# Designing Playful Interactive Installations for Urban Environments – The SwingScape Experience

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**Abstract.** This paper discusses design issues in the development of playful outdoor interactive installations featuring kinesthetic interaction and immersive music experiences. The research is based on the development and evaluation of the novel SwingScape installation, which is a permanent installation at an urban playground. The objectives of SwingScape are to encourage physical activity as well as creating a playful and social experience in an urban space. The interaction techniques include movement sensors built into swings, LED lights, and an ambient loudspeaker system covering approx. 180 square meters. The design issues include: creating playful and collective interaction, making a familiar swing interaction simulate the experience of a music mixing board, providing gentle integration of multimedia (light and sound) in the atmosphere of an urban space, and finally making installations robust and safe for an urban outdoor setting. The SwingScape installation has been developed in three phases for quite different urban settings, and the experiences from these are generalised to contribute to a foundation for design of interactive urban installations.

**Keywords:** Interactive light and sound installation, urban environments, outdoors settings, collective and playful activities, familiarity, user experience.

## 1 Introduction

The research behind this paper has taken place within the context of long-term activities in the city of Roskilde, Denmark, where the goal has been to develop and explore interactive playful installations in urban environments.

Physical space in urban environments can be seen as two extremes of a spectrum: those consisting of large distances, which induce feelings of coldness and grandeur and those of small distances, which call for intimacy and privacy. However, most contacts often take place in the in-betweens, the semi-private, and the half public. Therefore, SwingScape is an interesting example of an interactive urban installation, challenging the traditional urban space by creating opportunities for collective interaction in the zones in-between.

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During this process, the SwingScape installation has been developed and evaluated in various urban contexts; Roskilde city (at the Winter Festival) (see Figure 1), Roskilde Festival, and at PIXLpark – a raw industrial area in Roskilde. These experiences have lead to a number of generalisable findings that will be valuable for future designers of interactive multimedia installations for urban environments.

The final SwingScape installation consists of a large 180 sqm scaffolding setup with eight traditional swings equipped with movement sensors, and an ambient light and sound scape controlled by the swings' movement. The installation consists of two zones that illuminate in different colours when people swing.

**Fig. 1.** The SwingScape installation

The authors of the paper have been responsible for the development of the installation as well as the following evaluations among users. The development has taken place in close collaboration with the organisations in Roskilde, who are responsible for the future operation of the installation in the context of PIXLpark together with a number other installations and mobile games.

In [10], the notion of "interactive spatial multimedia" is introduced to denote multimedia integrated in the physical architectural environment, i.e. modern instantiations of Krueger's classical Responsive Environments [12]. In [10] there is a proposal for specific techniques aiming at developing such installations for art museums. This paper extends these ideas to an urban context, and proposes concepts and design parameters to address interactive multimedia installations in urban contexts.

The paper is structured as follows: Section 2 briefly reviews related work. Section 3 introduces design principles and interaction techniques. Section 4 describes how we implemented these principles technically in the final SwingScape installation. Section 5 discusses lessons learned based on qualitative evaluations of the various setups of SwingScape. Section 6 discusses challenges to consider when designing interactive installations for urban environments. Finally, section 7 concludes the paper.

## 2 Related Work

The focus of this paper is the synergy between: urban environments, familiar playful interaction, and aesthetic and kinesthetic interaction. While numerous installations exist for urban environments [4],[16],[5] only a few of these focus on large-scale physical installation based on interaction through familiar artefacts. In the following, we will highlight a few works of particular interest due to affording plain interaction.

Inspiration from urban domain was, e.g. Pianotrappan [15], which enhances stairs in a subway with analogue graphics defining each step of the stairs as piano keys. When walking on the steps a referring note is played, thus users play the stairs as a piano. The concept of adding sound and visual identity to familiar stairs, encouraging people to use stairs rather than escalators, was a great source of inspiration to us. Another project from the domain is "PLAYorchestra" [16], which inspires collective use and thus transforms the aesthetics of the urban space. By sitting on different cubes, individual instruments are played as part of a common classical music piece. As being a part of the urban space these installations facilitates collective interaction and hereby supports the behaviour and the atmosphere of this space. The earlier work on aesthetic interaction [14] has in the project been used as a way of stimulating multiple users to create a collective music experience beyond what is possible for an individual.

