: Ok, man kann sie nur auf einem Konzert verwenden

S: Ganz genau.

C: (setzt fort) und sonst ist sie komplett nutzlos quasi.

S: Ja, (-) dass die Leute, was weiß ich, dass man sagt die Soundfiles sind unter einer CC Lizenz und können die für nicht-kommerzielle Zwecke weiterverwenden, wenn sie wollen. Dann müssten sie aber auch Zugriff auf die MP3s haben.

C: Mhm

S: Dann ist es eine Einladung zu basteln. Sowas wär eigentlich ganz nett noch zusätzlich.

C: Ja

S: (setzt fort) weil man eh davon ausgehen kann, dass sehr viele Leute irgendwie mit Soundfiles herumspielen im allgemeinen (-).

C: OK, ich glaub auch generell, dass es vielleicht für die Leute interessant ist, wenn sie sich die Files vorher anhören

S: Mhm

C: (setzt fort) und sich eigentlich dann, gerade vor dem Konzert nichts drunter vorstellen können und dann erst wenn sies auf dem Konzert sehen, aha ok, es macht irgendwie doch Sinn.

S: Mhm, ja. Jaja, also ich find das sollte man nicht irgendwie total obskur halten, sondern so transparent wie möglich machen.

C: Mhm. Na gut, passt, dann sag ich danke!

S: Ok, gerne. (beide lachen)