



CHALMERS
UNIVERSITY OF TECHNOLOGY



UNIVERSITY OF GOTHENBURG



Designing applications for enhanced experienced atmosphere

Guidelines for design of smartphone applications applied to user experiences in the physical dimension

Master's thesis in Computer science and engineering

DANIEL AHLQVIST and RASMUS ANDERSSON

MASTER'S THESIS 2019

Designing applications for enhanced experienced atmosphere

Guidelines for design of smartphone applications
applied to user experiences in the physical dimension

DANIEL AHLQVIST and RASMUS ANDERSSON



UNIVERSITY OF
GOTHENBURG



CHALMERS
UNIVERSITY OF TECHNOLOGY

Department of Computer Science and Engineering
CHALMERS UNIVERSITY OF TECHNOLOGY
UNIVERSITY OF GOTHENBURG
Gothenburg, Sweden 2019

Designing applications for enhanced experienced atmosphere
Guidelines for design of smartphone applications applied to user experiences
in the physical dimension
DANIEL AHLQVIST and RASMUS ANDERSSON

© DANIEL AHLQVIST and RASMUS ANDERSSON, 2019.

Supervisor: Mafalda Samuelsson-Gamboa, Department of Computer Science and Engineering
Advisor: Markus Ruotsalainen, Liseberg AB
Examiner: Staffan Björk, Department of Computer Science and Engineering

Master's Thesis 2019
Department of Computer Science and Engineering
Chalmers University of Technology and University of Gothenburg
SE-412 96 Gothenburg
Telephone +46 31 772 1000

Cover: Collage of concept photos for the application presented in the report.

Typeset in L^AT_EX
Gothenburg, Sweden 2019

Designing applications for enhanced experienced atmosphere
Guidelines for design of smartphone applications
applied to user experiences in the physical dimension
DANIEL AHLQVIST and RASMUS ANDERSSON
Department of Computer Science and Engineering
Chalmers University of Technology and University of Gothenburg

Abstract

This master's thesis report presents the process behind the definition of fifteen guidelines for design of smartphone applications applied to user experiences in the physical dimension. User experiences in the physical dimension comprises experiences limited to certain locations, for instance theme parks, museums and exhibitions.

To define guidelines for the presented topic, a project related to it was executed. Stakeholder for the project was the amusement park Liseberg in Gothenburg, Sweden, and the goal was to create an application to enhance the experienced atmosphere of the themed areas in the park.

The report starts with definition of the problem, related theory and methodology. Thoroughly, the process of the project, the final product, the evaluation of it and insights are described. From the insights of the process and product evaluation, guidelines and factors impacting the experience were derived. The list of guidelines and factors are presented as the result of the report, followed by a discussion.

The guidelines are created as help for other designers who are creating smartphone applications for physical experiences. Additionally, the list of factors that could have an impact on the experience are generally focusing on the context of theme/amusement parks.

Keywords: user experience, atmosphere, theme park, interaction design, smartphone application, guidelines, enhanced experience

Acknowledgements

We would like to send our biggest gratitude to our academic supervisor Mafalda Samuelsson-Gamboa, for being incredibly helpful during the entire course of the project. We would also like to send a big thank you to our advisor from Liseberg AB, Markus Ruotsalainen, for supporting us during the project and letting us use your facilities as office. Last but not least, we would like to thank Klara Sundqvist at Liseberg AB, for helping us out with various tasks, including printing, opening doors when we were locked out and taking photos of us.



Daniel Ahlqvist and Rasmus Andersson, Gothenburg, June 2019

Contents

1	Introduction	13
2	Background	13
2.1	Research problem	13
2.1.1	Research question	14
2.2	Limitations	14
2.3	Definition of 'physical atmosphere'	15
3	Related work	16
3.1	The official Liseberg application	16
3.2	Helix	16
3.3	AeroSpin	17
3.4	My Disney Experience	17
3.5	Play Disney Parks	18
3.6	Brick City Tours	18
4	Theory	19
4.1	Relevant concepts	19
4.1.1	Design approach	19
4.1.2	Interaction design	19
4.1.3	User experience	19
4.1.4	Visual profile	20
4.1.5	Emotional design	21
4.1.6	User interface	22
4.1.7	Look and feel	22
4.2	Related research	22
4.2.1	Rich emotions	22
4.2.2	Amusement parks services	25
4.2.3	Amusement park experiences	26
5	Methodology and tools	28
5.1	Understand phase	28
5.1.1	Literature studies	29
5.1.2	Atmosphere scanning	29
5.1.3	Concept portraits	29
5.1.4	Interviews	30
5.1.5	Questionnaires	31
5.1.6	Stakeholder meeting	31
5.2	Define phase	31
5.2.1	Mood boards	32
5.2.2	User story mapping	32
5.2.3	Empathy mapping	33
5.2.4	User journey maps	34

5.2.5	How-Now-Wow matrix	34
5.3	Explore phase	34
5.3.1	Collage	34
5.3.2	Crazy 8	35
5.3.3	A/B testing	35
5.3.4	MDA (Mechanics-Dynamics-Aesthetics)	36
5.3.5	Usability testing with think aloud protocol	36
5.3.6	Pilot testing	37
5.3.7	Content analysis	37
5.3.8	Storyboarding	37
5.3.9	Triading	37
5.3.10	Cognitive walkthrough	38
5.4	Create phase	38
5.4.1	Rapid prototyping	38
5.4.2	Wireframing	38
5.4.3	High-fidelity prototyping	39
5.5	Other methods	39
5.5.1	Affinity diagramming	39
5.5.2	KJ technique	40
5.5.3	Extremes and mainstreams	40
6	Process overview	41
7	Project process	43
7.1	Start-up phase	43
7.1.1	Description of initial idea	44
7.2	Planning	44
7.3	Literature studies	44
7.4	Atmosphere scanning	44
7.5	Analysing Liseberg's DNA	46
7.6	Concept portraits	47
7.7	Questionnaire	47
7.8	Empathy mapping	48
7.9	Quick typing as warm-up	49
7.10	Change of direction	50
7.11	Cancelled concept workshop	50
7.12	Ideation on mechanics with content analysis	50
7.13	Framework for collocated interaction	52
7.14	Idea sketching	52
7.15	How-Now-Wow matrix	54
7.16	Mood boards	54
7.17	Storyboarding	55
7.18	Stakeholder meeting	55
7.19	The final concept idea	56
7.20	Triading	57

7.21	Prototype planning	57
7.22	Wireframing	58
7.23	High-fidelity prototype	58
7.24	Interactive prototype	59
7.25	Cognitive walkthrough	64
7.26	User experience test	65
7.26.1	Questionnaires	66
7.26.2	Observations	66
7.26.3	Pilot test	67
7.26.4	Tests with visitors	67
7.26.5	Tests with interaction design students	68
7.27	Affinity diagramming of user experience test	69
7.28	Extracting factors	70
7.29	Creating guidelines	70
8	Final prototype	71
8.1	Areas and missions	71
8.1.1	Liseberget	71
8.1.2	Lisebergs trädgårdar	73
8.1.3	Lisebergs lustgård	75
8.1.4	Hamnområdet	79
8.1.5	Myter och legender	80
8.1.6	Kvarteret Storgatan	82
9	Test results	83
9.1	Outcomes from user experience tests of missions	83
9.1.1	Mission 1: Height	84
9.1.2	Mission 2: Upside down	84
9.1.3	Mission 3: Together	85
9.1.4	Mission 4: Finding plants	87
9.1.5	Mission 5: Serenity	89
9.1.6	Mission 6: Collecting water	90
9.1.7	Mission 7: The declaration form	91
9.1.8	Mission 8: Transcribing runes	93
9.1.9	Mission 9: High pulse	95
9.1.10	Mission 10: Visit Sten-Åke	96
9.2	Knowledge of Liseberg area names	97
10	Result analysis	100
10.1	Process	100
10.2	Prototype	101
10.3	Map test	105
11	Final results	106
11.1	Factors	106

11.2	Guidelines	108
11.2.1	Design process	108
11.2.2	Design of activities	109
11.2.3	Physical dimension	112
11.2.4	Usability	116
12	Discussion	120
12.1	Process discussion	120
12.2	Map test	124
12.3	Factors	125
12.4	Guidelines	125
12.5	Ethical considerations	126
12.5.1	Privacy	126
12.5.2	Risks concerning research	126
12.5.3	Environmental awareness	126
12.5.4	Inclusive design	126
12.5.5	Consumerism	127
12.5.6	Addiction	127
12.6	Future work	127
13	Conclusion	129

1 Introduction

Some user experiences can be experienced from anywhere, by solely looking and interacting with a screen. Other user experiences are limited to certain places, where the user is interacting with and looking at the surroundings. Examples of such user experiences include museums, theme parks, exhibitions and different kinds of events. This master thesis project focuses on design of the latter and investigates what should be considered when designing for an enhanced physical atmosphere. By creating a digital artefact with the intention to enhance the experienced atmosphere of a physical user experience, the authors gathered insights during the process used to generate guidelines for design of digital artefacts for physical experiences.

The project presented in this report was executed with the amusement park Liseberg in Gothenburg, Sweden, as stakeholders. One of Liseberg's goals is to turn more into a theme park, i.e. an amusement park with one or several clear themes, hence the process and examples in this report will focus on design of user experiences for theme parks. The guidelines generated will though be for design of digital artefacts for physical user experiences in general, but the report will also result in a list of factors important to consider when designing for theme parks specifically.

The digital artefact designed for Liseberg in this project was a location-based smartphone application containing small challenges connected to different areas of the park. All areas of Liseberg have different themes and atmospheres connected to them, and the purpose of the application was to enhance these existing atmospheres and communicate the names and themes of the areas. Additionally, the stakeholders preferred if the application would entice visitors to come back to the park more often and if the application could be used when queuing to attractions, to make the queuing experience more attractive.

The project was executed by Daniel Ahlqvist and Rasmus Andersson, from now on referred to as the 'design team', from the Interaction Design and Technologies master's programme at Chalmers University of Technology, Sweden.

2 Background

2.1 Research problem

Liseberg has various visual profiles connected to their attractions and areas, often having a theme and an atmosphere connected to these visual profiles (see figure 1). Areas with themes currently at Liseberg include *Myter och legender* ('Myths and legends'), *Lisebergs trädgårdar* ('Liseberg's gardens'), *Hamnområdet* ('The harbour'), *Kaninlandet* ('The rabbit land') and more.

When expanding the experience of Liseberg with a digital artefact, it should enhance the already existing experienced atmosphere, emotions and themes the areas aim to communicate.



(a) Balder



(b) Aerospin

Figure 1: Left: Balder, using a Viking Age theme. Right: Aerospin, using a victorian theme.
Photos: Liseberg.

2.1.1 Research question

- *Which guidelines should be considered when designing digital artefacts for enhanced experienced atmosphere?*
 - *Which factors from the physical dimension should be considered when designing digital artefacts in the context of a theme park?*

2.2 Limitations

The focus of the project will be areas designed mainly for people above the age of 13, hence the area *Kaninlandet* will not be included. Primarily, the areas *Myter och legender*, *Hamnområdet*, *Kvarteret Storgatan*, *Liseberget*, *Lisebergs trädgårdar* and *Lisebergs lustgård* will be considered, since they have the most well-defined themes. The themes of the other areas are yet to be more well-defined and developed.

2.3 Definition of 'physical atmosphere'

In the Cambridge Dictionary (n.d.-a, n.d.-c), *atmosphere* is described as 'the character, feeling, or mood of a place or situation' and *physical* as 'relating to things you can see or touch, or relating to the laws of nature'. When referring to 'physical atmosphere' in this project, it refers to the mood and emotions a certain area or attraction, i.e. a physical location or artefact, in the amusement park arouses. The mood may be affected by for example the surroundings, visual design of the attractions or buildings, sound and the theme and narrative of the areas.

3 Related work

This section presents products and applications that are related or have a connection to the field of this project. Both applications related to amusement parks and other related concepts are presented.

3.1 The official Liseberg application

In 2018, Liseberg released a new official application for their park (Liseberg, n.d.). The application contains opening hours, a time plan, and various information about the park. Tickets can be purchased through the application and prices and length restrictions for attractions can be found. People having a season pass for the park can find it in a tab in the application. Also, a coloured map showing the locations of the attractions and facilities is included and the current queuing time is displayed for each attraction. Even though the map is drawn and coloured, it does not give a clear hint what themes the different parts of the park have.

The current queuing times for the attractions are included to give the visitors a hint where the queues are short. Liseberg has, though, told the design team that this leads to a problem. When a queue is displayed as short, many people are moving towards it, making the queue long instead. Meanwhile, the queues at other attractions are becoming shorter. This means that the problem is moved from one to another attraction, instead of being solved.

The Liseberg application uses the general Liseberg visual profile, and its goal is to be informative rather than entertaining.

3.2 Helix

The Helix mobile game was developed as a reward system and a way to make people engaged while queuing to a roller coaster named Helix at Liseberg. The game consists of multiple mini games with a futuristic theme, which users can play with a chance to earn express tickets for the roller coaster. Express tickets are used to save time, since they let the visitors skip the queue.

The game is accessed by entering a code, which is displayed in the queue to the attractions. The code is updated continuously, meaning that players must be present in the queue to have a chance to win express tickets. A practice mode is accessible from anywhere, though. The mini games are quick and winners are decided by amount of points earned during the round.

In the Helix game, it is possible to obtain achievements, which give the players extra points. The achievements include for instance 'ride Helix three times in an hour', 'ride Helix on a Thursday' and 'ride Helix past 9:30 PM'. The achievements entice users to come back to the amusement park several times.

3.3 AeroSpin

The AeroSpin application is a stand-alone application designed by Liseberg, and connected to their real-life attraction *AeroSpin* (Vasilis, 2016). The AeroSpin attraction has a victorian styled theme, dating back to the late 19th century when flying was still a dream for many people. The attraction let the visitors ride miniature aeroplanes in a carousel-like ride. Every plane is equipped with two levers, that control the two wings of the aeroplane. By steering the levers, the pilot can make the aeroplane spin. The pilot can in this way decide if they want to have a peaceful or a turbulent ride.

Based on the spin count in the real attraction, Liseberg has developed a mobile application, which both works as a stand-alone game and lets the user interact with the real attraction (Vasilis, 2016). The *amusement ride* mode of the application logs the number of spins from the real attraction, and in this way makes it possible to compete with others in amount of spins. The mode also features missions.

The other mode of the game works from anywhere and has no connection with the real attraction, more than sharing the same theme of victorian time flying (Vasilis, 2016). The game consists of levels, where the player controls a flying aeroplane in a track with obstacles. This mode also contains missions. The goal from Liseberg's side with this part of the game was to keep visitors entertained while queuing to the real attraction. The mode, though, works from anywhere.

3.4 My Disney Experience

My Disney Experience is the official application for Walt Disney World, where it is possible for visitors to plan, modify and access visit details and information. Park information, including queuing times, opening hours, events, tour details and more are also included. *My Disney Experience* provides features as purchase of tickets and express passes, finding and getting suggestions based on location and view and download photos from the visit.

The *My Disney Experience* application is very similar to the official Liseberg counterpart. It provides a map that is, just as Liseberg's, drawn and coloured, but the different areas and park themes are easier to discern from the Disney map. Similar to the Liseberg application, *My Disney Experience* is more informative than entertaining.

3.5 Play Disney Parks

Disney has created an application called *Play Disney Parks* to interact with their real-world parks Walt Disney World Resort and Disneyland Resort (Disney, 2018). The application was released during the summer 2018 and is a location-based interactive adventure game that can be used when visiting the parks. *Play Disney Parks* uses bluetooth and GPS to interact with the parks, meaning that the player must be present in the park to access most of the content.

The application includes a variety of content, for instance mini games with themes from the park, fun facts, trivia, achievements and Disney songs. Disney (2018) describe its content as 'unique experiences that bring surrounding environments to life'. The basis of the application is a map of the park, drawn in a simple style and with some animations. Locations with content are marked.

One of the intended benefits with the application was to create something that would keep visitors busy while queuing to attractions (Disney, 2018). Games are therefore accessed from the queue areas and might interact with the physical world, by for instance activating special show effects.

3.6 Brick City Tours

Brick City Tours was an application designed and developed by Human Computer Interaction students at the Rochester Institute of Technology in the United States in 2013 (O'Keefe et al., 2013). The application intended to improve guided tours of tourist attractions, in this case with focus on campus tours held for presumptive students at the university. The intention was, though, to make Brick City Tours easily scalable to other tourist attractions around the state of New York.

The issues with the former campus tours were first and foremost that they were impersonal and contained too much information (O'Keefe et al., 2013). This was solved by letting the users select a virtual guide with defined interests before the tour. The virtual guides were based on the real-life students and by doing this, the users got a more personal experience by selecting the one that mostly resembled him or herself. At the same time, the issue with too much information was solved, since only the information coupled with the users selected guide was given.

During the tours, the user could take photos using the application (O'Keefe et al., 2013). These photos were saved and used to create personalised digital 'souvenirs' after the tour, together with official professional photos taken by the university. The souvenirs could be shared to social media.

4 Theory

This section presents theory relevant for the the project described in this report, including relevant concepts and research.

4.1 Relevant concepts

In this section, relevant concepts, including terminology related to the subject of this report, are presented and described.

4.1.1 Design approach

A few approaches of design research are investigated by Gaver (2012) to gain insight about best practice of research within design. He problematises that design research is rather temporary and circumstantial. Hence design research is better suited as exploratory and should provide documented and concrete examples.

To answer the research question in this thesis, the design team produced a number of prototypes during the design process. From this process, the team derived insights which then resulted in guidelines. As Gaver (2012) suggested, this thesis provide concrete examples and relate them to each guideline.

4.1.2 Interaction design

Interaction design is a term mainly focusing on designing the interaction between humans and products. The products may be both digital or analogue. The goal with interaction design is to make these products' usages easy to understand and effortless and enjoyable to use, according to Preece, Rogers and Sharp (2015). Instead of developing the most straightforward solution, the user is set in focus. While trying to reduce negative aspects of the usage, including frustration and annoyance, the positive counterparts are enhanced, for instance enjoyment and engagement.

4.1.3 User experience

User experience (UX) is a term that has a debated definition, according to Hellweger and Wang (2014). There are several definitions for the term, and they are not exactly interchangeable. What is commonly said though, is that user experience is not equal to usability or user interfaces, but may include those terms. Most often, user experience is said to have three dimensions: user,

product and the interaction between those two. The different dimensions have factors that may affect the user experience. The user could have own values, different emotions, expectations and references to prior experiences, while the product has properties including for instance functionality, mobility, usability and adaptability. These dimensions and factors are together creating a user experience when using a product.

The official ISO definition of 'user experience' is 'person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service', meanwhile 'usability' is defined as 'extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use' (International Organization for Standardization, 2010).

4.1.4 Visual profile

A visual profile will in this project be defined as a bundle including for instance a logotype, typefaces, colours, images, textures and shapes, which together evoke emotions and/or communicates a messages. Visual profile is related to the concept of visual brand identity (Phillips, McQuarrie & Griffin, 2014), but instead of creating relations between a corporation and its customers, the goal is to communicate an emotion and resonate with or enhance the physical atmosphere.

Visual design can be seen as a part of user experience, according to Mesibov (2015). A study involving the relationship between aesthetics and usability has been made. In this study, the correlation between level of aesthetics and the perceived aesthetics were analysed. The results showed that after usage of the system, not only the perceived aesthetics, but also the perceived usability, was affected by the level of aesthetics.

Visual design can also be seen as a combination of UX design and graphic design, since usability and communication can be enhanced when incorporating visual design (Mesibov, 2015). While UX design on its own is more about interactions and functionality, the visual design uses a range of visual properties, e.g. colours, fonts and images, and considering for instance contrast, hierarchy whitespace and scale to guide the user through the interface, which will also improve the user experience.

The Creative Bloq (2015) gives five guidelines from visual design that can be beneficial and applied in the practise of interaction design. The five guidelines are presented here.

- **'Respect the dominance of vision'**

Vision is the most dominant of a human's senses, which means that visual input is what people first react to. The visuals influence behavior and interactions, and therefore the entire user experience. The user can either be guided or mislead by visual cues hence enhance or diminish the experience. As mentioned by Mesibov (2015), aesthetically pleasing design affect the perceived usability.

- **‘Provide clear orientation and navigation’**

Humans have a sense of mental orientation and the same applies to websites and other user interfaces. Visual cues are needed to understand where we are, have been and our possible directions. A few suggestions of components include menus, search fields and breadcrumbs. Navigation should be purposefully implemented and not for the sake of navigating which just adds to unnecessary visual stimuli.

- **‘Ensure visual consistency’**

Consistency makes a system easier to learn and makes it easier for the user to predict what actions are needed to complete a task. This also saves the users mental energy, which is crucial. Energy spent on anything else than completing the task itself will drain the user and affect the experience negatively.

- **‘Use UI patterns as a baseline’**

For the same reason as the previous point, UI patterns provide improved learnability, since they are common and often already known to the user.

- **‘Create consistency through style guides’**

This guideline is related to the two previous in terms of consistency, but this refers more to platform and/or brand visual guidelines. This varies from mobile to desktop or web and depends on the operative system, e.g. Android, iOS, Windows and Mac OS.

4.1.5 Emotional design

In the book *Emotional design*, Norman (2004) describes how emotions impact human behaviour and motivation. Norman divides emotional processing into the following levels:

- *Visceral* – dictates humans’ initial emotional response and first impression.
- *Behaviour* – the level where the most of our behaviour falls and similar to visceral, it is a subconscious process and is affected by both visceral and reflective processes, which means biological as well as societal and cultural influences.
- *Reflective* – contemplate and through the cognitive process then evoke emotions. In this way the reflective level can affect the behavioural.

The consideration of these levels in the design process will work as a framework to improve the product and user experience (Norman, 2004). Each layer is connected to their counterpart within design. Visceral design focuses on aesthetics, behavioural design on usability and reflective design on how the users view themselves and the thoughts the product evokes.

4.1.6 User interface

User interface is a complex term, referring to something that makes people be able to interact with or control an artefact. There are several ways this can be made, with graphical user interfaces (GUI) as the most common example (Zuckerman & Gal-Oz, 2013). The following list presents a few examples of user interfaces, of which one or several will be developed in this project.

- Graphical user interface (GUI) – an interface consisting of graphical components on a screen, e.g. computer screens.
- Tangible user interface (TUI) – an interface consisting of physically tangible or graspable representations of information or controls, e.g. a racing wheel game controller (Shaer, Hornecker et al., 2010).
- Gesture-based interface – an interface where the user is controlling the system through gestures and movement, without physical contact with any artefacts (Ünlüer et al., 2018).
- Voice-based interface – an interface where the user is controlling the system using his or her voice as input method, and is getting audible response as output, e.g. a smart speaker (Zondervan, Umair, Khan, Raman & Marian, 2008).