With regards to a movement-based perspective, kinesthetic interaction [5][9], concerns the bodily user experience. In projects such as Run Motherfucker, Run [18], Explosion Village [5] and Rope in Space [17] where all inspiring. Run Motherfucker, Run utilises a treadmill as means of interaction demanding high physical activity from the users. Rope in Space utilises a physical/virtual tug rope, which congregates competitors, still maintaining the high physical level of activity. The concept of Explosion Village is to interact collectively by hammering on barrels, and thus be rewarded by the appearance of a huge flame. In these three projects, the kinesthetic interaction establishes engagement and the activity becomes a motivating factor per se.

Regarding familiar interaction, e.g. PingPongPlus [23] has been of interest. It utilises ordinary ping-pong paddles and balls, where the table is digitally enhanced into a reactive table that senses the ball and supplies auditory and visual feedback. SMS Slingshot [20] draws likewise on the familiarity aspect by utilising a slingshot. An SMS is being sent to a wall by using the known actions of shooting a slingshot. In both projects the users find no difficulties in interacting due to the familiarity and direct simple ease of use.

In the SwingScape project, we were inspired by the manner in which the above projects worked with the urban space and directly addressing play and joyfulness as a means of motivating to interact. Furthermore, the deliberate use of familiar artefacts as the primary point of interaction and enhancing the experience with sound and light was the fundamentals of SwingScape.

## 3 Design Principles and Interaction Techniques

SwingScape is an interactive installation with the aim to revitalise urban spaces by: 1) motivating people to outdoor activity even in cold seasons. A main source of

inspiration for this was the ice skating rink, which is a traditional popular outdoor activity in winter time; 2) creating familiar interaction similar to skating and swinging; 3) creating a collective installation, which invites people to join in and let go of their usual behavioural patterns; 4) creating a landmark to draw attention among users.

This focused the design on simplicity and playful interaction embracing social and collaborative atmospheres. The idea was to investigate how these objectives could be obtained by utilising light and sound as the main forms of expression in order to affect the manner in which we act in public environments.

The installation was originally developed for a specific city plaza in the city of Roskilde, Denmark. The plaza is placed in between routes of movement and can therefore be seen as a dynamic meeting point for both people passing by on a bike, by car or by foot. Thus, physical movement and dynamics around and within the installation has been the starting point of the design.

During the transformation from event to permanent installation, we undertook various experiments, e.g. numbers of swings, physical space around them, and adding and subtracting soundtracks to swings. The original version of SwingScape consisted of ten swings - each with different soundtracks as part of a sonic universe. Five of the swings control tracks with beats, and the remaining five control tones of the music. In the following, we discuss design objectives in detail.

### 3.1 Familiar Playful Interaction

With the above objectives as a starting point, we focused on developing a concept with base in a known and familiar interaction – rocking a swing. The swing is a familiar artefact for most people from their childhood. Using intuitive interaction, SwingScape was supposed to appeal to a wide range of users: children using it as traditional swings, teenagers pushing the swings and using them as a jukebox, adults experimenting with the different tracks, and elderly resting their feet whilst slowly rocking the swing.

When interacting with SwingScape, the user is able to affect the visual and auditory universe by utilising the different swings. The sound from the swing on which the user finds herself, is predominant in the users sonic feedback, making the audio experience in each swing area unique depending on which has been chosen. Together with other people, the user can consciously create a remix of a song by planning which swings to use. Furthermore, the simplicity of the changing lights has clear references to the dynamics of computer games, where the user is familiar to visual feedback when making a move.

### 3.2 Aesthetic Forms of Expressions

In [14] the notion of aesthetic interaction has been introduced to focus on the forms of expressions that add emotional values to the use experience. When developing installations for urban spaces, new opportunities and challenges for aesthetic expression are revealed compared to indoor use, for example, in museums.

One of the aims of SwingScape was to draw attention and invite citizens to take part in a collective experience and use the urban space in new manners. The intention was to make SwingScape work whether it is experienced within the installation (immersed experience), just outside, or far away from the installation (see Figure 2).

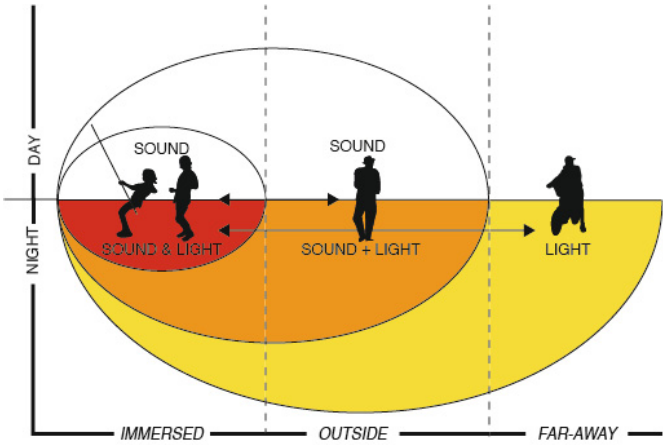


**Fig. 2.** Aesthetic forms of expressions in SwingScape and their zones of effect

**Sound Expressions**

A major parameter in relation to creating an aesthetic experience in the urban space has been the soundscape. Primarily due the fact that sound is audible all times a day in contrast to light, which only is an efficient form of expression at night.

The ambition was to develop a music installation in harmony with the kinesthetic experience, i.e. not compromising with the sonic experience. A cooperation with a musician from the electronic music genre was therefore made early in the process.

**Fig. 3.** A) SwingScape seen from far away. B) SwingScape seen just outside.

One of the primary design objectives was to experiment with how to create a meaningful interaction between the kinesthetic of the body and music - the movement of the swing acts like a metronome in music setting the pace, which influenced the

development of soundscapes. Further investigations of the intrinsic rhythm of the swings revealed different tempi that worked really well and this was incorporated to the development of the soundscapes. As a means of motivation, the sound was designed such that the volume increased concurrently with the height of the swings.

Going from being a temporary to a permanent installation, new expectations to the soundscape have emerged. Now, the soundscape is much more varied and the users of the installation have the possibility to make their own custom soundtracks.

**Light Expressions**

Using light as a form of expression was in this context powerful due to the long dark hours during the Scandinavian winters. To make a successful installation, motivating people to take a detour past the centre of the city, it was important to work with lightning, which could be seen from far away.

The installation works as a landmark through use of light (see Figure 3.A). By being a visual landmark one's attention is attracted from a distance, and you are guided to the installation as by a lighthouse. The experience already from the longer distance builds up your expectations. (Figure 2 – "far away", Figure 3.A). Getting closer to SwingScape, you are invited into an experience space where you can be a part of the sonic universe from a spectators view (Figure 2 – "outside", and Figure 3.B).

**Fig. 4.** The immersed experience

As you enter the installation you experience how the light creates a fictive demarcated room giving you the conception of being "inside" a smaller room (Figure 4).

The light tubes are connected to the frames of the structure and hereby highlighting the borders of the installation. By highlighting the borders, the physical boundaries are emphasised which states the clear demarcations of being inside or outside the installation – and more importantly creating a space toned with unnatural light (blue and green colours). Light also brings another aspect to the installation. During At night, a challenge in urban space is often that the darker areas create a feeling of insecurity. The intentional use of lightning may bring safety to the urban space and hereby enhance the motivation for using the installation.

### 3.3 Collective Use of the Installation

The installation is made to bring people together, motivating them to move, and to interact with sound and light in the urban space. The installation works well if a group of 3-4 people, who know each other, wish to experience it. They can activate a small number of swings and collectively move between different swings to experience various combinations of beats and melody tracks.