4.1.7 Look and feel

Look and feel is defined in Cambridge Dictionary (n.d.-b) as ‘the way that something, typically software or a website, appears to a user or customer, and how attractive or easy to use it is’. In this thesis, an existing physical atmosphere is dealt with, which can be seen as the look and feel of the physical world. When adding an interactive system, the look and feel is crucial to keep or enhance the user experience.

4.2 Related research

This section presents research already done by others, that might be helpful when working with the project mentioned in this report.

4.2.1 Rich emotions

When designing user experiences, rich emotions may be considered. It gives an experience more depth, since it involves several emotions mixed into one, according to Fokkinga and Desmet (2012). Rich emotion basically means triggering multiple emotions of various types to create a richer experience, just as real-life situations are likely to be. Fokkinga and Desmet mention

moving to a new city as a situation that involves rich emotions. It could be sad to leave friends and family and anguishing not to know anyone in the city, which could be seen as negative emotions. On the other hand, it could be joyful to explore the new city and exciting getting to know new people. These are considered as positive emotions. All in all, moving to the new city is a rich emotion with several dimensions.

Rich emotions involve, as stated in the example, both positive and negative emotions. The negative emotions may for instance be fear, anger or contempt, while the positive ones could be joy, excitement, fascination et cetera (Fokkinga & Desmet, 2012). Rich emotions are something that are often used by amusement parks, to give the visitors an experience to remember. Roller coasters are good examples on how rich emotions are used. Riding a roller coaster may be frightful, which is a negative emotion. Usually, fright is not something people would want to experience, since fright is naturally evoked when experiencing a threat. Despite this, roller coasters are seen as thrilling and joyful by many people.

People and negative emotions

What has to be explained is why riding a roller coaster is seen as something attractive to many people, despite fright is a negative emotion. There are three theories why people are feeling enticed to experience situations with negative emotions linked to them, according to Fokkinga and Desmet (2012). These theories, or explanations, are known as the utilitarian explanation, the aftermath explanation, and the intensity explanation. They are not interchangeable, since one theory explains certain situations, while the others might explain other cases.

The utilitarian explanation to why people are exposing themselves to negative emotions, is that they do it for the benefits of doing so (Fokkinga & Desmet, 2012). It could for instance be defying fear of flying, because flying is less time-consuming than other modes of transportation, or to exercise to get healthier. This explanation is not the one that is applied to roller coasters.

The aftermath explanation discusses the satisfaction factor that follows the experience. Fokkinga and Desmet (2012) mention mowing the lawn as an example to this. The activity is boring, but the following satisfaction of having the grass mowed is positive. This could be compared with riding a roller coaster in some cases, since the activity might bring satisfaction at the end of the ride, but it is not applicable to all people since others might find it joyful during the ride as well.

The intensity explanation is more abstract and focuses on the person's ability to inhibit and ignore the negative emotion and just enjoy the arousing effect of the activity. Fokkinga and Desmet (2012) gives horror movie fans as an example to this. The intensity explanation could be seen as another reason to why some people would ride roller coasters. They have learnt to ignore the fear and instead they get thrilled by the arousing effects.

Emotions affect humans

Different emotions have different bodily and mental effects on humans, according to Fokkinga and Desmet (2012). For instance, fear makes people's heart beat faster, it narrows the field of

attention and gives a feeling that time is passing more slowly. Other emotions have other effects. These bodily and mental changes are made to make the human better prepared to handle various situations. Also, the person's attitude towards the situation and surroundings changes depending on their emotions, which can be used when designing an experience.

Protective frames

What makes people enjoy negative emotions, for instance fear, is their belief that they are safe (Fokkinga & Desmet, 2012). When a person, psychologically, feel that they are safe, the fear instead becomes thrilling. This psychological belief that the person is at no risk for harm is called a *protective frame*. The protective frame could for instance be an animal cage at a zoo, which keeps the dangerous animals visible but yet locked in. This is a protective frame of the type *safety-zone frame*, which is one of four protective frames within user experience design. The others are *detachment frame*, *control frame* and *perspective frame*. The first means that the user is not interacting with a real situation, but a representation of a situation. It could for instance be watching a movie or reading a number of fatalities from an accident, instead of seeing a photograph of the dead people. The control frame means that the user controls the situation. An experienced racing driver might feel he or she has control, because he or she is the one controlling the car. A less experienced person might, though, find it terrifying to be a passenger in the same car. The last protective frame, the perspective frame, means that the person has a greater purpose with the handlings, for instance helping others.

Rich qualities

Based on the rich emotion research, Fokkinga and Desmet (2013) developed ten rich qualities that combine one negative and one positive emotion each, to form a new experience. Coupled to the rich qualities are also protective frames and descriptions of the transformation of perceptions and attitudes that follows, as well as a description of the cause of the emotion. The rich qualities can be used when experimenting with rich emotions when designing a user experience. A summary of the rich qualities can be seen in table 1.

Rich quality	Negative emotion	Positive emotion	Protective frame
The sadistic	Maliciousness	Amusement	DF or SZF
The thrilling	Fright	Joy	CF and/or SZF or DF
The challenging	Frustration	Satisfaction	CF
The eerie	Anxiety	Fascination	DF or SZF
The scandalous	Indignation	Fascination	DF or SZF
The grotesque	Disgust	Fascination	DF or SZF
The self-sacrificing	Reluctance	Pride	PF (possibly with DF or CF)
The indulging	Shame	Desire	DF or SZF or CF
The unreachable	Longing	Dreaminess	CF and/or DF
The sentimental	Poignancy	Enchantment	PF (possibly with DF)

Table 1: Rich qualities by Fokkinga and Desmet (2013). Key: DF = detachment frame, SZF = safety-zone frame, CF = control frame, PF = perspective frame.

The rich emotion case with roller coasters can be seen amongst the rich qualities in the table. The rich quality *the thrilling* combines fright with joy, by applying a protective frame. For *the thrilling*, three different protective frames are suggested, with the safety-zone frame most likely to be used in roller coasters, by adding safety equipment (Fokkinga & Desmet, 2013).

4.2.2 Amusement parks services

Amusement parks usually try to attract a broad variety of user segments, according to Roest, Pieters, Koelemeijer et al. (1997). This is done by offering widely spread activities that could for instance include attractions of different kinds, show performances, animal experiences, concerts and broadcasts of sports events. In addition to the activities, the parks usually offer services including bathrooms, restaurants and pubs. These widely spread activities and services are chosen wisely, to appeal a wide range of visitors. Different activities and services should attract people with different characteristics, including different ages and stages of the family life cycle. An amusement park manager cited by Roest et al. (1997), said that their goal was to make each person come back to the park at least three times during their life: as a child, as a parent and as a grandparent.

This project was made with the amusement park Liseberg in Gothenburg, Sweden, as stakeholders. An employee in the field of digital strategy at the park, told the design team that one of Liseberg's biggest flaws is their digital appearance. The application being designed in this project might help filling that gap, as well as serving as one kind of activity suitable for some user segments.

4.2.3 Amusement park experiences

New experiences that exceed expectations are always needed for companies to attract customers, according to Danielsson et al. (2011). In their report, they are presenting seven insights, seven trends and seven conclusions on what creates a world class experience. First of all, an experience should slightly push the personal boundaries, but not too much. Level of difficulty should be customised, and increased one step at a time, to create a flow.

Danielsson et al. (2011) present an experience matrix, originally from Pine and Gilmore (2011), having one axis spanning from 'passive participation' to 'active participation' and one axis spanning from 'immersion' to 'absorption'. Absorptive experiences with passive participation create entertainment (e.g. watching TV or reading a book), while absorptive experiences with active participation create education. Immerse experiences with passive participation create aesthetic experiences (e.g. watching the sunset or visiting an art exhibition), while immerse experiences with active participation create escapism (e.g. playing paintball or driving gokart). It is the last of the four experience types that are most interesting to amusement parks.

Another matrix also presented by Danielsson et al. (2011), is an experience map grouping experiences in four different categories that define 'top experiences'. The four categories are 'kick', 'competence', 'comfort' and 'contact'. Both experiences and customers can be categorised into these categories. The 'kick' group contains words including 'surprise', 'adrenaline' and 'pushing the boundaries'. The 'competence' group contains words including 'new discoveries', 'personal development', 'together' and 'achieved a goal'. The 'contact' group contains words including 'love', 'care', 'beautiful' and 'friendship'. The last group, 'comfort', contains words including 'inspiration', 'as expected', 'peace' and 'quiet'.

The four categories in the experience map generally suits different stages in life, starting with 'kick' and ending with 'comfort'. Young singles generally belong to the 'kick' group. Moving on to young couples, the people start moving from 'kick' to 'competence'. When the couple has grown older and their children are turning into teenagers, they generally move to the 'contact' category, before they at last move to the 'comfort' group as seniors. The experiences suiting the different stages in life are summarised by Danielsson et al. (2011) in the following way:

- Young singles – adrenaline and dreams.
- Young couples – confirming partner similarities; tickling adrenaline; between purposefulness and escapism.
- Parents of young children – experiencing through the children.
- Parents of teenagers – experiencing together with the children, before it is too late.
- Parents of adults – free from the children; searching for peace and luxury.

- Young seniors – comfortable discoverers, experiencing together with the grand children.
- Seniors – escapism in peaceful tempo.

Also noted by Danielsson et al. (2011), is that economy differs between the groups, limiting some from costly experiences. Parents of teenagers or adults generally have the best economy.

The seven conclusion

The report by Danielsson et al. (2011) results in seven conclusions. They are the following:

1. Set the arena for fellowship – the factor of fellowship should be the basis of an experience.
2. Turn up the experiences – the demand from customers on experiences are increasing all the time.
3. Use technology for hassle reduction and time efficiency – technology may reduce frustration of long queues and cancelled rides.
4. Maximise the year of experience and optimise the timing – events and happenings can help attract visitors during low season.
5. Facilitate and stimulate sharing of experiences and memories – people like sharing their memories on social media, which can be seen as the visitors helping with marketing.
6. Work with accessibility – the experience should be easy to access, both physically and mentally.
7. Invest in economic concepts and sustainable development – visitors expect companies to work for a sustainable future.

When working with the project described in this report, the findings from Danielsson et al. (2011) were considered at many stages.

5 Methodology and tools

This section describes the scientific method that was used during the course of the project. The project followed a version of the *double diamond* model, as described by Schneider, J. (n.d.), originally created by The British Design Council.

The double diamond is divided into two main parts, one being defining a strategy and the other being the execution of a solution (Schneider, J., n.d.). These two main parts are divided into two halves respectively, resulting in four phases in total. The first phase is to understand the problem, followed by a define phase, where a plan how to solve the understood problem is being decided before moving on to the execution part. The execution part contains an exploration phase and a creation phase. These two phases are done without a clear distinction and involves learning, building and measuring. Finally, a solution to the problem might be found.

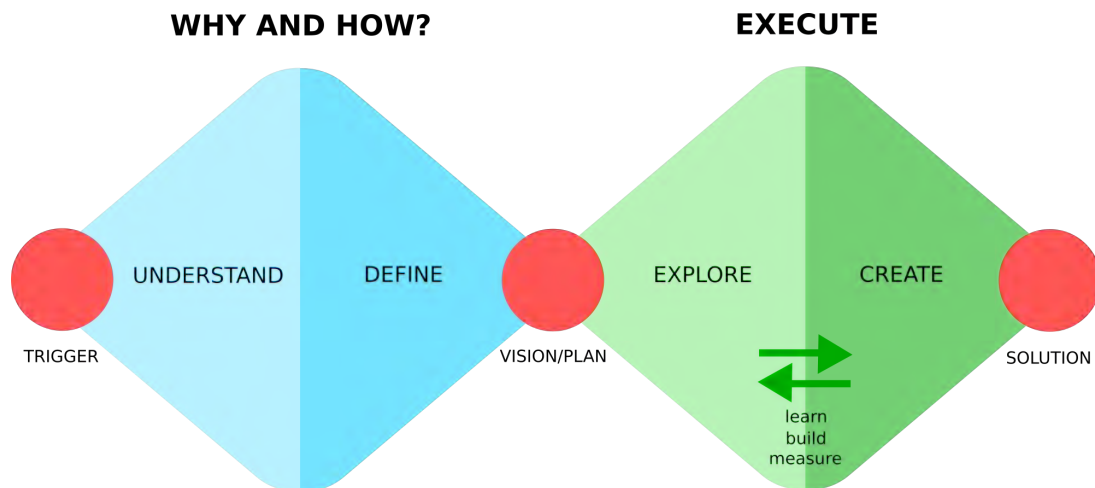


Figure 2: The double diamond design process as described by Schneider (2015).

The phases do not always follow in order and jumping back and forth is something to expect. In this project, the design team was aiming to do the execution part of the double diamond iterative, meaning that an exploration phases was made both before and after the create phase.

5.1 Understand phase

The understand phase is the first phase in the double diamond design model (Schneider, J., n.d.). Starting with a trigger, the current situation has to be understood. This is done in an exploratory way and could include for instance observation of users and business. The focus is on the current state and the issues. This section presents methods that were considered as likely to be used in the understand phase of this project.

5.1.1 Literature studies

When planning a project, previous research and works should be studied. There are several reasons to do literature studies, including not having to investigate problems that have already been investigated by other people, and to have science as basis for decisions.

In this project, literature studies were made to plan the project. The design team was reading upon related works and concepts to better understand the research field and what has already been done, as well as reading about interaction design methods that could make the project results better.

5.1.2 Atmosphere scanning

Atmosphere scanning is the name of a custom method created for this project by the design team. Since the aim with the project was to extend an already existing physical user experience and its atmosphere, the current user experience and atmosphere had to be explored. This was done by walking around in the amusement park and taking notes for each area of the park. Details, themes and perceived emotions, including nouns, adjectives and verbs, for each area, building and attraction were noted and were used for further research and ideation using other methods, for instance concept portraits and mood boards. In total, around ten words were noted for each location and all words should come from the first impression.

The atmosphere scanning method was used with the design team as participants, but the method might also be used with other people as participants. Participants should not be too familiar with the locations, since previous experiences might affect the outcome of the method. When having several participants, results can be compared and justified to form a more general summary.

5.1.3 Concept portraits

Concept portraits is a method described by Gkouskos (2016), used to ideate and define design requirements when working with concepts that are interpreted differently by different people. This is common when working with emotions, for instance. The goal is to get a summarised view of the concept, which can be used further in the ideation process.

The results of concept portraits are themes and words that are associated with the concept (Gkouskos, 2016). The method is divided into three segments, starting with an individual part, followed by a motivation round of the individual part and lastly an analysing part, where overarching themes are found and described.

The individual part is based around six questions, that are asked as 'If [concept] was a [noun], what would it be?' (Gkouskos, 2016). The nouns are selected by the designers. For example, if

the concept is 'love', the questions could be:

- If love was an animal, what animal would it be?
- If love was a country, which country would it be?
- If love was a famous person, who would it be?
- If love was a sport, which sport would it be?
- If love was a building, what kind of building would it be?
- If love was a movie, which movie would it be?

The questions should be answered quickly, to get the first thought for each topic. The answers are written down and are the basis for the next phase, where each participant motivates their choice of answer.

The last step is analysing the results of the previous steps, for instance by using another method e.g. affinity diagramming, to find overarching themes connected to the concept (Gkouskos, 2016).

The concept portraits method was used in the project described in this report, to find themes suitable for each intended emotion for the areas in the park.

5.1.4 Interviews

When data and opinions from for instance users and other stakeholders are needed, interviews may be a way to proceed. There are different kinds of interviews, including structured, semi-structured and unstructured interviews, used in different cases (Preece et al., 2015).

Structured interviews have a clear, predefined format (Preece et al., 2015). All participants in the study are getting the same questions and the questions are often closed, meaning that the participant gets to select an answer from a range of options.

Unstructured interviews are the opposite to the structured interviews (Preece et al., 2015). They are more similar to real conversations and the questions are mainly open-ended, meaning that the participant has to explain using his or her own words. The person who is in charge of the interview can direct the conversation in different ways and add follow-up questions whenever he or she feels for doing so.

Semi-structured interviews is an intermediate step between structured and unstructured interviews (Preece et al., 2015). They may contain both closed and open questions and the interviewer should have prepared questions beforehand, but may add additional questions during the interview.

5.1.5 Questionnaires

An approach similar to interviews is questionnaires (Preece et al., 2015). Questionnaires work in almost the same way as structured interviews, since researchers are not able to ask follow-up questions. Instead of asking the questions face-to-face, the researchers send or hand out a form with questions for the participants to fill in.

A questionnaire may contain both closed and open questions and is preferable when researchers and participants are not able to meet in real-life, when data from a big amount of people have to be collected or when the answers have to be completely anonymous (Preece et al., 2015). It is time saving when there are many participants and participants may get a longer time to think about their answers before responding.

Since researchers are not able to clarify their questions, it is even more important to formulate well. Closed questions should be used when possible, and a 'no opinion' (or similar) option should be included when having options to choose from (Preece et al., 2015).

Questionnaires may include questions where the respondent is asked to set a value on a range, for instance from completely disagreeing to completely agreeing. When dealing with user experience where more precise results are important, great scales with many steps are beneficial. The ranges with 7 or 9 steps are recommended in these cases (Preece et al., 2015).

In this project, questionnaires were used when collecting data from visitors at Liseberg and after user experience tests to be able to evaluate the results.

5.1.6 Stakeholder meeting

A stakeholder meeting is a meeting where stakeholders meet and discuss design objectives of a product, in combination with the business objectives, according to User Experience Professionals' Association (n.d.). During a stakeholder meeting, the purpose of the product could be discussed. The meeting is used to get a common view of the project and target.

5.2 Define phase

The define phase is the second phase of the double diamond design model, and is based on the findings from the understand phase (Schneider, J., n.d.). The knowledge gained is made into insights to define a first plan for a solution. This plan does not have to be detailed, but the target vision and outcome should be decided. This section presents methods that were considered as likely to be used during the define phase in the project presented in this report.

5.2.1 Mood boards

Mood board is as a creative tool often used by product and fashion designers to organise visual data to get an overview of the common theme, using primarily images but also colours, small artefacts, e.g. shells and pearls Cassidy (2011). This tool is not very defined and can be used in a number of different ways. In the case of this project, the most relevant category mentioned by Cassidy (2011) is the product specific mood board, focusing on style and theme, which can be used to give a visual representation of the mood of the atmosphere.

Mood boards as evaluation tool

Mood boards used in evaluation of emotional experience are explored by Chang, Díaz, Català, Chen and Rauterberg (2014). In the area of psychology, emotions are difficult to measure. The method used in research currently is the stimuli-response model. This means that if a happy image is viewed by a subject, the subject is also being reported as happy (Chang et al., 2014). Mood boards have been confirmed to be reliable as a tool for investigating emotional experience among a general population. Given this result, mood boards can work as a tool in ideation as well as evaluation of user experiences involving physical atmosphere and interactive systems.

In this project, an example of an evaluation could be presenting a number of different mood boards to users. The users then select the mood boards they believe best represent the mood or emotion experienced in the location. The method could be used to evaluate with and without additional interactive systems and compare the final results.

5.2.2 User story mapping

The user story mapping method originally comes from the agile software development and is used to conclude and communicate all collected knowledge about the users and the domain (Milicic, El Kadiri, Perdikakis, Ivanov & Kiritsis, 2014). In agile development, the typical approach is to create a prioritised backlog without connection to insights about user's needs. User story mapping can provide this extra dimension by giving every task in the backlog a connection to the needs of the users. Also, the method unites the vision of the project within the team with the visions of the stakeholders of different disciplines (Milicic et al., 2014).

The user story map can be divided into four different segments (Milicic et al., 2014):

- *Usage dimension* is defined as the steps the user would need to take to use the product, which should include the entire process in sequential order.
- *User dimension* is containing the needs and motivations of the target users to why they use the product.

- *Backbone* consists of activities that are required to perform each step defined in the usage dimension.
- *User stories as backlog items* is the subtask of each activity and can be written in the following way 'As [user] I want [feature] so that [value]'.

5.2.3 Empathy mapping

Empathy mapping is a method used within user-centered design, often in the beginning of a design process (Gibbons, 2018). The method is used to get an overview of what is known about the user and where research is lacking. Empathy mapping is used to map out and define the user group through behaviour and mindset. While gaining insight of the target user, it also helps everyone involved in the design process to grasp a common understanding of who the user is. The classic empathy map consists of four fields of a square ('say', 'think', 'does' and 'feel') and a circle in the centre representing the user. The user's perspective is in focus when adding insights to the different fields. The fields are described as follows:

- *Says* – quotes of what the user has said during user research. This could be answers from interview and/or questionnaires for instance.
 - Example: 'Queues are very long.'
- *Thinks* – what the user thinks based on research conducted. Some things are not verbally expressed but qualitative insights give an understanding of what the user might think.
 - Example: 'I am so bored.'
- *Does* – what the user does, based on observations from research.
 - Example: Plays a mobile game.
- *Feels* – what the user feels. Steps into the user's shoes and reflect on what emotional states the user is going through. What are the struggles and motivations? Connecting the feeling to a trigger.
 - Example: Impatient, due to long queues.

To carry out this method, everyone in the team should go through the material and research (Gibbons, 2018). The next step is to transcribe all the insights on sticky notes, which then will be placed on the *empathy map*. The team discusses and rearranges the notes until the team agrees on a constellation and has a common view of the target user. The empathy map should be updated and refined through the design process.

5.2.4 User journey maps

User journey maps is a method used to get an overview of the user journey (the path the user is taking) when using a product or going through an experience. Takeaways from user research are placed on the path of the user journey for each persona. The journey may include the entire process or specific parts depending on the goal of the method. User journey maps give insights into what interactions are working, not working and redundant. The purpose is to spark a discussion around the interactions needed and create a common view of the process (Martin & Hanington, 2012).

5.2.5 How-Now-Wow matrix

A How-Now-Wow matrix is used to evaluate ideas based on how original they are, in combination with how easy they are to implement, according to Interaction Design Foundation (n.d.). The method is based around a matrix with two axes: one for how difficult it is to implement and one for how original the idea is. The two axes form four quadrants, of which three are named 'how', 'now' and 'wow' respectively. 'How' ideas are original but difficult to implement, 'now' ideas are not very original but implementable, and 'wow' ideas are original and implementable. By placing the ideas along the axes, the designers can see if they should continue working with them or not.

5.3 Explore phase

When a vision and plan have been decided, the explore phase, which is the third step of the double diamond design model, starts (Schneider, J., n.d.). Its aim is to explore the best solution to the task and validate different options. Similar to the understand phase, this phase is divergent and could include exploration of multiple ideas. This section presents different methods that were considered as likely to be used during the explore phase in this project.

5.3.1 Collage

Collages may be seen as a combination of a data collection method (e.g. interviews, questionnaires etc.) and a mood board. The method is used to gain knowledge on how and what people think, feel, desire etc. relating to a topic (Martin & Hanington, 2012). Instead of expressing these aspects using only words, the researchers instead let them do it visually by creating a collage. Often, the participants are given a collection of images, shapes, words and more to use for their collages. These pieces of content are glued onto a blank paper using a glue stick.