Single users get a limited experience of being able to activate swings by hand and move between zones within the short timeframe that an unmanned swing use to fade to silence. Thus, the installation invites users to communicate and interact collectively, ideally making single or dual users call for by-passers, to extend the experience.

### 3.4 From Temporary to Permanent Use

SwingScape was created for the Winter Festival 2010 in Roskilde, which was on for two nights. Five months later, the installation was re-established at the music event, the Roskilde Festival, where it was exposed to 90.000 visitors for four days and nights, and finally, SwingScape was recently made into a permanent outdoors installation as part of a digital playground in Roskilde.

**Winter Festival 2010**
As mentioned above, SwingScape was developed for the Winter Festival (also called the "Ånd- og Videnfestival" - translation: "Spirit- and Knowledge Festival") in the centre of Roskilde in February 2010. The context was Roskilde city and it was supposed to reach a wide target group – all citizens of the city.

There were ten physical swings and the floor was covered with a green turf, which together with the wooden swings was supposed to refer to and bring warm associations to summertime, and was at the same time meant to be a contrast to the otherwise cold and rough urban surroundings. The choice of materials was together with the sound- and light design important for creating the aesthetic experience of the installation in order to attract citizens. The Winter Festival only lasted two nights, and the installation was supervised by two guards 24/7.

**Roskilde Festival 2010**
The installation was in summer 2010, re-established at the Roskilde Festival, which is an interesting context for testing new urban concepts. During the festival event, it is one of the largest temporary cities in Denmark; approximately 40.000 visitors intensively used the SwingScape installation day and night.

Compared to the first context, where it was only supposed to run during the nights, we were now challenged to make a new setup, which could work during the day as well. It is almost impossible to compete with the sunshine when coming to light, and therefore we found it important to unfold the audio experience even more. Another audio setup was created, being more "dreamy" and acoustic than the first one made for the Winter Festival. After one day, we realised that mixing the two setups gave the best result – giving variation to the soundscape 24/7. Furthermore, modifications to the floor were made, to obey to safety regulations a heavy rubber floor was laid out.

**PIXLpark 2012**

Recently, SwingScape was setup permanently in PIXLpark – a digital playground in Roskilde. This context is an old concrete factory and the surroundings are grey, industrial and raw. SwingScape was chosen for the digital playground, because of the duality of being a raw stabile, industrial construction during the day and being a strong, atmospheric landmark during the night-time. The centre of the swing area is set to always be lit, and gives a feeling of security to the area. For the permanent installation, a third sound scape setup was developed. This one being more a kind of a "sound puzzle", with animal sounds and realistic sounds inspired by nature. In PIXLpark, there are also offices where people work and it has therefore been important to work with a soundscape being interleaved in the natural surroundings. Finally, the Danish playground legislation required some adjustments of the physical construction.

## 4 Swingscape Technical Implementation

This section describes the SwingScape implementation in terms of infrastructure, sensors, light and sound control tools. Figure 5 shows SwingScape infrastructure and components. One swing cell is shown, while all indoor parts are shown in a grey box.

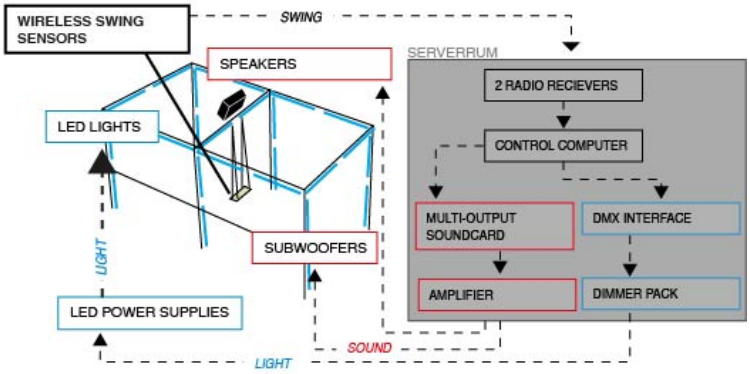


**Fig. 5.** The SwingScape technical infrastructure

### 4.1 Swing Seat Sensors

Battery operated wireless accelerometer sensors are placed in a cavity inside each (polyethylene) swing seat, protecting the electronics and making the swings appear ordinary to the public. Action starts when one or more of the swings are moved – accelerometers detect motion, a microcontroller will perform signal analysis and transmit MIDI note commands over 2.4 GHz radio to one of the two receivers. The corresponding radio receiver passes received MIDI commands to the control computer.

### 4.2 Light and Sound Control

The control computer will according to pre-programmed schemas activate the lights and sounds that correspond to the activated swing(s) in the current soundscape. The overview shows two signal chains – one for sound (red) and one for light (blue). The multi-output soundcard is connected to the amplifiers and speakers for each swing plus the subwoofer. The DMX interface is followed by a DMX dimmer pack and low voltage LED power supplies for the LED light strips that surround each swing cell. This system architecture allows all content (sound and light) to be defined in software at any time and also provides easy access to various computer generated usage data.

### 4.3 Radio System Issues

Initially, the seats were made of wood, which during dry weather worked fine. However, rain caused problems in terms of poor radio performance - caused by water turning the swing seats and the surrounding surfaces into radio absorbers. In turn, the dual AA alkaline batteries inside the swing seats started running out of power too quickly due to automatic increase in radio communication. Thus we had to replace the wooden seats with new polyethylene seats, as well as the two AA batteries in the seats with a single lithium 3.6V AA cell, and finally mount the sensors in IP67 sealed boxes inside the seats. This solved the radio problems.

## 5 Evaluation from Two Different Settings

The SwingScape installation has been evaluated qualitatively through video observations and interviews at the Roskilde Festival and in PIXLpark. The aim of the evaluations was to examine the use case and experiences of the installation. In the following, we describe in brief how we evaluated the user experiences from the Roskilde Festival and provide more details on how we did it in PIXLpark, as well as what results we got from the evaluations. Presentations of results focus on four focal points:

1) Playful Interaction (What are the users doing? I.e. what do they say they do, and what can we observe they do on the videos?); 2) Experience (What did the users experience? And how did they like the installation and the atmosphere in it?); 3) Collective communication (Did the users communicate with others when using the swings, and if so, how? Did they communicate with strangers? And did they see it as a social or individual experience?); 4) Understanding & Familiarity (Did the users understand the concept of the installation? For example, did they understand that what happened depended on what they did? And did they ascribe a familiarity to the installation?).

### 5.1 Evaluations from the Roskilde Festival

During the four festival days, twelve explorative interviews were conducted. Each interview had 1-3 interviewees, whom were addressed immediately after having tried the installation. The users were video recorded while swinging and the following

interviews were recorded on a dictaphone. The evaluation was carried out at different times of the day to see how that would inflict upon the users' overall experience.

We strived to interview users in different age segments and group sizes. The age span was from 17-53 years; however, most of the interviewees were in their twenties (the average was 26 years of age). In order to practically manage the interview, which was at a noisy location close to the installation, we found it important that the groups were not too big. The duration of the twelve interviews was 9 minutes in average (5:10 minutes to 13:18 minutes), and the users were rewarded with a ticket for a beverage. The interviews were semi-structured. First, the users were asked factual questions, such as how long they had tried SwingScape, and if they had tried it more than once. Following this, the interviewees were asked about their usage and impression, as well as questions regarding their communication and understanding.

**Playful Interaction**

Observations and interviews revealed that users spent 3-10 minutes in the swings after being in queue. In turn, they often ran up on the platform and grabbed the nearest swing. If they where there with others, they would choose swings opposite one another if possible, facing each other. Video observations showed that the swings at times were used by more than one person, thus making them social and playful artefacts. Most people would only try one swing, as all of the swings were in use constantly. Thus, the users did not experiment with several swings and many did not notice that they were creating the sound. When users were asked what they did, most of them said that they tried to swing as high as possible. Furthermore, those who were there with others said that they were looking at each other, and a few said that they tried to swing in time with each other.