Each participant should create their own collage and present their choices of content to the researchers afterwards, according to Martin and Hanington (2012). The results should be analysed using a qualitative research method afterwards.

5.3.2 Crazy 8

Crazy 8 is an ideation method used to quickly produce several ideas on how to solve a problem or task (Google, n.d.). Individually, the participants are sketching, using paper and pen, the first ideas that are coming to their minds. A paper is divided into eight squares, and for each square, an idea is to be sketched. A time limit is set for each square and when the time is up, the participant moves on to the next square. The ideas could build on each other or be completely different, but the goal should be to push beyond the first thoughts. After the eight rounds, the participants are explaining their sketches for each other.

5.3.3 A/B testing

A/B testing is an evaluation method where two different versions of a product are compared and tested quantitatively against a fixed goal (Martin & Hanington, 2012). When the test is carried out, the population is randomly assigned to the A or B group and test respective version. The goal of which the versions will be tested against must be quantitative and reduced to a measurable metric. The version which scores the best will be better suited to achieve the goal. For instance, if a company wants to increase the amount of people signing up for their services, the goal is then to increase the sign up rate. There could be a number of factors which come into play when a user decides to sign up or not. Two of these can for instance be length of the sign up form and the length of safety and privacy texts. The next step is then to create a new version of the sign up form. This version will be tested and will probably result in a different sign up rate. If the rate is higher than the current version, the result can be a decision basis and motivation to update the sign up form. The advantage of this evaluation method is that the result is measurable against the goal. The disadvantage of it is that even if one version does better in comparison to another, it does not explain why this is the case. A suggestion is to use this method in combination with a qualitative method, e.g. usability testing with think aloud, interviews or questionnaires to get explanations of the results.

The objective of this thesis is to preserve or enhance a user experience. A/B testing can be used as a tool to compare the current experience to an additional interactive system. If the additional interactive system gets a higher or the same rating in experience, this could be a measurement of the interactive systems success. The challenge will be to reduce the qualitative experience to a quantitative, measurable parameter. Just as mentioned above, the result cannot be the only consideration when evaluating the success of the interactive system. The use of a complementary qualitative method, which could let the design team gain better understanding of the actual user experience, would be needed.

5.3.4 MDA (Mechanics-Dynamics-Aesthetics)

The MDA framework was originally developed within the area of game design to manage the relatively unpredictable nature of games (Hunicke, Leblanc & Zubek, 2004). This framework consists of *Mechanics*, *Dynamics* and *Aesthetics*, which can be observed in isolation but are interconnected and affect each other.

Mechanics contain components, rules and structure of which the user can interact with (Hunicke et al., 2004). Dynamics are what happen when the user interacts with the mechanics and the following effects and consequences. Aesthetics are the emotions arising within the user from engaging with the artefact. During the iterative process of game design, mapping out these components help to visualise game flow. After that, testing, modification and refinement of the concept is done by changing the mechanics, since mechanics are what dictates the general dynamics. Combined, the mechanics and dynamics affect the aesthetics.

MDA can according to (Hunicke et al., 2004) be approached in two different ways: 'feature-driven', which is focused on the perspective from the mechanics, and 'experience-driven', where the user is in focus and therefore the aesthetics. The later is the most suiting in this thesis, since it revolves around the user experience and the physical atmosphere. The framework could be used as an evaluation tool and benchmark for ideation. This would provide a documented overview updated through the iterations in the design process.

5.3.5 Usability testing with think aloud protocol

Usability testing is a method used to test whether a product is usable by the intended target group, and if people in the target group are able to perform the tasks the product is designed to help with (Preece et al., 2015). People from the target group ('the participants') are given tasks to complete with the product and the researchers can for instance record a video of the executions for later evaluation. To get participants views on the experience, they are often asked to 'think aloud', meaning that they express all their thoughts by talking. The researchers should note or record everything they say. As a complement, participants often get a questionnaire or participate in an interview afterwards, to collect more data on their experience. This data can be used for further evaluation by the researchers.

The number of participants in a usability test should be between five and twelve, but exceptions might be made if the test is only exploring a small part of a system or if the researchers have a limited budget (Preece et al., 2015). In such cases, a smaller amount of people might be picked.

5.3.6 Pilot testing

Pilot testing is a session executed prior to a real test of a product, according to Schade (2015). The main reason to execute pilot tests is to fine-tune the test and check so everything works as it should. If not, the researchers might not get as valuable results during the real test as wanted. By performing pilot tests, formulations of test instructions, tasks and more can be optimised.

5.3.7 Content analysis

Content analysis is a way of structuring qualitative extensive data by finding common themes and connection between them (Martin & Hanington, 2012). Since qualitative data collected from for instance interviews and questionnaires are often not straightforward and cannot be reduced to a data point in statistics, content analysis helps sorting all the collected data and arrange them into one or a couple of themes. Affinity diagramming can then be used to group and move around observations and insights, which then can be used as a benchmark to come up with themes. For smaller data samples, affinity diagrams will be enough but with larger samples, digital tools could be useful (Martin & Hanington, 2012).

This thesis involved extensive user research and evaluation of a prototype, which led to much information. Content analysis made the data more comprehensible.

5.3.8 Storyboarding

Storyboarding is a method used to describe a technology or product for stakeholders or for considering design alternatives (Martin & Hanington, 2012). Storyboards build narratives around the technologies or products, and present them in a style similar to comics. A number of frames are drawn, showing steps in a scenario. The frames are complemented by a descriptive caption. The reason why storyboards are made is to communicate how, where and why people would engage with the technology or product.

5.3.9 Triading

Triading is a technique used to identify how ideas or concepts are different from each other (Hawley, 2009). Participants are presented to three ideas or concepts, of which they should select one that they believe is different from the others and describe why. This helps the designers to understand what is important to the target user, since attributes given by users often involve emotions.

5.3.10 Cognitive walkthrough

Cognitive walkthrough is a usability testing method used by experts to evaluate if a system reflects the way people cognitively process tasks (Martin & Hanington, 2012). Experts define tasks to test in the system, and then execute them. For each step in the process, four questions are answered:

- 'Will users want to produce whatever effect the action has?'
- 'Will users see the control for the action?'
- 'Once users find the control, will they recognise that it will produce the effect that they want?'
- 'After the action is taken, will users understand the feedback they get, so they can confidently continue on to the next action?'

Cognitive walkthrough may help designers find obstacles in the system, that could be improved for better usability.

5.4 Create phase

The create phase is the fourth and last phase of the double diamond design model, often iterating with the explore phase by learning, building and measuring (Schneider, J., n.d.). In the create phase, prototypes or fully-working products are produced. These creations could be released or used for further exploration. This section presents methods that were considered as likely to be used during the creation phase in this project.

5.4.1 Rapid prototyping

Rapid prototyping means creating simple prototypes to quickly test an idea (Design Kit, n.d.-b). The prototype must not test a full concept, but could test parts of it. The reason is to evaluate ideas. People from the target group should participate in the test, while the designers are instructing and noting feedback.

5.4.2 Wireframing

During design of interactive products with a graphical user interface, wireframes might be used to communicate basic thoughts on what the final interface will look like, according to Hamm (2014). Wireframes are not focused on details, nor look and feel, but communicates the most basic parts of the interface, for instance functions, form, components and their approximate positions.

Wireframes may have different fidelity, often starting with a very low fidelity early in the project (Hamm, 2014). They are often black and white and contain only outlines of components. Therefore, wireframes could be seen as the graphical user interface's skeleton. Later in the project, the wireframes might reach a higher fidelity, when more details are defined.

In this project, wireframes were created as an early prototype when the concept of the product was defined. Wireframes could also have been used for usability tests.

5.4.3 High-fidelity prototyping

High-fidelity prototype is by (Usability.gov, n.d.) defined as a prototype resembling the functionality as well as look and feel as close as possible to the actual system. In a blog post from Adobe, high-fidelity prototypes are defined as prototypes with three following characteristics: visual design, content and interactivity (Babich, 2017). In high-fidelity prototypes, visual design should be realistic and detailed, content and information should be authentic and representing the final design and interactivity of the prototype should be responsive and behave as the real system.

In this project, high-fidelity prototypes were developed in the later stages of the design process based on earlier iterations and knowledge gained during the process.

5.5 Other methods

5.5.1 Affinity diagramming

Affinity diagramming a bottom up approach to organise observations collected from for instance user research (interviews, questionnaires etc.) or usability testing (Martin & Hanington, 2012). The observations are written on for instance sticky notes and grouped based on theme, which help the team getting an overview of all the data and see which areas are of more importance. The observations are not always connected to just one theme, and there are infinite ways to organise and categorise the observation. This is a great opportunity to discuss within the team and move around the observations.

Affinity diagrams were used continuously during the design process to keep track of data from research and evaluation phases, but also during ideation.

5.5.2 KJ technique

KJ technique is a technique with purpose of coming to agreements of a specific matter and avoid external influences and involvement in the discussion (Martin & Hanington, 2012). This is an alternative to a standard meeting, where for instance power and personality often determine who is talking and getting their point across. Instead, KJ is a silent meeting technique.

KJ technique is performed in silence and everyone first of all gets time to write down their own observations and ideas on paper, e.g. sticky notes. The next step is to collect all notes and organise them in silence. In this way, everyone can display their point of view. Instead of comparing them with each other, the focus is on how they relate to each other and the problem at hand (Martin & Hanington, 2012).

5.5.3 Extremes and mainstreams

Extremes and mainstreams is a way of selecting user types when doing user research (Design Kit, n.d.-a). Instead of just choosing all users from the mainstream target group, users from both sides of the extreme spectrum are taken. When including extreme users in the design process, it challenges the designers to think creatively in new ways. Also, the designers have to design a more inclusive experience for people outside of the mainstream group.

6 Process overview

This project was carried out with the double diamond model as basis for the design process. Figure 3 shows the proposed plan and order of methods set prior to the project. The methods were considered as likely to help achieve the set goal. The plan and selection of methods were though updated throughout the course of the project, based on the outcomes of some of the methods, and changes of direction. The final flow of methods can be seen in the Gantt chart in figure 4.

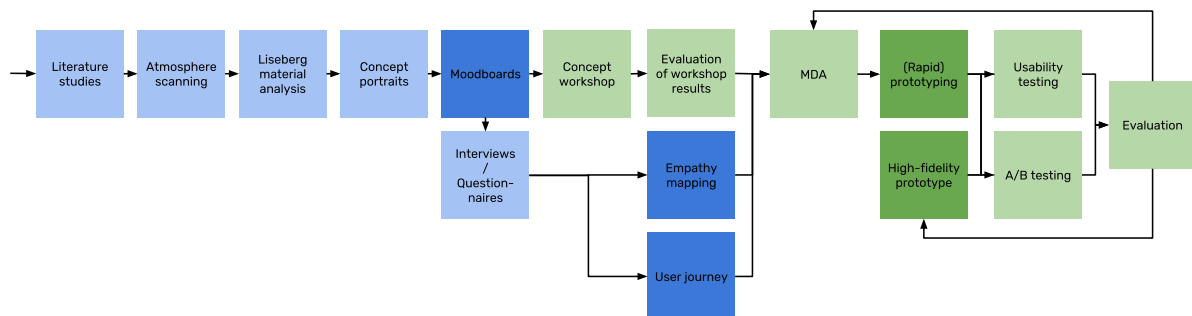


Figure 3: Proposed process plan including selection and order of methods prior to the start of the project.

The first step, which is not included in figure 3, was to define the scope of the project and find a research question. This was done with the help of affinity diagramming with KJ technique and rounds of Crazy 8. When this was decided, background studies were initiated by doing literature studies and testing of related concepts. Findings from literature studies and testing of other concepts are summarised in previous sections of this report.

Emotions, themes and visual details were important when working with this project. Therefore, the first steps after background research were to grasp the current atmospheres at Liseberg and analyse them, before deciding a concept to design. This was done by executing atmosphere scanning and comparing the results with material received from Liseberg known as their 'DNA', including their intended themes and emotions. Concept portraits were then made to generate more words connected the emotions. Results from the concept portraits, atmosphere scanning and analysis of Liseberg's DNA later became input for the creation of mood boards in the *define* phase, which helped the design team decide what themes were most suitable for respective areas. Prior to the define phase, though, were data collection using questionnaires, to gain data from Liseberg's visitors.

The define phase started with empathy mapping based on the questionnaires from the *understand* phase. Quite a short time after the start of the define phase, the *explore* phase was also started to generate ideas and explore possibilities. At this point, a framework for collocated interaction was used, ideas were sketched and storyboards were made. A How-Now-Wow matrix was created to select ideas to present to the stakeholders.

A stakeholder meeting, where ideas were presented and storyboards were shown, required the design team to rethink the concept, leading to a new final concept being defined to suit both the design team and Liseberg.

When the new concept was defined, the *create* phase started. Wireframes were made, followed by and interactive phase, were high-fidelity prototypes, based on the mood boards, were created along with an interactive prototype. With the interactive prototype done, a new iteration of the explore phase started with user experience tests and evaluation.

The final stage of the project included analysis of the results, leading to insights, which then led to definition of factors and guidelines according to the research question.

The final Gantt chart for the project can be seen in figure 4.

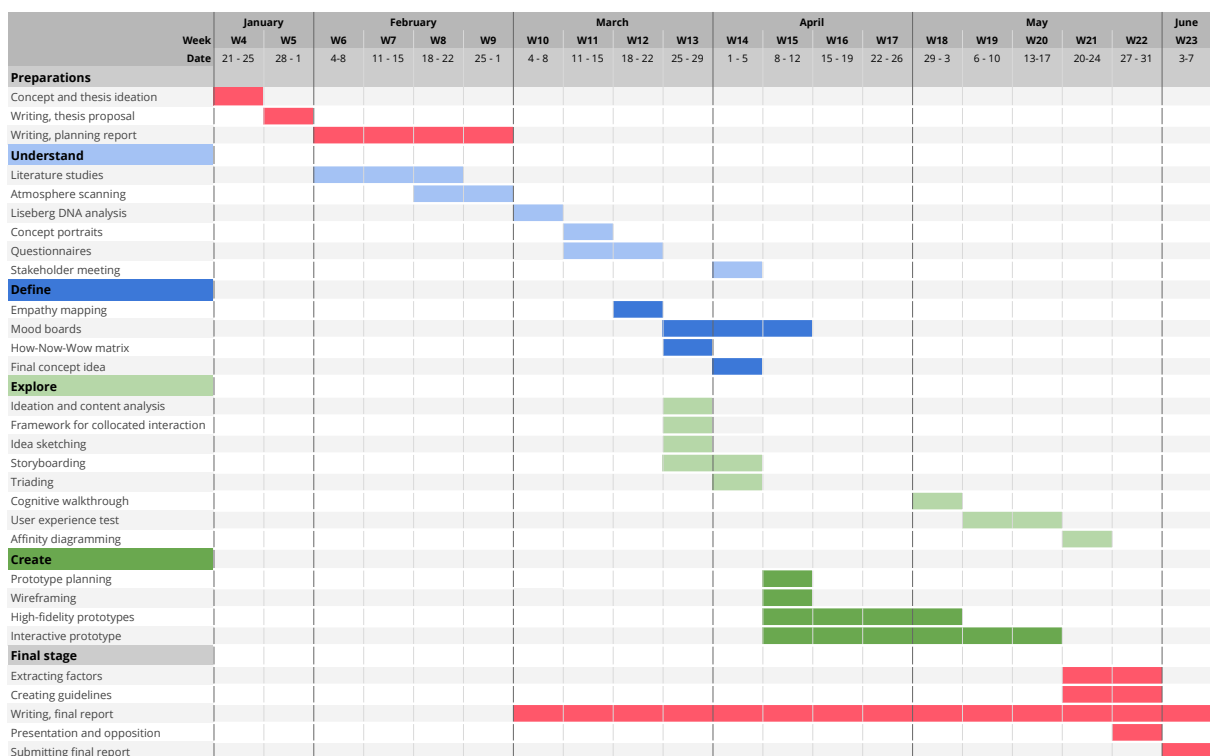


Figure 4: Final Gantt chart for the project, starting 21 January 2019 with week 1 and finishing in the end of May 2019.

7 Project process

This section presents the process of the project, which includes the methods, frameworks and important events.

7.1 Start-up phase

The start-up phase includes an initial meeting with Liseberg and ideation and evaluation of concepts and challenges. The initial meeting consisted of a walkthrough and discussion around Liseberg's visions and challenges between the design team and an employee having the role as digital strategist and project manager for the company. The employee had been decided to be the advisor from the company's side for this master's thesis project.

After the meeting, the design team analysed the data gathered and started ideating on solutions and ideas for the different areas and challenges. During ideation, brainstorming and Crazy 8 were used. All the ideas were then organised using affinity diagramming together with the silent KJ technique. Through these methods, the design team came up with the following categories of challenges: *general park experiences*, *installations*, *queues*, *staff*, *games*, *interactive screens*, *visitor data*, *environment* and *tickets and payment*. The affinity diagram resulting in these categories can be seen in figure 5. The design team afterwards used dot voting to select what category they wanted to continue working with, based on personal preferences. The dot voting resulted in the design team choosing the *general park experiences* category and an initial idea based on the category was formed.

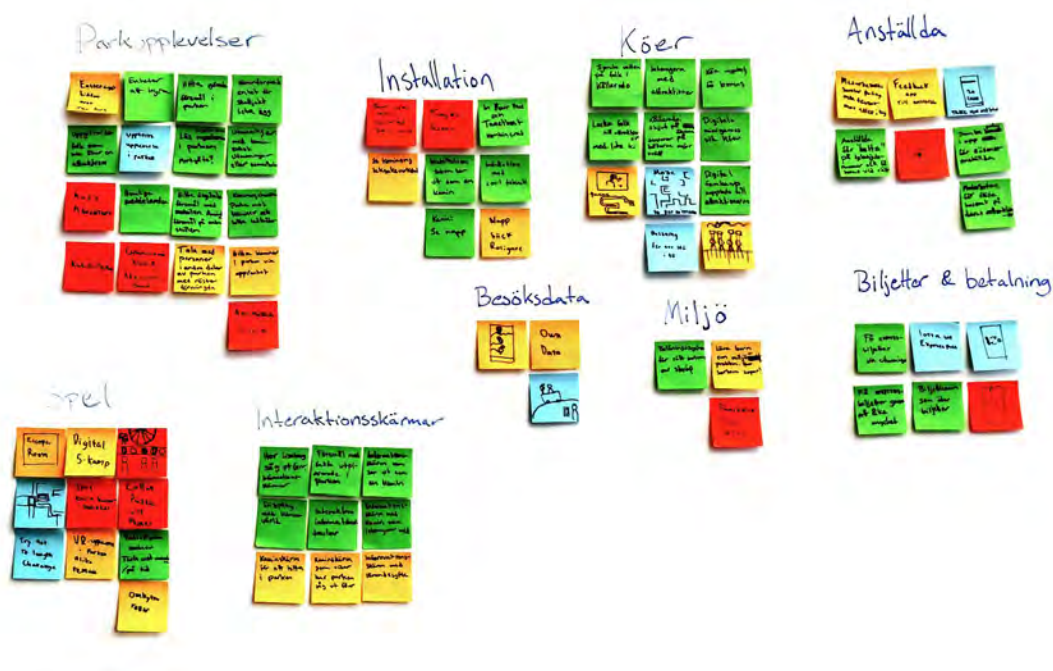


Figure 5: Affinity diagram from concept and thesis ideation.

After the category the design team wanted to continue working with had been selected and the initial idea had been formed, this was presented to the advisor from Liseberg, who concluded that the company would be benefited from a project in this field as well.

7.1.1 Description of initial idea

The initial idea was to create a location-based smartphone game (hereby referred to as 'the application') with the goal to improve the general experience of the theme park. The application would change content and theme based on the current location and contain different challenges, games and stories connected to the different locations in the park. The main objective was to enhance the experienced atmosphere of the locations, without distracting from the physical atmosphere. It would rather amplify and extend the experience. Additionally, the application would work in queues, to make queuing more entertaining, and include a dynamic to attract visitors to the theme park also during low season, which generally is a problem for amusement parks. These objectives were formed in discussion with Liseberg.

7.2 Planning

The planning phase was based on the literature studies including related work, theory and methodology. The *double diamond* design model was selected, which is divided into the following phases: *understand*, *define*, *explore* and *create*. After this, appropriate methods for the phases were selected. The process is described more in detail in the *Process planning* chapter.

7.3 Literature studies

The literature studies consisted of related work, theory and methodology. The design team also tested, explored and read about various applications and games from Liseberg and Walt Disney World. The outcomes of the literature studies and exploration of other applications in the same field are described in the *Theory* section of the report.

7.4 Atmosphere scanning

Important in this project was to understand how the current experience in the park is, including what themes the areas, attractions, buildings and more have, as well as what emotions they are communicating. To collect data on this topic, the design team came up with an own data collection method, named *atmosphere scanning*. The purpose of the method is to imbibe the atmosphere of a real physical environment, and transform it into words.

Since atmosphere scanning is a method created by the design team, it had to be developed during execution of it. This means that the method became more clearly defined in the latter parts of the process.



Figure 6: Execution of atmosphere scanning.

The design team executed atmosphere scanning on most areas and attractions in the park, one after one, and noted down impressions for each. During the process, it was discovered that only the first impressions should be noted, without giving extra time to think it through. The reason was that words that were forced often had a looser or non-existing connection to the actual physical atmosphere at the current location. This made the design team decide that atmosphere scanning should be a quick method, generally not taking more than a couple of minutes (though slightly dependent on the size of the scanned area) and more based on first impressions rather than strong cognition. Later, it was also discovered that spitting out all words coming to mind at first glance could lead to inaccurate and incorrectly formulated words too, caused by not finding the right word for the impression at first. This made the design team to add a constraint of at maximum ten words per attraction, meaning that the participants had to be sure the word was correct before saying it. Another guideline for atmosphere scanning that the design team came up with, was letting the participants express their impressions verbally and have a separate facilitator taking notes. Otherwise, the participants put too much focus on writing notes and might lose the mood the location communicates.

After the atmosphere scanning, the words had to be categorised. The design team discussed different ways to categorise and what names to use for the categories. Chosen categories were heavily based on the definition of 'physical atmosphere' used in this project, and were named *theme*, *visual*, *emotion* and *other*. Themes include overarching themes of the area, attraction or

building, for instance *late 19th century, the Alps, construction, victorian time* and *the Swedish-American emigration*. Visuals include visual attributes of the area, for instance *old ship, run down hotel, serif font, petrol* and *bright*. It was also decided to add impressions imbibed from other senses to this category, for instance hearing and scent. Because of this, *bird song* and similar words are also categorised as visuals. The emotion category is also vaguely defined and includes not only pure emotions, for instance *joy, anxiety, fright* and *dreaminess*, but also words similar or with a strong connection to emotions, for instance *wild, primitive* and *nostalgia*. Words not belonging to any of these three categories were placed in an *other* category, and could include anything from *buying bread* to *Alice in Wonderland* and *Ture Sveton*, i.e. words that were associated with the atmosphere, but did not have a clear visual connection to the theme of the area.

The atmosphere scanning resulted in a table of words for each area, attraction and building, categorised by themes, visuals, emotions and other related words. These words were afterwards converted into a digital affinity diagram, seen in figure 7, using Figma, with all attractions within the areas grouped and with the words colour coded by category for better overview.



Figure 7: Digital affinity diagram of atmosphere scanning. Key: Yellow = themes, green = visuals, red = emotions, blue = other.

7.5 Analysing Liseberg's DNA

By executing atmosphere scanning, the design team got words based on the actual atmosphere surrounding the areas, attractions and buildings, as perceived by observers. Liseberg has their intended atmospheres for their areas and guidelines they follow when developing the park. These guidelines and descriptions are summarised in what they call their 'DNA'. The design team re-

ceived this documentation to analyse and compare with the results of the atmosphere scanning. All words from the atmosphere scanning were checked to confirm that they did not go against the DNA, and words that did were removed. The point from the DNA saying 'Liseberg invites the visitor to a new world. We never leave Liseberg, Gothenburg, the west coast and the Scandinavian culture tradition, though' was the one that stopped the biggest amount of words from the atmosphere scanning, since they alluded on other countries and cultures.

The analyses of the Liseberg DNA also resulted in additional atmosphere related words for each area, and were added to the total collection of words in the digital affinity diagram, seen in figure 7.

7.6 Concept portraits

Words for feelings are abstract and may be interpreted differently by different individuals, based on their life experiences. The same might be for other abstract words, for instance the word *challenge*. To get a better understanding of the common interpretations of the feelings and other abstract words noted for the areas, attractions and buildings in the atmosphere scanning, the design team executed the concept portraits method. The goal was to get more inspiration on what evoke these emotions or similar concepts. For each attraction, one or a couple of the most important concepts (e.g. an emotion) was chosen and was used as basis for concept portraits.

The method was executed almost as described in the *Methodology* section of the report, except for the final step. Instead of summarising the findings using a method for analysis, all words generated were saved for future reference, since the design team wanted quantitative data rather than summaries of the concept portrait results. The team had noted a total number of 2 to 3 words from each motivation, making a total of around 20 to 25 words per abstract words.

7.7 Questionnaire

An important aspect when working with user experiences, is to understand the users and their problems and behaviours. To get data on people's Liseberg visits, a questionnaire was created using Google Forms, and shared on social media. The questionnaire mainly focused on why people visit Liseberg, how they do it and what areas attract them most. It included both open and closed questions.

One of the questions were phrased as 'Which words summarise your latest Liseberg experience?', followed by a number of options. The options were based on words connected to the *experience map* as shown by Danielsson et al. (2011), and included for instance 'surprise', 'together', 'as expected', 'adrenaline', 'achieved a goal' and more. Each of these words can be categorised into one of the four experience types *kick*, *competence*, *contact* and *comfort*, which define different types of amusement park visitors. The question helped the design team to understand which group each person belonged to.

In total, 43 answers were collected. Of these, 12 were categorised as *kick*, 12 as *competence*, 15 as *contact* and 4 as *comfort*. The following list contains the general takeaways from the questionnaire:

- Most people are talking to their company while queuing.
- Many people are checking their mobile phones while queuing, especially those belonging to the *kick* and *competence* groups.
- The majority in each group visit Liseberg for the attractions.
- The atmosphere is important for all groups.
- All groups are visiting Liseberg with company, of which one third is doing it with their partner.
- The average visitor is coming back to Liseberg two or three times a year.
- The ticketing price is the biggest concern for visitors.
- Queuing to attractions is also a concern, especially for *kick* and *competence*.

The top five words that people associated with their Liseberg experiences were the following, sorted by number of occurrences:

1. Together
2. Friendship
3. Adrenaline
4. Everyday escape
5. Beautiful

7.8 Empathy mapping

To get a better view of the results from the questionnaire, four empathy maps were created, one for each of the four visitor types. The empathy maps were created on a whiteboard and the findings were categorised as *think and feel*, *say and do*, *see*, *pain* and *gain*. Additionally, the most popular areas in the groups were counted.

An empathy map can be seen as some sort of persona, but instead of the design team coming up with characters, they are based on real people, making them more accurate. The empathy maps can be used to customise the experience for each of the four visitor types.

Results from the different groups were in many cases quite similar, but the following findings distinguished each group from the rest:

- Kick
 - *Myter och legender* by far the most popular area.
 - Games and wheels of fortune most popular in this group.
- Competence
 - *Myter och legender* and *Liseberget* the most popular areas.
- Contact
 - *Jubileumsplatsen* the most popular area.
 - Concerts the most common reason to visit Liseberg.
 - Food and drinks is an important topic.
 - Culture and areas to hang out in are of interest.
- Comfort
 - The results of most popular area was mixed and therefore not distinguishable.
 - The atmosphere is most important for this group.
 - Food and drinks is an important topic.
 - Culture is of interest.

What can be seen is that the *kick* and *competence* groups generally do not have any special needs, that are not mentioned by other groups too.

7.9 Quick typing as warm-up

When doing ideation, it is important to be creative. To spark creativity, an exercise to warm the mind up can be used. In this project, the design team used the method *quick typing* (Wejlid, n.d.) to better be prepared for ideation. The quick typing method is very simple. A timer is set on two minutes and each participant start writing a story, beginning with 'Once upon a time...'. The idea is that the first words coming to mind should be written, without extra thought. What the story is about does not matter. This method helped the design team warming up before ideation.

7.10 Change of direction

In the middle of the concept ideation phase, the design team got stuck. For more than a week, new concept ideas were constantly generated, but were quickly scrapped again. The problem was in most cases the size of the concept ideas. Very easily, the concepts became too large for the project size. An example of an idea was to create an adventurous game connected to multiple places in the park. Each attraction and area would have their own task concept and to succeed, the player would have to complete the tasks in a certain order. The concept was decided have a story connected to it, for instance to solve a mystery, and the different tasks would lead the player closer to solving the task.

The problem here was the huge amount of mechanics, tasks, stories, and other activities that would result in more clues. The ideas for tasks were often very large and could be as big as stand-alone games. What was needed here was a radical change in the realisation of the project.

A meeting with the design team's academic supervisor led to a change of direction for the project. Instead of having a large amount of mechanics and different tasks, it was decided to focus on one or a few very small mechanics, that are applicable to multiple areas and attractions. Still, results from previous methods could be used as well as before, but now with new applications.

7.11 Cancelled concept workshop

The design team planned to organise a concept workshop with other people. The purpose was to generate ideas on what the tasks in each area and attraction could be. The session was meant to be based around the emotions, visuals and themes from previous methods. The participants would have been divided into groups of three to four people, and provided with lists of words and collages of visuals and themes for the attraction. Also, one visual from a completely different attraction would have been given to them, for them to add to their concept. The reason was that the design team wanted to connect different parts of the park, making the player needing to visit other areas to get an item that would be needed to complete the task. In this way, the story would have been built up.

The concept workshop was quite well-planned and some invitations had already been sent out, when it was decided to cancel it. The reason was the change of direction, mentioned in the previous section, that was decided a few days before. The concept workshop was because of this unnecessary.

7.12 Ideation on mechanics with content analysis

With the new direction for the project, the design team had to come up with small mechanics that could be implemented for multiple attractions and areas. To more easily spark ideas, the team

started out by listing all technologies and sensors a mobile phone can take use of. These were used as reference in the later stages of the ideation.

The ideation on mechanics was mainly executed while walking in the park, somewhat similar to the atmosphere scanning method. For each attraction, small ideas and mechanics were listed. These mechanics included for instance quizzes, exploration of the surroundings, taking photos, measuring pulse, singing songs and solving collaborative puzzles. All ideas were first listed while walking in the park, and were then inserted into a spreadsheet for content analysis.

Each idea in the content analysis was given one or two general themes, to categorise them. For instance, the idea for *Lisebergs trädgårdar* described as 'Writing dreams and guess who's dream it is' was given the themes 'discussion' and 'question'. When all ideas had been given themes, they were sorted by theme and the team tried to find connections between the ideas within the themes. The themes that the team got from the content analysis were the following:

- Digital memories – creating digital memories of the visit at Liseberg, including for instance photos.
- Mobile games – concept ideas for mobile games.
- Personal data – ideas making use of the visitor's personal data, for instance pulse.
- Discussion – activities where the visitors are discussing with each other.
- Explore – exploration of the surroundings.
- Question – quizzes or questions about friends.
- Guessing – concepts where visitors are guessing.
- Physical activity – ideas involving physical activity.
- Sensor – activities making use of the mobile phone's sensors.
- Information – ideas based on giving the visitor knowledge or other information.
- Attraction input – interaction with the real attractions.
- Role play – concepts where the visitors are getting and playing different roles.
- Music and singing – concepts involving singing or playing music.

The design team decided to continue with three of these categories. Mobile games were ruled out because of the sizes of the concepts. Music and singing, as well as attraction input, was removed because it would suit far from all attractions. Information was skipped, since it was considered as too boring and was lacking interactivity. Sensor, discussion and question were all

good ideas, but could all be incorporated into concepts based on other themes. For instance, discussion should be part of all activities. Of the remaining themes, the ones chosen to continue with were 'explore', 'role play' and 'personal data'.

7.13 Framework for collocated interaction

The design team now had three topics to continue working with and develop more concrete concepts about. For a prototype in this project, it would be impossible to implement this for all areas, attractions and buildings in the park, which meant that a few had to be selected. The design team together chose seven attractions to continue with, spanning from a roller coaster to an open garden area, since it was considered important to test implementation for a wide range of physical atmospheres.

As help when applying the three topics to each attraction, the design team used a framework for collocated interaction by Lundgren, Fischer, Reeves and Torgersson (2015). The framework consists of thirteen properties with descriptions and states. It is mentioned in the description of the framework that when doing ideation with the framework as basis, it is recommended to choose four to six properties to play with. The ones chosen by the design team were *focus*, *information symmetry*, *information abilities*, *proximity* and *movement*. For each chosen attraction and topic, a state for each property was chosen, somewhat based on the emotions the areas or attractions are communicating, according to the atmosphere scanning. Table 2 shows as example the properties chosen for *Lisebergs trädgårdar*.

	Explore	Role play	Personal data
Focus	Collaboration	Collaboration	Communication
Information symmetry	Symmetrical	Symmetrical	Asymmetrical
Information abilities	Symmetrical	Asymmetrical	Symmetrical
Proximity	Objects	Objects	Devices
Movement	On the go	On the go	Combined

Table 2: Properties chosen for the garden area.

The properties chosen from the collocated interaction framework were used as basis in the following idea sketching.

7.14 Idea sketching

A total of seven attractions had been chosen to continue working with, and for each, up to three different concepts could be created, making a total of 21 activities. This was to be based around

the properties chosen from the collocated interaction framework. Some ideas had already been discussed, but they were not yet very well-defined. To come up with more ideas for the specific attractions, the design team decided to do an individual idea sketching session. In the session, pen and papers were used and the two members of the group sketched ideas individually based on the three topics and five properties for the seven attractions chosen. Some topics did not suit certain attractions well, and those were decided to skip. An example to this was personal data for the restaurant *Skeppsmagasinet*. Not all of the remaining ones were sketched upon, because 21 activities was seen as too many for the project.

Additionally, the finding from the questionnaires saying that the top five words associated with Liseberg were 'together', 'friendship', 'adrenaline', 'everyday escape' and 'beautiful', was also taken into consideration, combined with the fact that almost all visitors come to Liseberg with company. This gave the design team the restriction that activities should be designed to work with groups of people.

When the sketching session was over, the two members of the design team described their ideas and sketches to each other and gave feedback on how the ideas could possibly be improved further. All ideas were summarised and given a descriptive title:

- *Thieves and polices* (role play, Radiobilarna) – a competitive role playing activity where thieves compete against polices in the real attraction.
- *Viking adventure* (role play, Valkyria) – a collaborative role playing game where players are manoeuvring a viking ship together using different controls.
- *River adventure* (role play, Kållerado) – similar to the Viking adventure, but with another theme.
- *Fairy tale in the garden* (role play, Lisebergs trädgårdar) – a role playing activity where players are playing out an act together as different characters.
- *Roles in Gasten* (role play, Gasten) – a competitive role playing activity, where players are acting as different characters when in the haunted house Gasten.
- *Who in the group?* (role play, Kållerado) – an activity where players are discussing and answering 'Who is the most/least...' questions.
- *Letters along the river* (explore, Kållerado) – a collaborative activity, where players are finding letters hidden along the ride that together form a word.
- *Water the plants* (explore, Lisebergs trädgårdar) – an activity where the players explore real plants in the garden and tries to water the correct ones based on a description.
- *Valkyria pulse* (personal data, Valkyria) – an activity where players are discussing their pulses before and after the ride.

- ### 7.15 How-Now-Wow matrix

After finishing with the How-Now-Wow matrix, the results were evaluated and the ideas that were positioned in *Now* and too far up in *How* were scrapped, as well as one in *Wow*, that had some issues with the connection to the experience of the real attraction. The ones scrapped for these reasons were *Thieves and polices*, *Who in the group?* and *Roles in Gasten*, reducing the total number of ideas from eleven to eight.

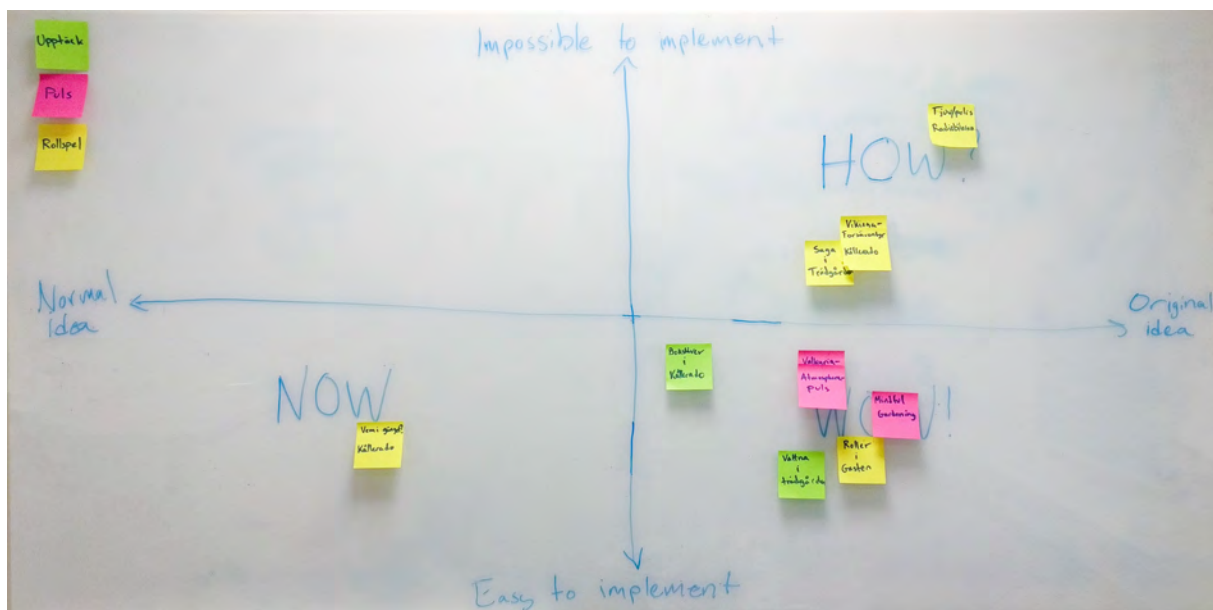


Figure 8: The final How-Now-Wow matrix with the ideas inserted.

7.16 Mood boards

54

created mood boards for all six areas to include in the application. The mood boards were created using Adobe XD CC and Adobe Photoshop CC and consisted of a selection of colours, fonts, objects, photos of environments and settings, and shapes. When creating the mood boards, the results from the atmosphere scanning, analysis of Liseberg's DNA and the concept portraits were used as basis and inspiration, to get them as accurate as possible. The reason for creating the mood boards was to get a common view on the themes in the park and get inspiration when designing the prototypes.

7.17 Storyboarding

After the eight ideas for small activities for the Liseberg application had been decided, the ideas were to be presented to the real stakeholders, including two representatives from Liseberg. At this point, the design team only had the ideas in mind and a few sketches that would not be enough to be shown stand-alone. To communicate the ideas to the stakeholders, the design team decided to create storyboards, one for each of the ideas. The storyboards, of which two examples can be seen in figure 9, were created using pen and storyboard templates, describing the complete flow of the activity, from beginning to the end. Each drawing in the story was complemented with a descriptive caption.

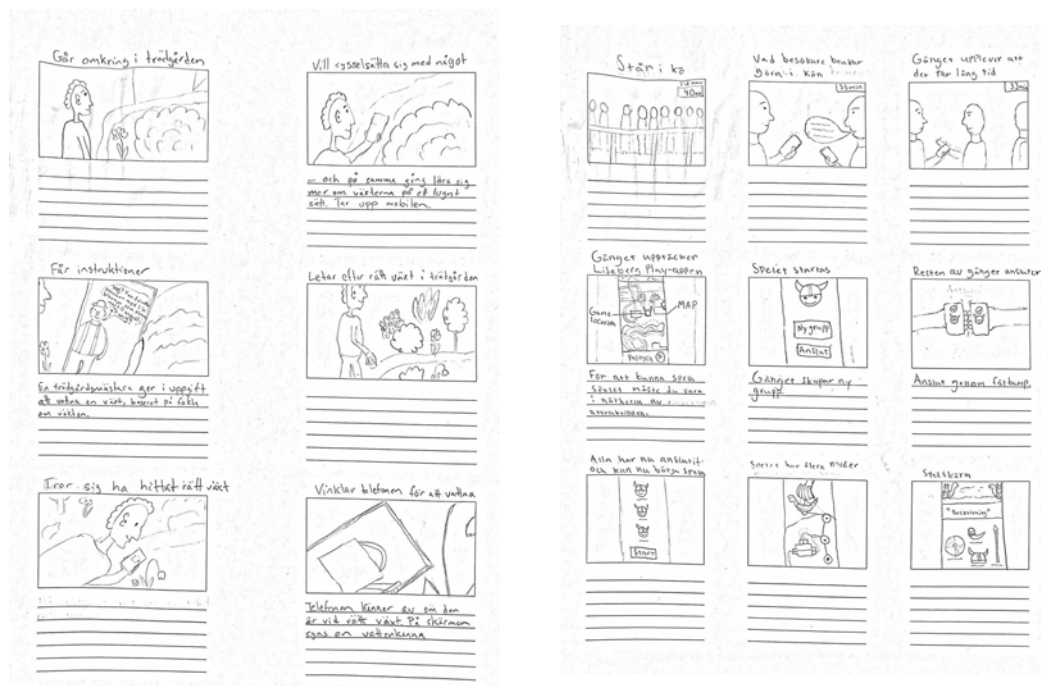


Figure 9: The storyboards for *Water the plants* (left) and *Viking adventure* (right).

7.18 Stakeholder meeting

The ideas and current status of the project had to be presented to Liseberg, to get their view on what had been made so far. A stakeholder meeting was set up with the design team and two

representatives from Liseberg: the creative manager and the digital strategist. The design team started the meeting by describing the process and status, followed by presenting the ideas with the storyboards as help.

Generally, the stakeholders expressed positive comments about the ideas presented. It was, though, decided to focus more on communicating the different areas in the park and interview them, instead of developing specific mechanics for each attraction. The reason was that Liseberg is in a transition phase from an ordinary amusement park, into a theme park with more explicit themes in different areas. Liseberg therefore is interested in ways to communicate the themed areas and their names as a whole to their visitors. They want the visitors to feel like they step into a new world when they walk from one area to another. Liseberg also want a way to introduce the visitors from Liseberg's overarching theme to the area specific themes.

The new focus after the stakeholder meeting was to find a way to better fulfill the new criteria presented by the stakeholders. The previous ideas got positive comments, making it possible to retain parts of them into a new concept, but moved from attraction specific to area specific. There also had to be a way to make transition between areas and have some sort of general concept that would follow through all areas of the park. One idea that came up during the meeting was having a map that changed theme depending on where the visitor was, and having marks on the map showing where the activities were.

7.19 The final concept idea

Since the design team had eight challenge ideas, distributed into three very different topics, it was hard to narrow it down to just one general concept. To simplify these ideas into one concept, the design team brainstormed together with the academic supervisor. This gave the design team another perspective on the project. The final concept idea was a result of taking the essential concepts of each topic and combining them to create a new general concept. From the topic named 'explore', the design team took the concept of *discovery*. From the collaborative mobile game ideas, earlier mentioned as 'role play', the concepts of *cooperation* and *accomplishment* were taken. Lastly, from the topic known as 'personal data', the design team took the concept of *sensors*.

The final idea utilised discovery by making the user visit different areas of the park; areas which the user may or may not be familiar with. Either way, the user should have a new enhanced experience when using the application.

In the concept, the user of the application will be presented a mystery box. The visuals of the box will be connected to the theme of the target area and in this way give a clue to where the user should go to solve the mission. When the users find the correct area, the mission will be presented and the users can start solving it. The solutions of these boxes are either connected to physical elements of the park, or to the smartphone sensors. Since the design team wants to enhance the physical atmosphere, these solutions should be aligned with the theme, the emotions and context of the current area.

7.20 Triading

Prior to the stakeholder meeting, the design team had several ideas for small challenges for the concept. The final concept idea required the design team to rethink the challenges. Inspiration from the previous challenges could be taken, but some new also had to be designed.

All challenges were decided to play on properties that are typical for the areas they are designed for. To find what could be suitable properties for the areas, the design team executed triading.

For each area, properties that are unique or very characterising for the area were listed. These properties included for instance height, harbour, small stores, rippling water etc. The list of properties was used to spark ideas for new challenges for the areas.

The previous challenge ideas from the idea sketching section were merged with the new plans, forming missions. When the merge was done, the prototyping phase of the project began.

7.21 Prototype planning

Before starting with prototyping, a plan for the phase was set up. It was decided to begin with basic wireframing, including setting the layout of the mission screens. After wireframing, high-fidelity screens were to be designed, before implementing testable prototypes by simple programming.

For each mission, an implementation plan was made, including a short description of the mission, what kind of indication should be given on how to solve the mission, and a technical description. The technical description was divided into two parts: one plan for the interactive prototype and one plan for how it could be realised if the concept was to be released to the public. The technical plan for the interactive prototype mainly focused on simulating smartphone sensors, rather than using them, which would require more advanced coding.

7.22 Wireframing

The first step according to the prototype plan was to create wireframes for the missions. The wireframes were created using Figma, allowing members of the design team to work concurrently.