**Experience**

When asked for immediate reactions, eight of the interviewees said they felt like a child again. Two groups said, that they "lost track of time". In addition, most of the interviewees found the installation relaxing, and four mentioned that they liked the breeze then swinging. Those who had tried the installation both at night and in daylight said that they liked it better at night due to the lights, which were much more predominant in the dark. Furthermore, the swings were less crowed at night, which the users liked. At day, many were turned off by the long queue, and thus, most of the interviewees had only tried the installation once.

**Collective Communication**

The users did not talk much when using SwingScape. However, if others they knew were present, they were conscious of what they did; e.g., whether they would initiate a competition for the highest swing. Furthermore, the users were asked if they perceived it as an individual or a social experience. In four of the interviews, the answer was 'individual'; in three it was 'social', and in the remaining five it was both. Even some of the users who were there with someone they knew would say that the experience was individual, because "You fall into your own world". None of the interviewees talked to strangers when swinging. Some said they liked relaxing and

swinging by them selves. Others thought it was a social experience because they were there with others. “It wouldn’t have been as fun without my friend”, said a 21-year-old girl, and two 29-year-old guys said they wouldn’t have used the swings if they were alone.

**Understanding and Familiarity**
With regards to the users’ understanding of the installation and concept, it was clear that no one knew that they themselves created the music. Due to the fact that all seats were continuously occupied and that the users swapped seats a few at a time (instead of all at once), the installation was mostly regarded as “the cool swings with the music”. Thus, the swings themselves were a familiar concept; however, mixing music when using them, was not easily comprehended in the given context. Many paid compliments to the music, however, a few did not even notice the music due to a concert nearby, and none of them experienced that the volume increased concurrently with the height of the swings. The lights were only noticed at night and not that they followed the movement of the swings. At night, the lights were predominant, and at day, the music was what people noticed (except when there were concerts close by). Most of the interviewees were surprised when they learned about the concept and logic after the interviews. However, in spite of the lack of understanding, the swings were very popular at the festival. They were mainly seen as a place for relaxation and fun.

## 5.2 Evaluations from PIXLpark

Since the opening of PIXLpark, we have conducted an evaluation with video observations and four explorative interviews in daylight. Each of the interviews had 1-4 interviewees aged between ten and 39 years. Group 1 consisted of four people between 16 and 24, who had visited the installation 5-6 times before. Group 2 was a couple in their late thirties with a 10-year-old daughter, who was there for the first time. Group 3 consisted of four 13-year-old boys, who had tried SwingScape on several occasions, and the fourth interview was with a 21-year-old man, who visited the installation with two others for the first time. The duration of the video recorded interviews, were 8:30 to 10 minutes. The interviews were semi-structured. To compare the answers with those given in the interviews at the Roskilde Festival, we took the same interview guide as a starting point and only made smaller adjustments to fit the new context.

**Playful Interaction**
Both the video observations and the interviews revealed that what the users did after sitting down and starting to swing was to experiment with the installation. Most of them tried out other swings and communicated with other users verbally or non-verbally about which ones to try. Group 1 said that they “…started to use signs with the body to communicate and plan which types of music they wanted to make by selecting the right swings”. The interviewee in the fourth interview said “Just moving from one swing to another is quite an experience in itself”. The family (group 2) also experimented with other swings; however, not until they had the whole installation for themselves, because they were afraid of disturbing other users. Further, group 2 said

that they competed on who could swing highest; though this objective was less general than in the Roskilde Festival interviews. On average, the users spent approx. 25 minutes in the installation at PIXLpark.

**Experience**

All of the interviewees were excited and found that SwingScape was great fun. The young ones in group 1 were initially surprised that the swings were accompanied by sounds, but they quickly discovered how to collaborate on creating music. Group 2 said: "There is a nice atmosphere in the installation. It feels a lot like walking into some kind of space". Initially, group 2 did not think of the swings as being "active" as they called it, and were positively surprised when they discovered the sounds when they commenced swinging. The teens in group 3 thought SwingScape was "awesome", they particularly liked the sound changes, making it exciting for them to return "wondering which sounds are on today". Furthermore, they liked the direct response from the swings. However, sometimes they were unable to distinguish the sound from their own swing. The father in group 2 also thought the auditory variation between swings was fairly subtle. The young man in the fourth interview also enjoyed the experience very much and thought it was "different". Even though it was his first visit, he had a good grasp of the concept: "It seems like it plays louder and louder, the more you swing. And it plays different sounds… it kind of makes a tune. Then perhaps, one plays a bit more drums and one more the guitar. I think it's super cool".