Since wireframes mainly focus on positioning the interactive elements, the wireframes in this project became quite lightweight. The reason was the low amount of interactive elements in the missions, since they are mainly based around sensors and very simple interactions.

Even though the wireframes, which can be seen in figure 10, were lightweight, they helped the design team set the basic structure and positioning of elements, that were to be given a graphical theme in the next step of the prototyping phase.

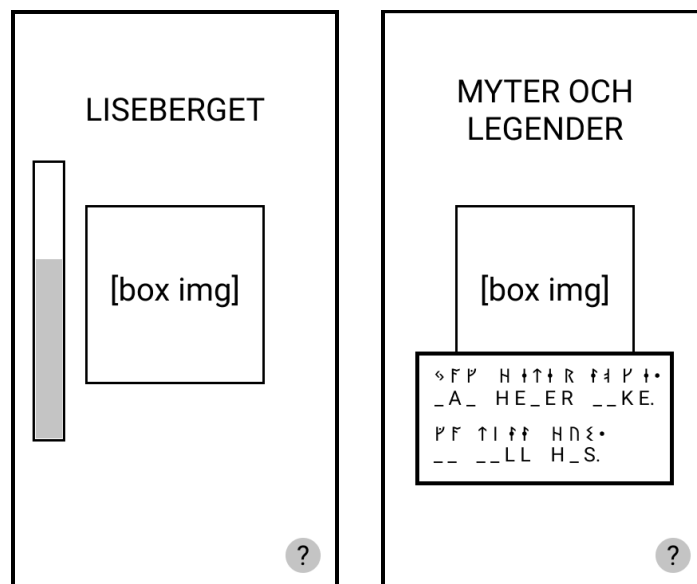


Figure 10: Two examples of simple wireframes.

7.23 High-fidelity prototype

One of the most important parts of the concept is presenting graphical elements that represent the themes and emotions of the areas. Based on the wireframes, the design team created high-fidelity screens with look and feels suiting the missions and areas. Again, Figma was used to create the prototypes; this time together with Adobe XD CC for some refined screens.

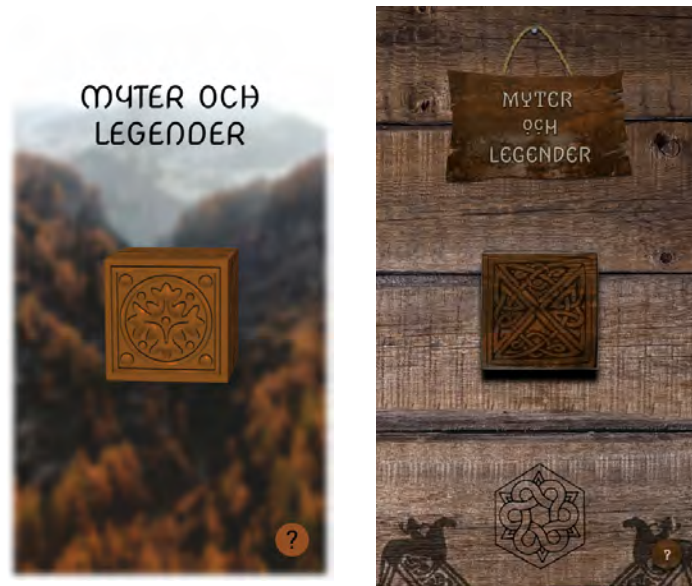


Figure 11: Two different iterations of the same high-fidelity screen. Note the horses at the bottom of the right screen, which were changed into ships later on to better suit the theme.

The themes, visual styles and emotions of the physical areas were important, meaning that each area had to be designed based on research of the areas. In this case, the missions were based on the results of atmosphere scanning, analysis of Liseberg's DNA, concept portraits and the mood boards. Graphical components, images, textures and fonts were put together using a combination of files from the internet, released with free licences, and images created from scratch by the design team. The graphical components were extracted in parts from the high-fidelity screens, to be used when implementing the interactive prototype.

When implementing the interactive prototype, presented in the next section, the process was iterative in combination with redesigning of the high-fidelity prototype, meaning that before making changes to the interactive prototype, the high-fidelity screens were redesigned. The first iteration of the high-fidelity screens were far from the final ones, which can be seen in figure 11, because of that.

7.24 Interactive prototype

The interactive prototype was implemented in an iterative fashion, using a combination of fully implemented functionality together with Wizard of Oz to control location and progress for some of the missions. The prototype was limited to a maximum of four users simultaneously, since the design team would not be able to manage more users for the functionality requiring Wizard of Oz technique.



Figure 12: Four smartphones displaying the interactive prototype.

Web-based prototype

The interactive prototype was made as a web application. The initial reason for this was mainly the skills within the design team being more web focused, but also that the prototype was supposed to work on both Android and iOS smartphones. The team though later found out that accessing various functionality and styling was impossible on the more restricted iOS platform, hence the design team decided to only continue with Android for the prototype.

Technical implementation

The prototype consists of a back end written in PHP, combined with a MySQL database containing the data of the users, areas and missions. The front end is continuously sending requests to the back end and retrieving data used to update the interface when needed. To accomplish this, HTML, CSS and JavaScript (partly using jQuery) was used for the front end. Back end and front end was implemented simultaneously by the design team. Backlogs and the web tool Trello was used to keep track of the process.

Iterations

As mentioned in the previous section, the high-fidelity prototype was updated iteratively before making major changes to the interactive prototype. In this way, solutions could be explored before the design team invested time into implementing the solution. Figure 13 shows a comparison between the high-fidelity prototype and the interactive prototype for one screen.



Figure 13: Comparison between the final high-fidelity prototype (left) and the final interactive prototype (right).

Basic components

The prototype has four basic components always visible: a background, title, box and help button (see figure 14). The background, title and button are connected to the current area, while the box is connected to the current mission. When changing area or mission, the components are automatically changed.

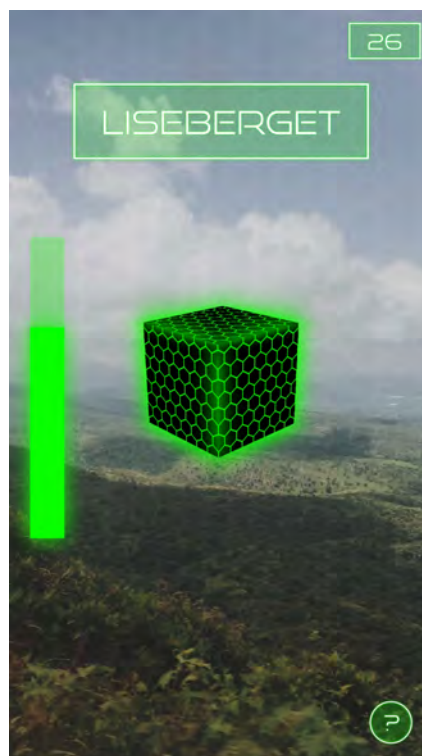


Figure 14: The interactive prototype for mission 1 (*Height*).

Modules

Each mission has a dedicated module containing all components connected to the mission, except the box. When a user enters the area corresponding to the mission, this module will be displayed (see figure 14) and the user can start solving the mission. With these components and modular system, each area and mission can be updated individually without effecting the other parts of the application.

Full screen

Since the prototype should emulate a smartphone application, a start screen (see figure 15a) was implemented when opening the web application. When pressing 'start adventure', the smartphone enters full screen mode, which also should give a more immersive experience and minimise clutter, since it hides the browser and native Android interfaces.

Changing area

The team noticed, when switching areas, that the components were loading at different speeds, making it unclear that the area had changed. The solution was to create a portal (see figure 15b) which closed when exiting the area and opened up when the new area components had loaded.

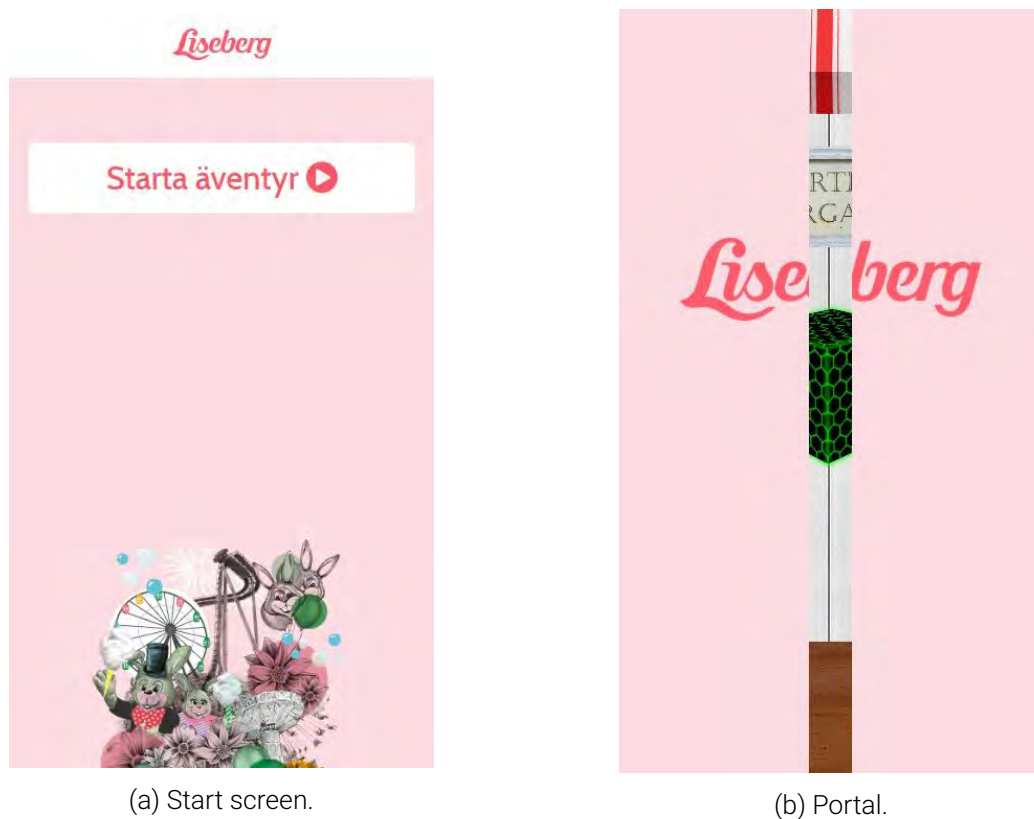


Figure 15

Administrator unit

Together with the client side application, the team implemented an administrator interface (see figure 16) which can control which area and mission each user currently sees on his or her display. The administrator interface consists of four columns of inputs, one for each user. The inputs included are text input for the users' name, two drop-down lists for selecting current mission and area, customised input to each mission when mission is active, and a done button which marks the active mission as done when the user has completed a mission. Below the user specific input, there is also a set of buttons which can set all mission specific values for the users simultaneously. Additionally, in the right corner, a 'reset progress' button to reset the progress for all users is placed.

The administrator interface was used on an Apple iPad (by the design team called the 'admin unit'), controlled by the design team during prototype testing. No focus was put on visual design or perfect usability, since the administrator unit was only to be used by the design team to control Wizard of Oz functionality during prototype testing. The quickest way possible to implement the interface was done.

The screenshot shows the administrator interface on an Apple iPad. It is organized into four columns, one for each player (Spelare 1 to Spelare 4). Each column contains the following elements from top to bottom: a text input for the player's name (John, Maria, Charles, and a hyphen for Spelare 4), two drop-down menus for selecting a mission and an area, a customised input field for the active mission, and a 'Done' button. Below the player-specific controls, there is a section labeled 'Set same for all players:' with a row of buttons numbered 0 to 10. In the bottom right corner, there is a 'Reset progress' button.

Spelare 1:	Spelare 2:	Spelare 3:	Spelare 4:
John	Maria	Charles	-
M9: 3 - Hög puls	M9: 3 - Hög puls	M9: 3 - Hög puls	M1: 5 - Höjd
3. Myter och lege	1. Kvarteret Storç	2. Hamnområdet	1. Kvarteret Storç
Current mission: M9	Current mission: M9	Current mission: M9	Current mission: M1
0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3
4 5 6 7	4 5 6 7	4 5 6 7	4 5 6 7
8 9 10	8 9 10	8 9 10	8 9 10
Done	Done	Done	Done
Set same for all players:			
0 1 2 3 4 5 6 7 8 9 10			
Reset progress			

Figure 16: The administrator interface as seen on the Apple iPad.

Sensors

Four of the missions were intended to use smartphone sensors, including two which should use activity bands to measure the user's pulse. Since the design team did not have access to activity bands nor had the time to implement this functionality, it was simulated through the administration unit. The other two missions using sensors, are using the built-in smartphone sensors, accessed by JavaScript. The sensors can track tilt of the smartphone back to front, right to left and the compass direction. With the help of back to front tilt, it is possible to calculate if the users

is looping the device, which was necessary for one of the missions. The left to right tilt is used in a mission where the smartphone was simulating a water bucket. When tilting the phone too much in one direction, the water pours out.

QR signs and runes

Two of the missions required exploration of very exact positions in the park. This was in the interactive prototype solved using QR codes, confirming that the user was at the right position. The QR codes had to be positioned on the ground and to keep them in place, QR signs were created. The codes were printed and round sticks were cut in pieces of approximately 15 centimetres, with edges cut at 45 degrees, making the codes tilt in one direction. Because of the outdoor locations, the signs had to be weather resistant, making the design team laminate the QR codes, before gluing them to the round sticks at the 45 degree edges. The QR codes, of which two can be seen in figure 17, were positioned at the correct locations in the park during the upcoming tests, by being pushed into the soil.



Figure 17: QR signs being built.

One mission required papers with runes on distributed in one physical area. Also in this case, the papers were laminated, before being put up in the park using tape and adhesive putty. The lamination made both QR signs and runes resist rain.

7.25 Cognitive walkthrough

The initial plan with cognitive walkthrough was to test that everything worked with the interactive prototype before the tests. Since cognitive walkthrough is evaluating usability and not general

user experience, the design team noticed after testing two of the mission that this method would not result in what was needed. In the digital experience, perfect usability is in many cases not wanted because a part of the experience is to figure out what to do. This led to the design team deciding to cancel the method. Instead, it was decided to go through the experience and log technical issues and usability problems, which can be seen in figure 18, needed to be fixed before the pilot tests.



Figure 18: Instead of cognitive walkthrough, the design team did a technical test. Here, an early iteration of the administrator interface can be seen.

7.26 User experience test

The user experience tests focus mainly on the general user experience, unlike usability tests where the goal is to find as many issues regarding usability as possible. The design team was interested in how the user experience of Liseberg is influenced by the digital artefact, in this case a smartphone application. The team later realised that it is hard to solely test user experience,

since usability is something that has a great influence on general user experience and is very noticeable if it is bad. To minimise the risk of usability issues, the team made some internal tests and then two pilot tests to discover and fix high-priority issues before the real tests. Since the user experience tests were to be carried out with observations, extensive usability feedback would be generated. The design team decided to create a questionnaire focused on the user experience to gain insights into what the users really thought and felt about the experience.

7.26.1 Questionnaires

There were two types of questionnaire, as seen in figure 19: one for the users testing the application to fill in after the user experience tests and another for the visitors in the park without knowing about the application. In both questionnaires, there was a map where the user were to fill in the names of the respective areas. Another part also being included in both questionnaires was a list of eight words which the users/visitors were to rank on a nine point scale, how well they thought the words suited the area they were currently in. The users testing the application answered this for every mission they carried out, after completing a mission, together with the following additional questions: how the application affected their experience, how well mission and the visuals of the interface suited the area, how it could be improved and finally how they would rate the overall experience of the mission. In the end, the users filled in their age, how many times they went to Liseberg last year, additional comments and optionally an email address.

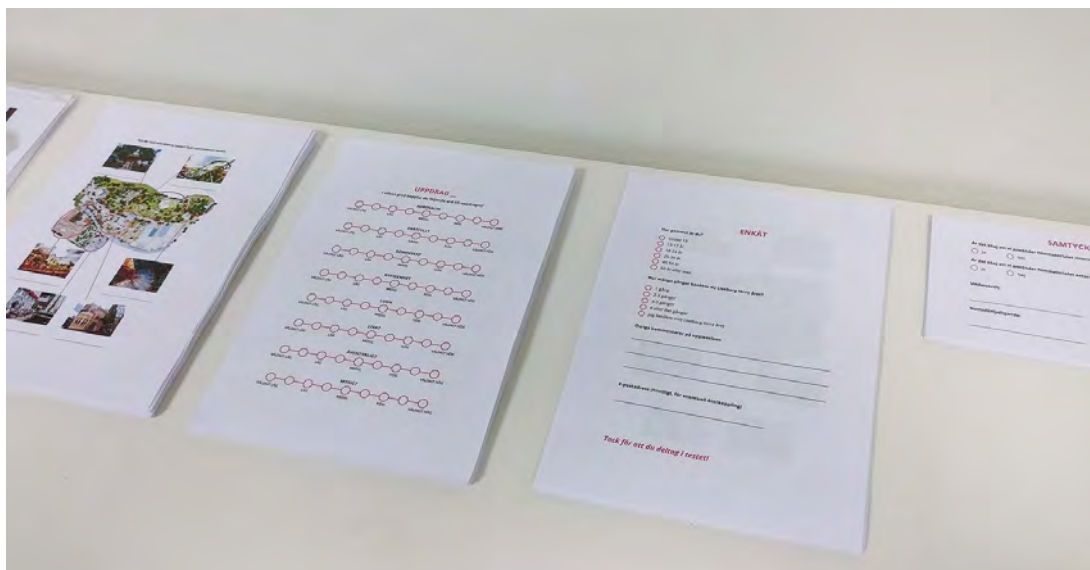


Figure 19: The questionnaires.

7.26.2 Observations

During the tests, one of the designers in the design team controlled the administration unit, while the other was focused on observing and taking notes. During some of the tests, the team recor-

ded video and/or took photos both for internal research purpose and external usage in presentations as well as showcasing of the concept. In these instances, the team handed out and collected consent forms where participants filled in if they accepted usage of the material internally and/or externally or not, together with a signature and clarification of signature.

7.26.3 Pilot test

Pilot tests were carried out with Liseberg employees when the park was closed to the public. The missions were arranged in a sequence, taking locations and type of mission in account. This sequence was divided in two halves and carried out by two different pairs of testers, one in the morning and the other in the afternoon the same day. The procedure of the test was aiming to emulate a real test, including introduction to the concept, and formalities around the test, including telling them that the design team will stay behind and observe and take notes. During these tests, the team got extensive feedback and insights about usability, but also how the execution of the tests can be improved. The design team thinks that the employees of Liseberg have better knowledge about the park, which might make it easier for them to find the correct location and solve some of the missions. After the pilot tests, the design team discussed the outcome and made some adjustments and improvements to the prototype.

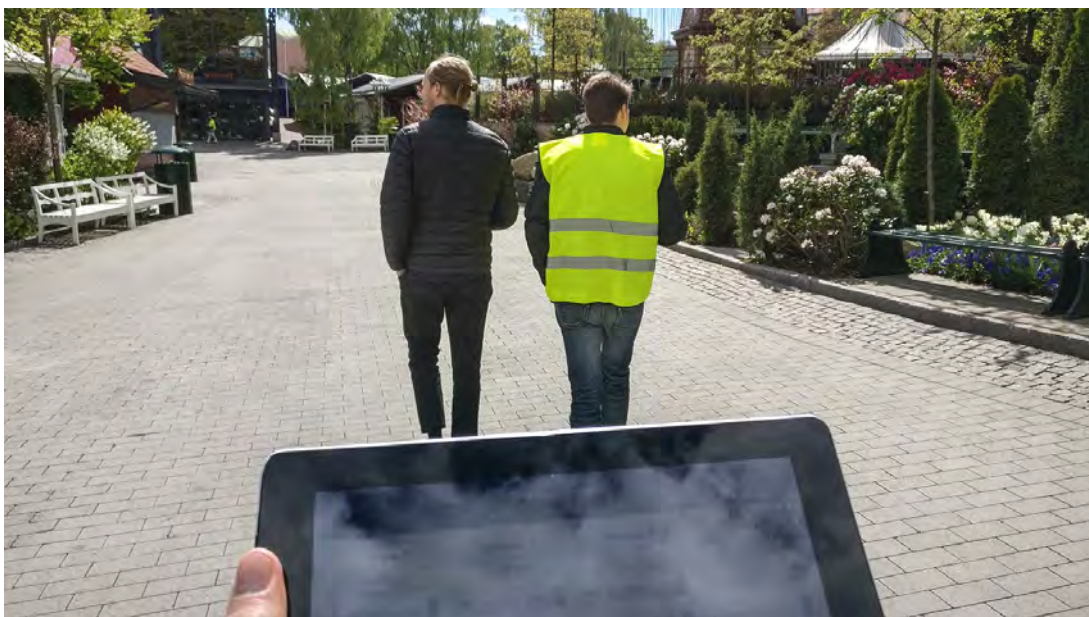


Figure 20: Pilot test with Liseberg employees.

7.26.4 Tests with visitors

The tests with visitors in the park were carried out by approaching them and asking if they would like to test the digital experience. If they were interested, the design team gave formalities about how the test would be conducted. After that, the design team gave a brief introduction to the

concept, handed the smartphones to the visitors and gave them signal to start. The users started in one area and got a mission from another to make sure they at least had to move around in two different areas. The groups of visitors varied from one to four. As mentioned, after each mission, they had to fill in a mission questionnaire before being asked if they wanted to continue with another mission or stop the test. When they wanted to stop, they got to fill in the final questionnaire, before getting a chocolate bar as reward.



Figure 21: Two visitors testing one of the missions.

7.26.5 Tests with interaction design students

The design team invited four interaction design students to a full day of testing. The purpose was to test all missions and the entire concept, but also to get other designers perspective on the experience. The design team noticed that the tests with designers resulted in much more extensive feedback during the test than with any of the other visitors participating. This full day of tests was carried out similar to the tests with visitors, but this time the participants could choose to walk around more freely, riding attractions and take breaks where they could discuss the current mission they were trying to solve. This test resulted in usage closer to the intended usage of the application, where the digital focus is secondary.

After the tests, the notes and data were transferred to digital format.



Figure 22: Test with interaction design students. To the right, a facilitator controlling the administrator unit can be seen.

7.27 Affinity diagramming of user experience test

After the last day of testing, all feedback and comments gathered, together with the observations from the user experience tests, were summarised in an affinity diagram. The diagram was grouped by mission and divided into three categories: negative comments, positive comments and suggestions for improvements. The final affinity diagram can be seen in figure 23). After this, the design team went through the groupings one by one and derived insights which they categorised in the following way:

- | | | |
|-------------------------|----------------------------------|----------------------------|
| • Questionnaires | • Progress | • Usability |
| • User experience tests | • Smartphone usage | • Distribution in the park |
| • Theme | • Environmental focus | • Park information |
| • Visibility | • Distractions in user interface | • Target group |
| • Emotions | • Audio | • Improvements |
| • Introductions | • Narrative | • General concept |
| • Natural borders | | • Other |



Figure 23: Affinity diagram of user experience test results. Key: Green = positive comments, orange = negative comments, yellow = suggestions, pink = other observations.

7.28 Extracting factors

Factors were derived from a combination of what the design team wanted to know before they designed the prototype and what they found out during and after the user experience tests. The factors were derived to act as a foundation for the guidelines and focus on the context of a theme park. In practice, the design team tried to plan how to test the factors listed before the evaluation, i.e. *Noise/Audio*, *Light*, *Mobility/Obstacles*, *Weather/Rain*, *Queue and waiting time* and *Theme*. Testing of all of these factors relied on observations, including *Noise/Audio*, which was consciously planted to be tested in one of the missions. After evaluation and result analysis, the factors were reworked to match the findings. The final set of factors are listed in the *Final result* section.

7.29 Creating guidelines

The guidelines were derived from the categories and insights listed in the section about *affinity diagramming of user experience test*, together with the insights derived from an analysis of the process. The insights considered to be relevant for other people designing digital artefacts for physical experiences were selected and then rephrased into guidelines. The guidelines were then reworked and sorted into the following categories: 'Design process', 'Design of activities', 'Physical dimension' and 'Usability'. This was done in iterations until the design team were satisfied with the result. The final guidelines are listed in the *Final result* section.

8 Final prototype

The final product designed in this project was a smartphone application, simulated as an interactive web application prototype. The concept is based around solving missions in six differently themed areas of the amusement park Liseberg. Each mission is only solvable when being in the correct area of the park. To find the correct area, the user is given a digital box, designed with a theme based on the correct area. For instance, the box for *Hamnområdet* (the harbour area) is wooden with an address label and an anchor symbol, resembling the theme of the area. The user therefore has to explore the different areas of the park to find the correct one.

When coming to the correct area, the mission starts. All missions, which are ten in total, are presented one by one in the upcoming sub-sections of this chapter. When the mission is completed, the user gets points for finishing it, and is given a new digital box for another area of the park. There is also a possibility to skip missions.

When walking between different areas of the park, the interface changes theme depending on what area the user is currently in. This happens no matter what box the user currently has. The only component not changing between areas is the box, making the user notice that the box is or is not belonging to the current area.

The missions in the application are based around different parameters of the locations. Some are focused on mechanics that are regarded as suitable for the area, for instance getting more adrenaline, and some are more based on scenarios that suit the theme, for instance exploring and discovering items in the surroundings.

8.1 Areas and missions

In this section, all areas and their respective missions are presented. Important to note is that mission names presented in this section are not displayed to the users of the applications, since some of them would spoil the challenges. The names were used to communicate within the design team and are inserted here as descriptions.

8.1.1 Liseberget

Liseberget is a hill located in the park, and one of the six areas. The material collected by the design team showed that the area, and especially the attractions *Helix* and *Atmosphere*, has a futuristic theme, meaning that the components of the interface got sharp and simple shapes and fonts, and a futuristic look. Some of the attractions are using a green colour, making the design team select different nuances of green as the main colours. Since *Liseberget* is a hill surrounded by woods, the background image of the interface shows a green valley as seen from a hill.

The box designed for Liseberget is black, with a green hexagon-shaped pattern, resembling the one of the attraction Helix. The box is glowing with a green tone, to get a futuristic expression.

Mission 1: Height

The *Height* mission is one of the missions belonging to Liseberget. When coming to the correct area, a vertical progress bar is displayed on the screen. The further up the hill the user gets, the more the progress bar is being filled. The opposite happens when going down the hill. At the top of Liseberget, the progress bar is still not completely filled. This indicates that the user has to get even higher. The only way to do this is riding the attractions *Atmosphere* or *Lisebergshjulet*, which are the tallest attractions of the park. When riding one of these attractions, the mission is completed.

The *Height* mission is more based on a mechanic of the area, rather than a scenario. Height was selected, since it is a unique property of the location, and for that reason seen as suitable. Research of the area showed that *adrenaline* is a key word for Liseberget, and by making the user ride an adrenaline-filled attraction, which Atmosphere could be seen as, the design team predicted that adrenaline levels would rise.

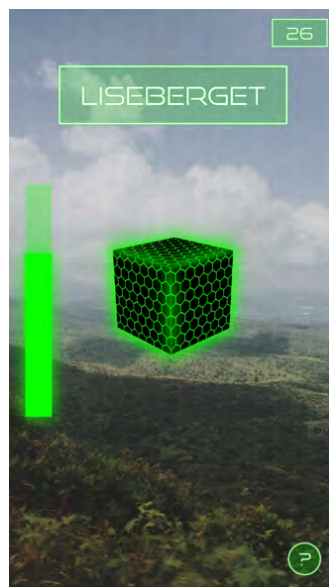


Figure 24: Mission 1 (Height).

Mission 2: Upside down

The second mission for Liseberget is also mechanic-based and has adrenaline as one of its key word, but this time the mission is connected to the attraction *Helix*. *Helix* is a roller coaster having seven inversions, meaning that it is going upside down seven times. The mission is to complete seven loops with the mobile phone. This could either be done by simply riding Helix, or by rotating the smartphone around the horizontal axis seven laps, within a time limit as long as the time it takes for Helix to complete one run.

To indicate what has to be done, the mission starts with seven drawn circles, that are not filled with colour. As a complement, a green laser-styled ribbon is going horizontally across the screen, which is moving vertically up and down when the user is rotating the device around its horizontal axis. This gives a hint to what axis the device has to be turned around. The more laps the device is rotated, the more of the circles are filled with green colour. When all seven are filled, the mission is completed.

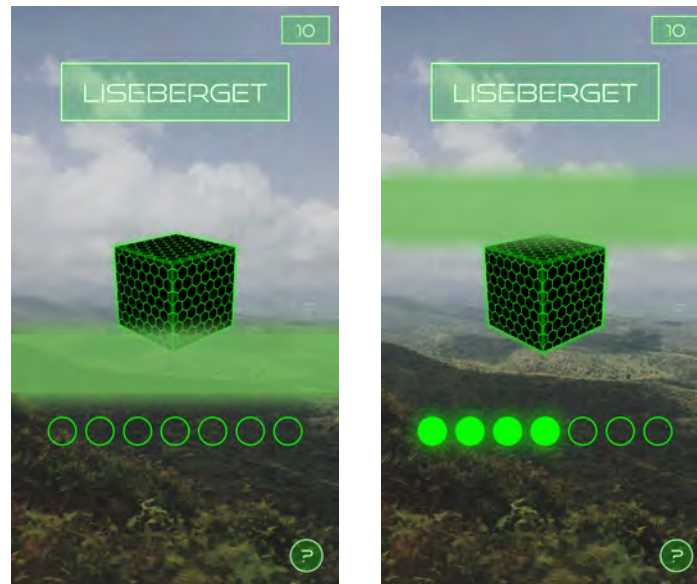


Figure 25: Mission 2 (Upside down).

8.1.2 Lisebergs trädgårdar

Lisebergs trädgårdar ('Liseberg's gardens') is a garden area situated on the lower parts of Liseberget. The area has a victorian style, dating back to the second half of the 19th century. Key words for the area are *passion*, *love*, *happiness* and *dreams*, and the area is filled with flowers, trees and bushes. Benches and attractions have the typical detailed victorian shapes, and colours are happy but not extreme. The area should evoke positivity, but also has one small part called *Den förbjudna trädgården* ('The forbidden garden'), that is darker and has dangerous plants locked into cages. Atmosphere scanning resulted in the team getting a fairy-tale like feeling, with mostly the good, but also elements of the bad.

The interface for the Lisebergs trädgårdar area make use of typical victorian colours and detailed fonts and shapes. The background image consists of a zoomed in brown victorian book cover texture, and drawn images of flowers and a girl with typical victorian upper class clothes. The goal with the interface theme was to evoke emotions connected to childrens fairy-tales, and to make use of the victorian style to the maximum.

The box designed for Lisebergs trädgårdar is white, with black victorian shapes and victorian-styled chest knobs.

Mission 3: Together

The *Together* mission is one of the missions belonging to Lisebergs trädgårdar. The mission is based around happiness and love, and the goal is to come as close together as possible to the company the user visits the park with. The mission is completed when all are together and the smartphones are almost touching each other.

To indicate what the company should do, the users get a progress bar with seven victorian-shaped hearts on the screen. The closer together all people in the company are, the more hearts are filled with red colour. When they are as close together as possible, all hearts are filled and the mission is completed. This mission is, similar to the two missions in Liseberget, closer related to a mechanic or emotion related to the area, rather than a scenario.



Figure 26: Mission 3 (Together).

Mission 4: Finding plants

The *Finding plants* mission is heavily based on the previous concept idea called *Water the plants*, presented in the idea sketching section of the process chapter. This mission is more based on a scenario connected to a garden, rather than a simple mechanic. The goal is to explore and discover plants in the real garden.

When coming to the area, the user gets a list of three plants. All plants have a short description, which works as a clue, but the names are replaced by question marks. By reading the descriptions, the user has to figure out what plant it is referring to. To select a plant, the user first has to find it in the garden and then scan a QR code next to it, using the magnifying glass button in the interface. When scanning a plant, a pop-up with a photo of the plant is displayed, together with a description. If the plant is in the list, the name is revealed in the list and a tick mark is made next to it, otherwise the user gets negative points for guessing wrong. When all three plants are found, the mission is completed.



Figure 27: Mission 4 (Finding plants).

8.1.3 Lisebergs lustgård

The most anonymous area of Liseberg is probably *Lisebergs lustgård*, because of its location and lack of attractions. It is situated in a corner of the park, on the lower parts of Liseberget. The area consists on narrow gravel paths, winding between trees, bushes, flower beds and a stream. There are also small wooden cottages and a windmill, built with an 18th century style. Key words for the area is *recreation* and *nature* and it should evoke serenity and work as a time-machine to the rural life a few hundred years back.

The interface designed for Lisebergs lustgård is having a dark wooden texture background, resembling the material the cottages are built with. The screen is surrounded by flowers of different colours, butterflies, birds and a lantern hanging from the top of the screen. The goal was to evoke serenity, by reflecting the beautiful nature.

The box designed for the missions in Lisebergs lustgård is an old wooden box, partly covered with ivy.

Mission 5: Serenity

Since recreation is a key word for Lisebergs lustgård, one of the missions is to rest and become serene. The mission *Serenity* is loosely based on the previous concept idea called *Mindful gardening*, but moved from Lisebergs trädgårdar to Lisebergs lustgård.

After being to areas of the park where adrenaline is high, the heart of the user might beat heavily. To complete the *Serenity* mission, the user has to get a low pulse. This could be done for instance by sitting on a bench in the area and relax, while looking at the surrounding nature.

To indicate what the user should do to complete the mission, the screen has different levels of blur and brightness. The higher pulse the player has, the darker and more blurred the screen is. When reaching a low pulse, the blur and dark overlay of the screen disappears and the mission is completed.



Figure 28: Mission 5 (Serenity).

Mission 6: Collecting water

Opposite to the *Serenity* mission, the *Collecting water* mission is based around a scenario that suits the theme of the area. Back in the 18th century, people did not have water taps inside their houses, meaning that water had to be collected from wells and other sources. This mission plays out a scenario when the people living in the cottage is out of water.

When coming to the area, the user gets a message from the inhabitants calling out that they need help and that the user should bring his or her friends. When approaching the cottages, the user gets a new message instructing the user to take a bucket and collect water from the nearby stream. The user gets a bucket icon on the screen and has to set off to the stream to scan QR codes to collect water from the stream. There are three QR signs at three different places along the stream. The one that is closest to the cottage gives 2.5 litres of water, the one at an intermediate distance from the cottage gives 5 litres of water and the one farthest away gives 7.5 litres of water. The user has to walk patiently back to the cottage to deliver it, since when the smartphone is tilted, water flows out of the bucket.

The *Collecting water* mission is collaborative, since the cottage needs a hundred litres of water for the mission to be completed. Each user has one bucket, which can take at maximum ten litres of water. This means that the users have to go to the stream several times to complete it. The more users that are working together, the faster it goes. Also, users get individual points for every litre of water they bring back to the cottage, to trigger everyone to help out.

The mission was born out of the previous concept idea *Water the plants*, but instead of watering plants, the mission was changed into collecting water to the cottage, since it better suited the location. The part of finding plants was instead kept for the *Finding plants* mission in Lisebergs trädgårdar.



Figure 29: Mission 6 (Collecting water).

8.1.4 Hamnområdet

Hamnområdet ('the harbour area') is an area of Liseberg which includes restaurants, a pub, a dance hall and a ghost house. The area has a harbour theme, resembling a harbour in a bigger Swedish city during the early 20th century. There is a combination of houses reflecting different social classes in the area, with everything from upper class buildings and *landshövdingehus* to pirate lairs and run down warehouses. A theme for the area is cargo, and signs in the area also indicate that the Swedish emigration to America during the late 19th century is another. A key word for the Hamnområdet is *lively*.

Items associated with harbours became an obvious part of the Hamnområdet interface. The background image consists of a wall with white flaked colour, and pieces of advertisement from the emigration to America. At the bottom of the screen, a wooden wharf is visible.

The box designed for Hamnområdet is a wooden cargo box, with a burnt in anchor symbol and a small address label on one side. The reasoning behind the box design was the cargo theme of the area and the large amount in wooden cargo boxes in the real physical area.

Mission 7: The declaration form

Cargo and shipping is one of the main themes for the Hamnområdet area. The theme is generally communicated to the visitors using props and signs in Hamnområdet; no attractions or activities in the area are related to the shipping theme. The mission *The declaration form* is trying to improve the communication of the shipping theme, by creating a scenario where cargo is in focus.

When coming to the Hamnområdet area, a declaration form for the box is shown on the screen. What the user has to do, is to fill in the information missing. Given is a sender company name and the name of the shipping company. What has to be filled in is the address of the shipping company, and what product the box contains. The missing information can be found by searching on signs in the physical area. The address of the fictional shipping company is found on an advertisement sign for the company on a facade of a building, and the product name can be found on a sign about the sender company at another place in the area. When entering both the name of the correct product and the correct address of the shipping company, the mission is completed.

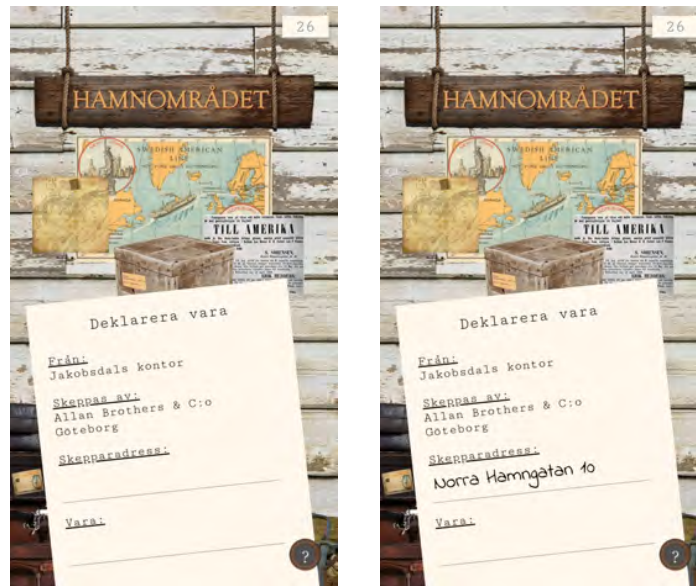


Figure 30: Mission 7 (The declaration form).

8.1.5 Myter och legender

Myter och legender is an area with a theme dating back to several hundred years ago in the Scandinavian history. It is, together with Liseberget, one of the two areas that are focusing on more extreme attractions than the rest of Liseberg. Houses and attractions are wooden, to resemble constructions of the past. A majority of the area is based around the viking age, and attractions are named after people in Norse mythology. The part closest to Hamnområdet, though, is based approximately around the 18th or 19th century, but still has a connection to the rest of the area as seen to texture and props. A key word for *Myter och legender* is *adventure*, creating a combination of *danger*, *excitement* and *fellowship*.

Opposite to the interfaces for some of the other areas, the *Myter och legender* interface has no graphical components resembling real objects, except for a sign displaying the name of the area. Otherwise, it is only styled using a wooden texture background, and a silhouette drawing including viking ships burnt into the texture.

The box for *Myter och legender* is wooden and with a pattern resembling the patterns visible on the real life buildings of the area.

Mission 8: Transcribing runes

During the viking age, runes were the type of letters used to write. A heritage from the viking age, still present at some places in Scandinavia, is runestones. The runes most common in Sweden from this time are runes known as short-twig Younger Futhark runes. This alphabet consists of only 16 runes, meaning that some runes represent more than one of today's letters.

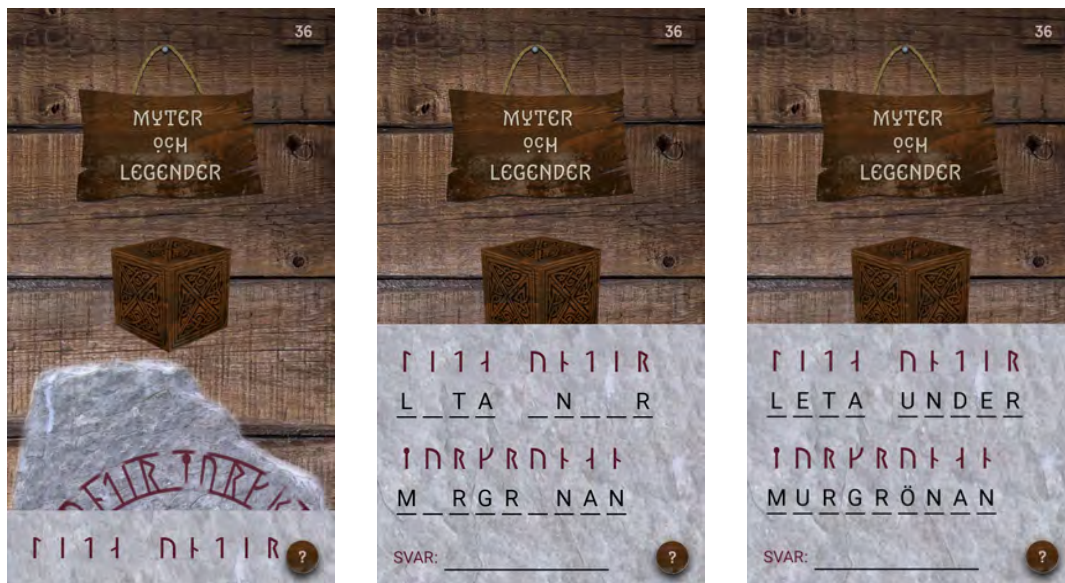


Figure 31: Mission 8 (Transcribing runes).

In the *Transcribing runes* mission, users are receiving a runestone to transcribe to today's language. To solve the task, users have to search for runes hidden in the physical area. Each hidden rune is complemented with what letters of today's alphabet it represents. On the screen, the users can enter the letters when found, to decode a message on the runestone. The message guides the users to a specific place in the park, where a last text is hidden. When entering a name found in the hidden text in an 'answer' field in the interface, the mission is completed.

The *Transcribing runes* mission focuses on a small scenario of the heritage from the viking age, and tries to evoke an adventurous and exciting feeling. The mission works best when collaborating with friends, since users can then try different letters each for the runes representing several letters. In this way, it tries to create fellowship.

Mission 9: High pulse

Opposite to the *Serenity* mission for Lisebergs lustgård, the *High pulse* mission for Myter och legender is aiming to increase the pulse of the user. The intention is to get the emotions of going on a dangerous adventure.

When entering the area, the box starts beating at the same pace as the user's heart. When the pulse is going up, it beats even faster. The goal is to reach a high pulse, which could be done by riding one of the roller coasters in the area. When a pulse high enough is reached, the mission is completed.



Figure 32: Mission 9 (High pulse).

8.1.6 Kvarteret Storgatan

In the centre of Liseberg, the area *Kvarteret Storgatan* is located. The area resembles a small town in Sweden during the 1930s, with wooden colourful small stores and cafes, sett paving and nostalgic signs. Key words for the area are *nostalgia*, *cosiness* and *fellowship*.

The interface for Kvarteret Storgatan tries to imitate a setting in a 1930s town store, displaying small food boxes, a plate of biscuits and flowers in a vase, with a white wooden wall and an awning with red and white stripes, resembling a typical awning from the targeted era. The ambition was to make it look cosy and inviting.

The box designed for Kvarteret Storgatan is a package of biscuits from a fictional company named *Karlssons kakfabrik* ('Karlsson's Biscuit Factory'). The colours and style of the box and logotype was aiming to match those popular in the 1930s.

Mission 10: Visit Sten-Åke

In the Kvarteret Storgatan area, a statue of the famous comedian Sten-Åke Cederhök is standing in a corner of the street. Cederhök was popular during the second half of the 20th century and is probably most famous for his role as Albert Karlsson in the humorous TV series *Albert & Herbert*. The mission *Visit Sten-Åke* is a simple mission where the user has to walk up closely to the statue of Cederhök. The goal is not directly indicated in the interface. Instead, audio clips from Albert in the TV series guide the user to the right place.

When entering the area, an audio clip of Albert saying 'Hebbe lille' (a phrase used by Albert to call his son Herbert) is played from the smartphone. If the user continuous walking towards the statue, the same audio clip will be played again every now and then to confirm that the user is

walking in the correct direction. If walking in another direction, away from the statue, an audio clip with Albert saying 'Vart ska du ta vägen nu då?' (a phrase meaning 'Where are you going now?') is played. This indicates that the user should change direction. When standing within a metre from the statue, the mission is completed.

The goal with the *Visit Sten-Åke* mission is to bring nostalgia and a feeling of fellowship by being called on by Albert.



Figure 33: Mission 10 (Visit Sten-Åke).

9 Test results

This section presents the results from the user experience tests. Also, the results of the survey about visitors' knowledge of Liseberg's areas with and without having used the application created in this project is presented.

9.1 Outcomes from user experience tests of missions

This section presents comments, results and outcomes from the user experience tests of the application. For each mission, scores given by users are presented. The 'area match' score shows how well the users thought the mission matched the area ('How did you think the mission matched the area?'). The 'graphical match' score shows how well the users thought the graphical interface matched the theme of the area ('How did you think the graphics matched the area?'). The overall score shows how fun the users thought the mission was ('What did you think about the mission?'). Also included is the number of users the scores are based on.

9.1.1 Mission 1: Height

Area match	Graphical match	Overall score	Based on
7.8 / 9	4.8 / 9	7.3 / 9	4

The *Height* mission for Liseberget was only tested with one group of four people. The main issue noted with this mission was the mismatching box for the task. The mission was connected to the attractions *Atmosphere* and *Lisebergshjulet*, but the theme of the box had a strong connection to the theme of the roller coaster *Helix*, another attraction in the Liseberget area. The theme mismatch made users confused and a low score on graphical match was given.