**Collective Communication**

The interviewees were asked, if they thought of it as a social experience or as an individual experience. All of the groups except the family (group 2) thought of it as mainly a social experience or that it was more fun when they were more than one. The father in group 2 thought it was both, and that it would have been easier to explore the installation on his own. He thought he would have discovered the variations in the sounds had he not been obliged to push his daughter on the swing. However, he also liked to be more people "to find a sense of oneness with others". Group 2 did not talk much during use, as they preferred to listen to the sounds. The young people in group 1 mostly communicated through body language, because they found it hard to make themselves heard above the music. But when they spoke, it was about composing a great tune. In addition, they would not just enter SwingScape without asking, if others used it. One of the teens in group 3 had tried SwingScape on his own, but enjoyed it much more when trying it with others: "It is more fun when you can play tunes". As was the case with group 1 and 2, the teens did not talk much, except about the music composition: "You would say 'wow that sounds cool. Try that swing over there!'". In addition, they thought it was quite cosy despite the fact that they did not talk much. The 21-year-old man in the fourth interview also thought of it as a great social experience, and that he would bring his family there for future birthday parties and the like.

**Understanding and Familiarity**

The understanding of the SwingScape concept was visible both via body language in the videos, and in the utterances of the users' when talking about their actions and

experiences. Firstly, no one had doubts that they were intended to be swings, but that they were not ordinary swings. We asked them explicitly if they experienced something different depending on what they did; and what they thought the logic was behind the technical part of the installation. Contrary to most of the interviewees at the Roskilde Festival, all of the interviewees at PIXLpark understood that they were initiating and collaboratively controlling the sounds. In addition, groups 1, 3 and 4 also discovered the soundscape change. Group 2 and 3 even had a quite accurate explanation of the technical construction. However, in broad daylight (as in all of the interviews), it was difficult to see the lights of the installation and that it would follow the movements of each swing. Only the teenagers who had been there on numerous occasions (one could see the installation from his bedroom window) knew that, and especially liked it in the evening, "because then it is really cool - because there are lights".

Finally, each group was asked about their opinion of the main concept. All groups interpreted the installation as either a musical instrument, a playground or as a combination of the two. Further, despite the swings, they did not consider it as a children's installation, but that it embraces a broader target group due to the musical experience and atmosphere. To conclude, the evaluations have pointed to the fact that there have been challenges in making such a large-scale interactive urban installation, and that these challenges have differed from one setup to the other. Thus, the next section will deal with these challenges and discharge into generalisable do's and don'ts.

## 6 Challenges for Interactive Urban Installations

Based on the development experiences and the evaluations, we discuss important challenges that we dealt with and that are applicable in general for urban installations.

**Challenge 1: Immersive Sound may Disturb City Life.** The purpose of the installation is to give users a playful and immersive music experience. This requires fairly loud music; however, for urban spaces with quiet living and office areas this may lead to unwanted noise and disturbance. Thus, it is necessary to calibrate music and sound levels to the given context.

At the Winter Festival, where the installation was placed at a fairly quiet square, the sound was calibrated to create attention about the installation at the square, such that by-passers not able to see the installation would be dragged by curiosity from the sound to get to the installation. Here it is a challenge to create such attention without being too noisy and also to create attention when nobody was activating the swings.

On the contrary, at the Roskilde Festival, the surroundings were very noisy by music coming from several competing scenes in the neighbourhood. Also, all the swings were in almost continuous use, making it hard to experience the activation of different tracks. In this context, the volume has to be loud and the subwoofer turned up, and much of the interactive experience comes from the light feedback, making the sunny daylight experience become hard to interpret as an interactive experience at all. Several interviewed users reported that they felt they were swinging to the music and not in fact creating the music and light experience.