Users commented on the height progress bar only showing the current height, and the lack of a mark showing the highest position reached. If, for instance, users would ride *Helix*, they would afterwards not see how high they had reached when riding the roller coaster. The design team otherwise received positive comments about the progress bar, since the users liked seeing updates on their progress while trying to figure out the task.

- + Immediate feedback when proceeding.
- Highest altitude reached not displayed.
- Box not matching the mission, making users confused.

9.1.2 Mission 2: Upside down

Area match	Graphical match	Overall score	Based on
7.8/9	7.9/9	7.1/9	11

The *Upside down* mission for Liseberget was tested on several groups, with a total number of eleven users. The mission shared the same box design with *Height*, but since this mission was actually designed for *Helix*, it got a much higher graphical score.

Very few negative comments were made about the mission. Some thought that it was hard to figure out how to solve it, but all users finally managed. Some people mentioned that the green colour used in the interface did not resemble the one *Helix* is painted in, which made them slightly confused.

A couple of the users testing the mission found a sign at the entrance of *Helix* saying that the attraction had seven inversions. They both saw this as a clue on what should be done, and gave positive comments on the mission taking use of clues in the physical dimension.

None of the eleven users solved the mission by riding Helix. All figured out how to complete it stationary. One reason for this could be that Helix was closed during one of the test days, which included four users. The stationary usage might have been the reason why the majority of the users said the mission decreased their adrenaline experienced in the area, which was opposite of the intention. Instead, it increased their fellowship and curiosity, probably since they talked much about their ideas on what to do and that they had to experiment to understand.

- + Visual design of box matched the targeted location.
- + Taking use of subtle clues in the physical dimension.
- Green colour not matching targeted attraction.

9.1.3 Mission 3: Together

Area match	Graphical match	Overall score	Based on
6.6/9	6.8/9	6.5/9	8

The *Together* mission was tested with two different groups of four people in each. The results from the two groups were very different from each other. The first group was very critical, and even when they had solved the task, they were still not sure what they did to solve it. The second group was instead very positive towards the mission and understood what made them solve it. The scores given by the two groups were far from each other, creating a mediocre average score.

The reason why the two groups had very different opinions was probably since they executed them in two very different ways. The first group, which was mainly negative, entered the area using an escalator, as seen in figure 34. This meant that they started in a place without seeing the theme of the area in the physical dimension and were all standing closely together, meaning that they had most hearts filled in from the start. When reaching the end of the escalator, they almost immediately turned to each other and got the mission completed.



Figure 34: Users taking an escalator to enter the area.

The other group testing the mission entered the area from another place, where they immediately came to the garden in the physical dimension. They also started more separated than the first group and tried to figure out how the hearts worked. When doing the mission, they walked to many different places in the area before finally figuring out that they got more hearts when walking closer together, and were losing hearts when one or more people in the group walked in another direction. This made them solve the task. As hoped, the mission increased their fellowship, curiosity and cosiness, and decreased their adrenaline and sense of speed.

The main complaint about the mission was the design of the box leading to the area. Even though it had a typical victorian styled decoration, the black shape on the white box gave wrong associations for most users. Comments saying that it seemed to suit a scary place and that the black shape resembled a tribal tattoo were given by several users. Suggestions included that the box should have flowers and be colourful instead. Otherwise, the rest of the visual design of the interface got very positive comments, with one user even putting stars next to the graphical question in the questionnaire.

Another complaint made about the mission was that it was lacking focus on the physical dimension. Users did not have to look at or interact with any items in the area, meaning that the connection to the area was quite low. This made the experience less enhanced.

- + Visual design (except box) matching the area.
- Box design not matching the area, making users confused.
- No interaction with physical dimension.
- Experience bad when entering area using escalator.

9.1.4 Mission 4: Finding plants

Area match	Graphical match	Overall score	Based on
8.3/9	6.4/9	6.0/9	7

Finding plants was tested by one group of four people, one group of two and one person alone. All thought the mission suited the area very well, giving it one of the highest average area match scores in the test. The visual design of the interface got low scores, for the same reason as *Together* (since it shared the same style). The box was considered as not matching the area, while the rest of the interface got no negative comments.

The main disliked point with the mission was the number of QR codes in the garden. Since only eight of hundreds of plants had QR codes in the test, users started searching for QR codes in the flowerbeds instead of plants, as soon as they realised they had to scan QR codes to solve the task. Comments were made that if all plants had QR codes, they were more likely to look at the plants.



Figure 35: Users searching for plants in the *Finding plants* mission.

The mission had a usability issue that made users confused. When reading the list of plants to find, the list covered the button used for activating the scanner. After this had been realised in the first tests, the design team decided to tell the users about the usability problem before starting the mission. The reason was that usability was not the main focus of the test, and all of the first users were struggling to understand how to activate the scanner. Another usability problem was that it was not clear enough when the user selected an incorrect plant for the first time. They thought they had got it right until a few moments later, when they realised that they had not gotten the plant ticked off in the list.

Users commented that an explanatory introduction should have been given at the start of the mission, since many users did not understand that they should scan QR codes and not the flowers directly. Some also got frustrated when they scanned the first plant that was not in the list, since they got negative points for doing that. One user pointed out that the presence of incorrect plants should have been introduced in the beginning.

The Lisebergs trädgårdar is divided into two sections separated by a wide path. It is not intuitive for visitors that the two sections are actually the same area, since the wide path works as a kind of natural border. Several of the users doing the *Finding plants* mission did not understand that they had to walk over to the other section to find more plants for the task, until the design team finally told them. Some of them suggested that a map of the area would have been suitable to communicate where plants could be found.

Even though all users thought the mission suited the area well, one said that looking at flowers is not what she would do at Liseberg. A couple of users expressed their interest in flowers, while some of the users expressed the opposite. One of the users generally having an interest in plants though said that it was frustrating not to find the last plant. He thought it was very fun in the beginning, but after spending much time searching for the last plant, which he could not find, he gave a mediocre score to the mission.

The mission was said to increase curiosity and adventurousness, which was considered as good, but decreased the serenity for a couple of users.

- + Mission suiting the area very well.
- Lack of QR codes, making users change focus.
- Hard to understand what parts belong to the garden.
- Lack of explanatory introduction, making users confused.
- Usability issues, making users confused.

9.1.5 Mission 5: Serenity

Area match	Graphical match	Overall score	Based on
7.8/9	7.8/9	4.8/9	4

The *Serenity* mission was only tested by one group of four people and got the lowest overall score of all ten missions. The reason why this mission was only tested once, was the by the design team predicted failure of the mission, which was confirmed by the first test.

The reason for the failure of the mission was how bad the interface communicated and gave clues on what should be done. The design team predicted that the blur and brightness of the screen would not be enough to understand that the user had to reach a low pulse. The four users in the test walked around in Lisebergs lustgård for a long time, and never understood the slightest of what they should do. Finally, one user got so tired of it making her decide to sit on a bench and give up, when the mission suddenly was completed since she reached serenity. The discovery made the users laugh, but they commented that the clues were too bad.

Not only was the blur and brightness not indicating the pulse well enough, but also was the different levels of blur and brightness too similar to each other, making the users barely notice the differences.

Another issue with the mission was that users looked on their smartphones during almost the entire mission, because they tried to figure out when progress was made. This made the users lose focus on the physical dimension, which was not intended.

Despite the low overall score, the visual design of the interface and the 'area match' of the intended mission was considered as good.

- + Mission and visual design suiting the area well.
- Bad clues, making it very hard to understand.
- Too much focus on smartphones.

9.1.6 Mission 6: Collecting water

Area match	Graphical match	Overall score	Based on
7.8/9	5.8/9	7.8/9	4

The *Collecting water* mission was just like the other mission for Lisebergs lustgård only tested once, with one group of four people. The decision to only do this mission once was taken later in the testing process than the decision to only do *Serenity* once. The reason was that Lisebergs lustgård was very hard to find for users and just to find the area would take much time from the rest of the testing. Also, the design team got useful insights already after the first group, meaning that other missions were regarded as more important to test.

The mission was popular amongst the four users testing the mission. What was said to be the main reason for that was that it had a clear scenario and narrative, where the users had to help the inhabitants of the house. This made the mission fun and engaging. One user, who tested all missions, said this made it her favourite of the ten missions. The way the mission worked, including the interactions with the surroundings, was also praised as very fun.



Figure 36: User holding a QR sign to help friends scanning it.

When executing the test, the mission could not be completed entirely, because of a technical failure caused by all four users being connected to a WiFi hotspot activated on one phone. This made it impossible for the users to split up and walk far away from each others. When rating the

event, the users said that they would try to oversee the technical issues, but it might have affected the outcome.

Another issue was scanning the laminated QR codes. The sun light was reflected in the plastic, making it very hard to scan them. Users solved this, as seen in figure 36, by grabbing and pulling the signs up from the ground, and angle them to prevent sun from hitting the plastic.

Except the technical and QR issues, the main flaw of the mission was not the mission itself. The group did not know about the existence of Lisebergs lustgård, and the box was not of much help when searching for the area because of the lacking knowledge. It took them a long time of walking back and fourth in the whole park until they finally managed to reach the area. This was said to be the reason for the low graphical score. The group tested this mission before *Serenity*, making the latter mission get higher graphical score since they now knew about the area.

What was noted by the design team was that the mission suited the theme and narrative of the area well, except the emotions connected to it. The mission was considered as quite energetic, which could be seen as the opposite of serenity, one of the key words for the area.

- + Narrative and scenario made it more engaging.
- + Interaction with the surroundings.
- Very hard to find area.
- Lacking connection to key word of the area.

9.1.7 Mission 7: The declaration form

Area match	Graphical match	Overall score	Based on
8.0/9	8.9/9	6.8/9	9

The declaration form mission was tested by a total of nine users, divided into four groups. The mission was generally considered as suiting the area very well, but received a mediocre overall score with only one user giving it the highest possible points. What was noted here was that the mission suited people who liked exploration well, but people visiting Liseberg more for adrenaline found it quite boring.

The mission being considered as more boring than similar missions could be explained by a couple of reasons. The two words that had to be entered in the declaration form were both found on the same building, making the mission use far from the whole area. Feedback given suggested distributing the words on different buildings.



Figure 37: Users looking for clues on a sign.

A major usability issue mentioned by most users doing the mission was the lack of feedback when entering words. If one word was correct and the other not, no feedback on what word was wrong was given, making it hard to debug. This made the users confused, frustrated and bored.

Mentioned by users was that the mission would be more exciting and engaging if it included a suitable narrative. When the mission was to fill in a declaration form, it was considered as strange that the actual customs house in the area was not included in the mission. A story around the customs house and the whole area would have made it more fun and engaging.

The mission got a very good graphical score, but several users mentioned during the test that the wall in the interface did not resemble any walls in the area. This made them slightly confused.

The interface for the Hamnområdet area is cluttered with many objects, including for instance maps and an article from an old newspaper. The design team noticed during the tests that a majority of the users thought the details were part of the mission. This made the interface distract them from the physical dimension and trick them to believe the details were clues.

A finding from the tests of the mission was that the Hamnområdet box was probably the most clear box of all. There was no doubt that the box led to Hamnområdet, probably thanks to the anchor symbol.

- + Box and interface matching the area very well.
- + Mission suiting the area very well.
- Lack of narrative made it less exciting.

- Texture in interface did not match the area.
- Interface cluttered with details of no significance.
- Lack of feedback when entering words.

9.1.8 Mission 8: Transcribing runes

Area match	Graphical match	Overall score	Based on
8.4/9	8.5/9	6.9/9	10

The *Transcribing runes* mission was tested by ten people divided into three groups. The mission received generally very high overall scores, with eight of ten people giving it a seven or higher. The 'area match' and 'graphical match' scores were both very high and most comments were positive.

When trying to solve the mission, some users used the camera of the smartphone to take photos of the runes, as seen in figure 38, to avoid having to go back and look again. This was an out-of-the-box solution which worked well. This did not destroy the atmosphere or the mission according to the design team. Some users, who collaborated, took one letter each for those runes that could be transcribed to several letters. This was the tactic that the design team had predicted to be the optimal for solving the mission, and the tests partially confirmed this.



Figure 38: User taking a photo of a rune.

The two users who gave the mission low overall scores both complained that they had to walk back and fourth within the area to find the runes, and both expressed that they were very tired

overall when executing the mission. This might have had an effect on the results. As seen in other tests, there were at least a couple of ways to avoid having to walk back and fourth, making the design team not noting this as a drawback for the mission.

One user complained about the lack of a notebook paper in the interface, to note all runes found. Also, a couple of users mentioned that there are several ivies (the plant the users should search for according to the transcribed message) in the area, which made it hard to find.



Figure 39: Users entering letters to decode the message.

There were not any major complaints about the usability of the mission, except that input was not validated in any way. Since several runes could be transcribed into several letters each, the words 'leta' and 'murgrönan' could also be transcribed into for instance 'lita' and 'mörkrönan', making some users confused. In a couple of cases, the design team had to orally give the users hints that a word was wrong. This usability issue was less serious than the similar issue for *The declaration form*, but still made an impact.

The targeted emotion for the mission was adventurousness. That was reached successfully according to the questionnaires for the mission.

- + Box and interface matching the area very well.
- + Mission suiting the area very well.
- + Targeted emotion reached.
- + Could be solved in multiple ways without losing connection to atmosphere.

- Input not validated, making users not realise input was incorrect.
- No place in interface for user notes.

9.1.9 Mission 9: High pulse

Area match	Graphical match	Overall score	Based on
8.5/9	9.0/9	7.0/9	6

The *High pulse* mission for Myter och legender was tested by two groups, divided into one group of four people and one group of three. This mission, having probably the most simple of all interfaces, was the only to receive the highest score on 'graphical match' from all respondents of the questionnaire, making it the winner in the category.

The mission was regarded as suiting the area well, but all users testing it struggled to understand the clue given by the interface. None of the users figured out that it was connected to the pulse, before the revelation in the end. One of the groups decided to ride Valkyria because they wanted to ride the roller coaster, and in this way the mission was automatically solved. One of the group members decided to stay on the ground though, feeling Valkyria was too extreme for her. This made her fail the mission and she refused to answer the questionnaire, since she did not execute the task. She though explained that the mission did not make a positive impact on her, and that it was like visiting the area without the application at all.

The other group searched in the area for very long, believing the beating box meant that they had to go to a certain place in the area for it to be opened. Finally, after a few quite clear clues from the design team, they decided to ride Balder. This made them solve the mission.

Generally, the hint communicating the connection to the users pulse was too unclear for the users to figure out, similar to the *Serenity* mission for Lisebergs lustgård. This was a common complaint from the users.

An issue noticed with the interface for Myter och legender was the difficulty of seeing details when the sun shone. Most components of the interface have dark brown nuances with small contrasts, especially the box, and differences were hard to perceive in the sun. The box looked almost completely black, making its texture hard to see.

The targeted emotions for the mission were partially reached, especially by the fact that all users mentioned it communicating low serenity and an increased adventurousness. One user commented that he liked having a connection to an attraction.

- + Box and interface matching the area very well.
- + Mission suiting the area very well.

- + Targeted emotion reached.
- Bad clues, making it very hard to understand.
- Limited to users riding extreme attractions, giving others nothing.
- Hard to see details in sun.

9.1.10 Mission 10: Visit Sten-Åke

Area match	Graphical match	Overall score	Based on
7.5/9	7.0/9	7.4/9	8

Visit Sten-Åke was tested by eight people, divided into one group of four, one of three and one person walking alone. The mission was, contrary to what the design team had expected, a massive success amongst the majority of users. Six of the eight users gave it an overall score of eight or nine, and it provided more laughs than any of the other missions. The only user giving it a very low overall score was the one who walked alone.

Of the eight people testing the mission, only one knew who Sten-Åke Cederhök was. Despite this, most people enjoyed the mission and said it was fun. The design team noticed that the groups talked and tried to figure out what the messages were by discussing and making jokes about the voice. On the other hand, the user walking alone showed an ounce of discomfort doing the mission. This could have played a roll in the fact that all users except the one walking on his own gave it a high overall score.

The main issue with the mission was hearing what the voice said. Many users did not hear because of noise in the park coming from other visitors and attractions. Some users tried to focus so hard on interpreting the voice, by holding the phones very close to their ears, that they almost collided with other visitors.

Positive comments were given about the fact that progress was communicated directly when moving. One user wrote 'I think this mission was almost perfect! Super fun!' in the questionnaire.

The interface design for Kvarteret Storgatan was generally receiving good scores, but was not outstanding. One user pointed out that objects in the interface did not match the era of time it intended to represent. Several users also thought the biscuit package and objects in the graphical interface were clues to the mission, misleading them for a short while.

Regarding emotions, users gave mixed feedback. Generally, *fellowship*, *cosiness* and *curiosity* were considered strong. The most varying property was *adrenaline*, that according to some was enhanced or strong, while some had the opposite opinion.

- + Made users discuss and laugh together.
- + Immediate feedback when making progress.
- Objects in the interface not connected to mission.
- Audio hard to interpret in noisy atmosphere.
- Dynamic of fellowship lost when doing alone, leading to discomfort.

9.2 Knowledge of Liseberg area names

One goal of the concept was to communicate the different areas of Liseberg and their respective names. To test this, the users of the application got to fill in the names of the areas on a map after the test had ended. The same map was also filled in by other visitors of the park, who had not used the application. The results were afterwards compared.

In total, 28 visitors tested the application and 61 visitors participated in the map task without having used the application. The 28 visitors testing the application did not know about the map task until they had finished the test. Important to note is that all 28 users did not visit all areas, and only the areas they visited were included in the analysis. No groups testing the application did it in the exact same way. For instance, some were only doing one mission but walked through several areas, some did one mission but were only visiting a couple of areas and some did several missions in multiple areas. In the results from the map test, all visitors having used the application were grouped together, independent of how many areas they visited, how many missions they did and for how long they participated in the test.

In several cases, visitors filled in names similar to the correct ones, and these were categorised as 'almost correct'. Doing this categorisation was discussed with Liseberg, and was decided to be reasonable. Table 3 shows all names accepted as 'almost correct'.

Correct name	Variations accepted as 'almost correct'
Lisebergs trädgårdar	Trädgård, Trädgården, Lisebergs trädgård, Trädgårdsområdet, Trädgårn
Liseberget	Lisebergsberget
Myter och legender	Myterna
Lisebergs lustgård	Lustgården, Lisebergs lustgårdar
Hamnområdet	Hamnen, Hamn, Hamngatan
Kvarteret Storgatan	Storgatan, Området Storgatan

Table 3: Names accepted from questionnaires.

According to the results of the map test, which can be seen in figure 40, the names of most areas were completely unknown for the 61 visitors not using the application, with four of the six areas getting no completely correct answers at all. One visitor knew the correct name for Liseberget and as many as 13 knew the name of Hamnområdet.

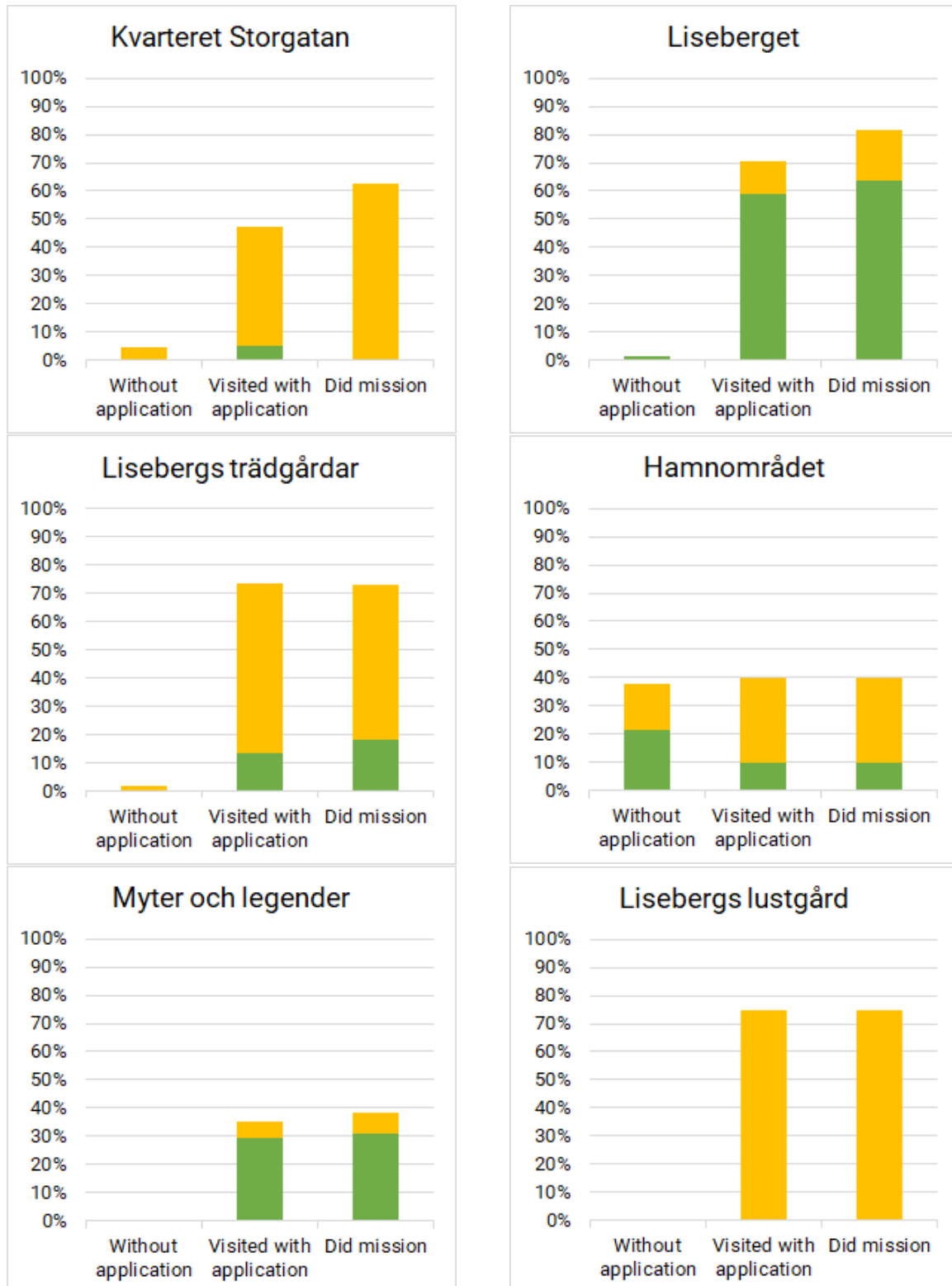


Figure 40: Results from the map test. Green means completely correct phrasing of name and yellow means almost correct name.