Finally, PIXLpark, is an open space, and the sound can affect living areas in the neighbourhood relatively far away. Thus, the sound volume has to be adjusted to not make noise for the living areas. Running the same few tracks will create a too monotonic sound experience for neighbours. Thus, several different soundscapes were made to choose among, where some are more melody oriented and less beat oriented. The sound should gently invite people from the living areas to come down and use their bodies to experience and change the music experience. A lot of young people pass by the installation everyday – a motivation for them to stop and try the swings out, is to offer a change of soundscapes from time to time.

**Challenge 2: Light Expressions Degrade During Daytime**. Light is a great tool for creating atmosphere in an interactive installation. But working with light in an urban installation will always be a challenge, thus it is next to impossible to compete with the sun. This gives the installation two expressions; one at day, and another at night. Therefore, it is important to work with another effect to draw attention to the installation during daytime.

**Challenge 3: Obtaining Outdoor Robustness and Safety 24/7**. Making an interactive installation robust and reliable enough to withstand all kinds of weather and vandalism is an immense challenge. Numerous physical adjustments of the first design were made along the way. For instance, to obtain an approval in relation to formal playground rules for a permanent installation, a lot of safety measures in terms of foam and falling surfaces have been added. Lighting devices have been made stronger and more sealed to be able to last in all sorts of weather, the scaffold welded together to manage the potential rough use of it and secured flooring to carry weight from returning jumping around. Finally, the seats that contain the radio to communicate sensor data to the controlling computer had to be replaced from wood to a plastic material. This was due to the fact the wooden seats absorbed too much water hindering the radio communication making the energy consumption of the senders going up and in turn require frequent battery exchange.

**Challenge 4: Too Many and Too Few Concurrent Users**. Being too many users, i.e. all swings being occupied, limits the experience - the variations in the mix of tracks are hard to hear even though swings are used in varying manners. It is therefore a challenge to create a balance where the interaction technique actually makes people go off swings after having used them for some period of time and at the same time provide the feeling of freedom and control to the use. The size of the installation may influence the collective use patterns. It remains to be analysed whether people are reluctant to approach the installation and disturb others even though there are vacant swings. With a relative short distance between swings, some people may think they disturb the comfort zone of others by sitting on a swing. More evaluations are needed to analyse such use patterns and provide knowledge for future designs.

**Challenge 5: User Contributions versus Aesthetic Control**. A general challenge for interactive works of art, narratives and designs is how much freedom should the user have when it comes to the level of contributions and options of action? This question is contradicted with the question of how to make an aesthetic coherence in

the installation, which is pleasurable for the user to engage with? The more control the designers have over the installation, the more coherent and exciting the experience may become. On the other hand, the higher level of interactivity the users experience, the less controlled and coherent the experience may become [11]. For future versions of SwingScape, we consider opening up for users to submit soundscape compositions via a moderator, who assesses the submission similar to App store verification, and if it meets requirements, it may become an option in the installation. Such features have so far been omitted, because they require extra interaction for users to choose among compositions and recordings, and mechanisms to avoid intrusive playback or invocation of user compositions overruling the choices of others.

## 7 Conclusion

This paper has described and discussed design issues for the development of outdoor interactive multimedia installations combining playful kinesthetic interaction with light and sound feedback as the aesthetic forms of expression. The research is based on the development of the novel SwingScape installation, which is now a permanent installation at an urban playground. The objectives of SwingScape were to encourage people to become physically active in a playful and social atmosphere in the urban space. The design issues discussed include: creating playful and collective interaction, gentle integration of light and sound in the atmosphere of an urban space, and making installations robust and safe for an urban outdoor setting. Evaluations of the SwingScape experiences discussed stemming from two quite different urban settings show that the design objectives have been largely fulfilled, and the principles and challenges may be generalised to future design of interactive urban installations.

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