Visitors using the application generally knew the names of the areas better. Exact phrasing was not guaranteed amongst those remembering the area, but several answers were close to the correct ones. Easiest when having used the application was Liseberget, which by the design team is believed to be because it is one single and simple word. Also easy to remember was Lisebergs trädgårdar, but opposite to Liseberget, not many users got the phrasing right. Kvarteret Storgatan got similar results, with most users remembering the area had the word 'stor' in its name, but not always the rest of it. The word 'kvarteret' was missed by all but one user. When the users remembered the name of Myter och legender, they in most cases got the name completely correct, but the majority got it completely wrong.

A conspicuous finding was the results from Hamnområdet. Results showed that many people knew the name without using the application, and users of the application failed to perform better than the visitors without. Even more participants without the application got the exact phrasing right than the visitors having used the application. The reason for why more people knew the name of Hamnområdet compared to the five other areas is believed to be because Liseberg has used the name more frequently in marketing than the rest of the area names, and that Hamnområdet is one of only three areas in the test (the others being Kvarteret Storgatan and Lisebergs lustgård) to have a portal with the name over the entrance of the area. Compared to the other areas with portals, the Hamnområdet portal is positioned at a location that more people walk by.

Lisebergs lustgård was only visited by one group of four users, which makes the results for the area more unreliable than the other areas. Three of the four users got the name almost correct, which at least indicates that the application helped them, since no of the 61 visitors without the application knew the name of it.

The results of the map test indicates that users of the application knew the area names better than the visitors of Liseberg not using the application, with a few exceptions. However, after executing the map test, the design team realised a few flaws with the questionnaire. This included for instance the fact that the visitors were not asked whether they have been to Liseberg before, how long they had been in the park or which areas they had visited. These questions would uncover important factors affecting the result. The flaws are discussed in greater detail in the map test section of the discussion chapter later in the report.

10 Result analysis

This section analyses the process, the prototype, and the survey about visitors' knowledge of the park, based on the project and the insights in the previous section. The analysis is the basis for the definition of the factors and guidelines in the *Final results* section.

10.1 Process

The process in this project is also a result, since the design team derived insights as a basis for guidelines, while they executed the design process. In this section, these insights will be presented. The process in the discussion section will give a more overarching view of the process and go deeper into specific parts of the process.

The design process and opening dates

One thing which had an significant effect during the entire design process, especially during the evaluation phase, was the opening dates, which is also out of the design team's control. Since the project spawns over the spring semester and the theme park opens in the end the semester. This was something the design team had to work around and resulted in less time to evaluate the prototype and collect data. The design team addressed this as something that should be considered before designing for a theme park or experiences with seasonal openings.

Usability issues make it hard to test user experience

When the design team started the pilot test, they realised quickly that almost all insights had to do with usability. Since this was not what the team wanted to test, which made this a problem. Luckily the team was able to fix all usability issues, which came up during the pilot tests. Since observations alone will not give feedback focused on user experience. That is why they created a questionnaire to be able to gain insights about user experience. Even if this action is taken the majority of insights will often be usability, until a fair level of usability is reached.

Using biscuits as enticement

In the evaluation phase the the design team conducted a survey and used biscuits as an enticement. In the beginning this worked fine, since the design team approached an adult audience, were many of them did not even want biscuits. When younger children noticed the biscuits they were eager to fill in the survey. When we later looked at the surveys they were only max values, the same values on all factors and/or random text/doodles. The design team then make a conscious decision to avoid bringing biscuits as a means to entice visitors to participate in a survey.

10.2 Prototype

The results from the user experience tests of the missions in the prototype led to several insights regarding the addition of a digital layer to a physical atmosphere. In this section, the insights from the user experience tests of the missions will be presented.

Feedback when proceeding

Users expressed positive comments regarding feedback when proceeding in missions. In the *Height* mission, the progress bar was praised, and in *Visit Sten-Åke*, the users liked hearing feedback immediately when they moved. Meanwhile, users commented on the lack of feedback in *The declaration form* as a negative aspect. This indicates that feedback should be provided when designing activities.

Visual design compared to physical dimension

Users were confused when the theme of the interface did not follow the theme in the physical dimension. The box for Liseberget was confusing when doing the *Height* mission, since the theme of the box had a strong connection to the roller coaster *Helix*, but the mission had not. Also, the Liseberget interface used a green nuance not resembling the one present in the physical area, which was noted by users. Similarly, the box for Lisebergs trädgårdar gave the users wrong associations because of the visual design.

The Hamnområdet interface received comments about the background texture mismatching the texture in the physical dimension. Also, the interface for Kvarteret Storgatan received comments saying that the items in the interface decorations did not match the targeted era of time.

These results indicate that it is important to strictly follow the themes of the physical dimension, not to make users confused or get wrong associations.

Making use of the physical dimension

Users generally gave positive comments when finding clues for the missions in the physical dimension. For instance, a clue for the *Upside down* mission was found on a sign, making users figure out how to solve it.

Positive comments were also given when users had to interact with the physical dimension, for instance when doing the *Collecting water* mission. Also, the *Together* mission received comments from users saying that they wanted more focus on the surroundings.

These results indicate that users like interacting with and seeing clues in the physical dimension.

Inconsistency affecting user focus

For two of the missions, QR codes were used for interaction with physical objects. In the case of *Finding plants*, the small amount of plants with QR codes in the prototype made the users change focus. Instead of looking for plant characteristics, the users started searching for plants with QR codes. This indicates that inconsistency in how interactive elements are added may affect the focus and experience.

Natural borders

Users were struggling to understand what parts of the park belonged to Lisebergs trädgårdar when doing the *Finding plants* task. The reason was a wide path dividing the area in two sections. This indicates that natural borders is a factor that should be considered when designing for physical atmospheres.

Explaining activities

Users complained about the lack of an explanatory introduction in the *Finding plants* mission. This made users try to take photos of the plants using the QR scanner, before finding the first plant having a QR code. In the same mission, some users also complained when they scanned their first incorrect plant, and said the application should have warned them about incorrect plants from the beginning. It is believed by the design team that both of these issues would have been lesser if all plants had QR codes, which also some users said. This, though, indicates that explanatory introductions should be given to avoid unwanted negative emotions, when actions are not entirely clear to the users.

Usability

Several usability issues not directly coupled to the challenges were found when using the application. Users struggled to find the QR scanning button in the *Finding plants* interface and in both *The declaration form* and *Transcribing runes*, users complained about the lack of input validation.

The missions *Serenity* and *High pulse* also got usability related comments, since the clues hinting what the user were supposed to do were very unclear. Here, perfect usability was not wanted, since it would have spoiled the challenge, but these clues were considered to be too bad. This was something the design team also realised during the tests, and agreed with.

The usability issues made the users frustrated and in some cases lose patience, indicating that usability should be considered both for actions not being a direct part of the intended challenge, as well as when it is. Different levels of usability should be considered in these two cases.

Smartphone contra physical dimension as primary experience

Focus on the physical dimension was lost when doing the *Serenity* mission, since users were constantly looking at their smartphone for changes in the interface. Similarly, *Visit Sten-Åke* made a few users so concentrated on trying to interpret the audio, making them almost collide with other visitors of the park. Users also expressed negative comments about having to hold the

smartphones in their hands during almost the entire test, with one user giving suggestions on making use of smartwatches for the most critical information, as well as sending notifications when something happens.

Meanwhile, positive comments were expressed for several missions, when users were forced to look at the physical dimension. This made them spot more on details and props in the physical dimension compared to regular Liseberg visits.

These findings indicate that the digital smartphone layer may enhance the Liseberg experience, as long as it is secondary compared to the physical dimension.

Using narrative and scenarios

The *Collecting water* mission was praised by the users for having a small narrative, which made them more engaged with the theme and mission. Meanwhile, *The declaration form* got complaints saying that the lack of narrative made the mission less exciting. Narratives and scenarios in general seemed to enhance the experience, indicating that narratives and scenarios should be used when designing activities for enhanced experienced atmosphere.

Coordinating with existing information

Lisebergs lustgård was very hard to find for the users, since the entrances to the area are almost hidden and Liseberg are not having any fingerposts pointing out the areas. The box design did not help the users find the area, since they did not know about its existence. This indicates that coordination with existing information in the park should be considered, and for instance complement the missing information by adding it to the digital layer. In this case, a map where areas are marked was suggested.

Emotions contra context

The *Collecting water* mission was considered to suit the theme of the area very well, but despite this, it lacked connection to a key word for the area. The key word for Lisebergs lustgård is 'serenity', but the mission was considered to have quite a high pace. In this case, the mission was designed only to match an action from the era of time the area resembled, and emotions targeted for the area were not considered.

Opposite to *Collecting water*, the mission *Together* only focused on the parameter 'fellowship', without a connection to the context. The lack of context was something the users complained about since the theme of the area was not enhanced, just the targeted emotion.

The *Transcribing runes* mission was targeting the key word 'adventurousness' and it had a scenario involving transcription of runes from the viking age, i.e. a scenario from the context. The users said the mission increased adventurousness, and the context of the mission was said to suit the area. In this case both context and emotion was considered, indicating an enhanced experienced atmosphere.

The results indicate that both context and emotions should be considered when designing an activity, to enhance the atmosphere.

Distracting elements in interface

Users had trouble to understand what was clues and not when doing the mission *The declaration form*. The background was cluttered with information and elements that were just pure decoration, added since it suited the theme and context of the area. The decorations were believed to be clues by several users, making them stand still and look on their phones for a long time, instead of looking for clues in the physical dimension. The decoration did in this case just trick them to believe it was part of the mission, without enhancing the experience. Similarly, *Visit Sten-Åke* had for the mission unnecessary graphical components in the interface, making users believe they were of significance for the mission.

Meanwhile, the interfaces for the Myter och legender missions had no unnecessary distracting elements, but still it got very high 'graphical match' scores and experience was believed to be enhanced. This indicates that unnecessary distracting elements should be avoided if not communicating anything of importance for the task, as long as the rest of the interface follows the theme.

Forcing users to certain activities

The mission *High pulse* forced the users to ride an attraction in Myter och legender, making the users' pulses increase. The attractions in this area were regarded as too extreme for some users, making it impossible for these users to complete the task. This meant that a users not riding an attraction was left alone, and made her feel like visiting the area without the application. In this case, atmosphere was not enhanced.

Upside down was another mission connected to a specific attraction, but opposite of *High pulse*, this mission was possible to complete without riding the attraction too. The possibility to complete it without riding the attraction made people not wanting to ride the attraction still able to complete it. This did not lead to unwanted emotions.

The different missions were suiting different people, and missions liked by some users were not as popular amongst others. This indicates that forcing users to certain activities, without a possibility to opt out, should be avoided.

Social focus

It was noticed during the tests that some users preferred collaboration and some preferred competing. This indicates that by designing activities inviting to both collaboration and competitive usage, a greater range of users may feel pleased. Those preferring collaboration can choose to collaborate, and those preferring competition can choose to compete. Good examples of missions that could be executed either by collaborating or by competition were *Finding plants* and *Collecting water*.

Weather impact

Users had problems seeing details on the box for Myter och legender, when the sun was shining. The reason was low contrast and very similar colours in the interface. This indicates that higher contrast should be used for interfaces designed for outdoor locations.

Rain was falling during a part of the test. This led to users wanting to use an umbrella, making it harder to interact with the application. Also, during one day of testing, the weather was cold, making one user freeze so much that holding the smartphone constantly was hurting.

These findings indicate that weather and light conditions are two factors that have to be considered when designing a digital layer for a physical experience.

Audio navigation

The *Visit Sten-Åke* mission used audio to navigate within the area. Since Liseberg is a crowded place with much noise and audio, it was difficult for users to interpret the audio feedback. This indicates that critical audio feedback should be avoided when designing for crowded places. Also, it indicates that existing audio in an atmosphere is a factor that needs consideration when designing digital artefacts.

10.3 Map test

The test made with visitors regarding their knowledge of Liseberg's area names also generated insights. Visitors having used the application knew area names far better than those not having used the application. This indicates that information can be embedded in an interface without being the main focus, and users will still remember it. In this case, the names of the areas were included in the interface, without affecting the experience.

11 Final results

This section presents the final result of the project, including the final factors and guidelines.

11.1 Factors

When designing the digital artefact, the design team noticed some factors to consider, which had an effect on how the digital artefact suited the theme park. The factors are presented in this section.

Noise/Audio

Theme parks are often crowded which leads to massive noise. In addition to this noise, the theme park plays music and/or audio all over the park. This makes it difficult to hear audio coming from the digital artefact and limits the way audio can be used without any additional aids, e.g. headphones.

Light

Theme parks often takes place outdoors, which means that some days there will be very bright light. This effects shiny surfaces and especially smartphone displays. When bright light hits the phone display, it makes it hard to interpret what is on the screen. Because of this, it is important to test the interface in these light conditions.

Visitors

Theme parks are often crowded which is something that needs to be considered when designing a digital artefact for a theme park. People moving in different directions increase the risk of collision. Adding an digital artefact, for instance a phone, will decrease the awareness of the surroundings. This means when designing the digital artefact, you need to consider how the artefact affects the users behaviour in the park.

Weather

Weather has an great impact on theme parks, both in terms of number of visitors and experience. During sunny days, the factor of *Light* applies. Rainy days are very common in the city of Gothenburg and is something that needs to be considered. There are different degrees of rain, which will affect the degree the smartphone can be used. With a light degree of rain, an umbrella can help but then the fact that the users can only interact with one hand at a time has to be considered. If there is a high degree of rain, there is great chance that it will not work. This is especially applicable in parks like Liseberg, where there is minimal covers from the rain.

Queue and waiting time

Queues and places the visitors have to wait is the aspect of the theme park which the visitors find the most boring. This is why this factor is important to consider, since the addition of a digital artefact can change the experience of waiting. Making the queuing to an activity in itself or add an activity which can be done in the queue, can improve the queuing experience and at the same time improve the overall experience.

Theme

The theme is a crucial aspect of the theme park, since the park should follow a certain theme or themes. To experience these themes, the architecture, objects, materials, smells, music, etc. play a role in the atmosphere. Also what the digital artefact communicates has an impact on the theme, similar to the previous mentioned aspects, which means the theme can be skewed by the digital artefact if it does not align with the rest of the theme. This could ruin the experienced atmosphere.

Natural borders

Natural borders are not always clear and not all areas have entrance portals. If the digital artefact is dealing with different areas, it is important that the user knows where an area begins and ends. If this is not clear, the user might create their own perception of borders, for instance based on separators including paths, buildings, walls etc. If this is the case, some kind of addition of support to the digital artefact is needed, e.g. a map or borders indicated in the interface.

Existing park information

Good information communication in the park is very important for the user to be able to navigate through the park. When designing a digital artefact, the already existing park information needs to be considered, in order to know if anything has to be added either in the physical or digital dimension.

11.2 Guidelines

This section presents the final fifteen guidelines which the project resulted in. The guidelines are divided into four categories: 'design process', 'design of activities', 'physical dimension' and 'usability'. A summary of all guidelines can be seen in figure 41.

DESIGN PROCESS	DESIGN OF ACTIVITIES	PHYSICAL DIMENSION	USABILITY
1 Coordinate the design process with opening dates of physical experiences limited to seasons.	4 Design for smartphones to be secondary.	7 Graphical components should strictly follow the theme in the physical dimension.	11 Keep the interface free from unnecessary distracting elements.
2 Fine-tune usability before testing general user experience.	5 Activities should invite to both collaboration and competitive usage.	8 Design interactions and communication using physical objects.	12 Use high contrasts when designing for bright outdoor locations.
3 Do not use rewards as main enticement for user research; align rewards with effort of participation.	6 Do not force users into activities that are not within their field of interest.	9 Combine emotions with context to enhance experienced atmosphere.	13 Avoid audio navigation in crowded places.
		10 Use narrative or scenarios to empathise themes.	14 Keep activity introductions minimal, but enough to prevent misunderstandings.
			15 Coordinate with the existing physical information structure.

Figure 41: A summary of all guidelines.

11.2.1 Design process

1. Coordinate the design process with opening dates of physical experiences limited to seasons

When planning the design process, time and resources are crucial factors to address. When dealing with places and/or events limited to a seasons or time periods, this needs to be calculated into the time plan with buffer time included, since unexpected things often occur.

2. Fine-tune usability before testing general user experience

Usability and user experience can be seen as two separate focuses but are mutually affecting each other. When testing user experience, the usability needs to be at an optimal level for the experience being designed. When the optimal level of usability is reached, the general user experience can be tested without too much influence of usability issues.

3. Do not use rewards as main enticement for user research; align rewards with effort of participation

Rewards to people participating in user research, for instance answering to questionnaires, should be appropriate and aligned with the effort the participants have to sacrifice. If giving away rewards too attractive to the participants, they might participate just for the sake of the reward. This might affect the results in a negative way. For tasks requiring a small amount of effort, it is recommended not to give away rewards at all. Rewards should not be the main enticement for participating in user research. Present the task and wait for first reactions before presenting the reward.

11.2.2 Design of activities

4. Design for smartphones to be secondary

When designing a digital layer (e.g. a smartphone application) applied to a physical experience, the digital layer should be secondary and seen as a complement. If designing an immersive digital layer that makes users constantly looking at their smartphones, the physical experience is neglected rather than enhanced.

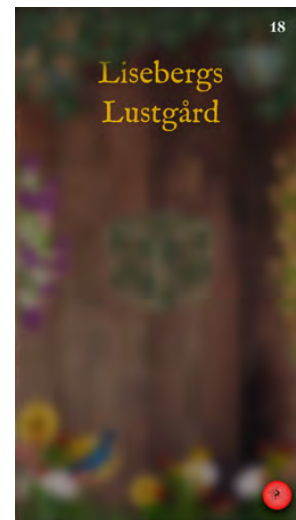
Too much focus on the smartphones will also drain the battery of the devices. In physical environments, opportunities to charge devices are often lacking. Having focus on smartphones while walking makes the users lose control and reaction, adding a high risk of accidents.

Many users do not appreciate walking with smartphones in their hands at all times, just to see if something happens and when not necessary for the activity. This is especially relevant in cold weather conditions and rain. A suggestion is having critical information on a smartwatch, and sending notifications when critical interactions are available.



(a) **Following guideline**

In the *Transcribing runes* mission, the smartphone is used as a tool for note taking and the main activity requires the user to look for clues in the physical environment, in this case runes leading the user to a physical location where a solution is hidden.



(b) **Not following guideline**

In the *Serenity* mission, the user relies solely on what is happening on the screen, without any need to investigate the physical dimension. In this case, the user gets very subtle feedback which is dependent on the user's pulse. This requires the user to be very focused on the screen to notice the subtle changes.

Figure 42: 'Design for smartphones to be secondary'.

5. Activities should invite to both collaboration and competitive usage

Design activities that can be executed either by collaboration or by competition, to please a greater range of people. Different people prefer different kinds of social focuses; some prefer collaboration and some competition. Important to note is that the social focus might affect the atmosphere.

Example

Activities should be possible to be executed together as a group or compete within the group. The concept presented in this report provides a range of different types of activities designed for fellowship, which do not tell the users how they should be executed. This creates room for interpretation and letting the group dynamics determine the social focus of the activity.

6. Do not force users into activities that are not within their field of interest

Users should not be forced into activities that are not aligned with their field of interest or are outside their comfort zones, without a possibility to dismiss. When forcing a user into doing something outside their field of interest or comfort zone, the experience might lead to negative emotions, for instance boredom or fright. When designing for a broad audience, try to create activities for all personalities and let users decide what activities they want to take part in. Else, select a narrower target group for the whole concept.



(a) Following guideline

The *Upside down* mission can be solved in more than one way. In this case, the activity can be solved by riding an attraction in the theme park consisting of seven loops, but the user can also figure out other ways to loop their device. Both ways will result in completing the activity.



(b) Not following guideline

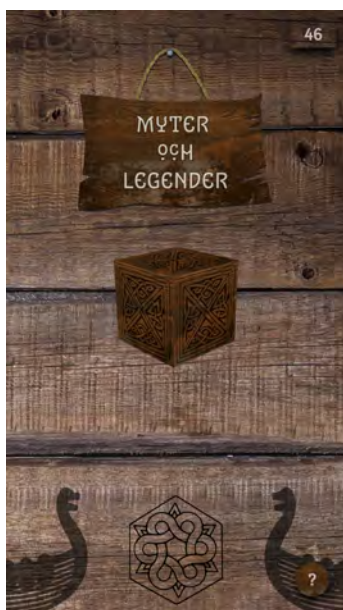
The *High pulse* mission can only be solved in one way, which requires the user to do one specific thing. In this case, the activity requires the user to ride one of the attractions in the area to raise the pulse. If the users are not the type who enjoy the attractions in the area, they might feel left out since there is no way for them to solve the mission. Even though another solution would be running around to raise the pulse, this is limited due to the park usually being crowded.

Figure 43: 'Do not force users into activities that are not within their field of interest'.

11.2.3 Physical dimension

7. Graphical components should strictly follow the theme in the physical dimension

When designing the graphical components for an interface, it is important that they strictly follow the theme in the physical dimension, or are building upon it. If the graphical components include details that mismatches with the physical theme, users may become confused and the experience of the theme is changed instead of enhanced. For instance, when including wall texture in the interface, consider matching the wall type and condition of the walls of the houses in the real physical area. In this case, having wall texture that is heavily worn in the visual interface should be avoided if the walls in the physical dimension are in good condition. Adding details that are not present in the physical dimension may work, as long as it does not contradict any details in the physical dimension and is considered to be appropriate for the context.



(a) **Following guideline**

The interface for the *Myter och legender* area is only having necessary components and graphical details, which convey the theme. The more graphical details there are, the easier it is to make a mistake and communicate the wrong message. In this case, only the necessary graphical components, e.g. background, title, box, score and help button are included, plus a couple of additional details at the bottom. The theme of these align with the theme in the physical dimension.



(b) **Not following guideline**

The interface for the *Lisebergs trädgårdar* area has one component that does not match the theme of the area. In this case, the box did not suit the victorian theme as intended. The box was described as suiting a scary location and its black pattern was compared to tattoos. Even through the pattern was inspired by the victorian theme, the colour of it and the details conveyed another theme.

Figure 44: 'Graphical components should strictly follow the theme in the physical dimension'.

8. Design interactions and communication using physical objects

Activities should make use of objects in the physical dimension to enhance the experience of an atmosphere. By not putting everything needed in the digital interface, and instead make users search for objects and information in the physical dimension as well as interacting with it, users tend to see details in the physical dimension that might otherwise be missed. This will enhance the theme of the physical dimension and prevent the smartphone from being the primary attraction. It is important to note that interactions should correspond to the users' mental models. If not, this will lead to confusion and the users will be less immersed into the activity.



(a) Following guideline

The *Collecting water* mission requires the user to interact with the physical environment and only uses the smartphone as a tool and giving information when needed to frame the activity. In this case, the user gets a task to locate and deliver water to a house. The smartphone acts as a bucket, which the user can fill with water by scanning a QR code by a stream and then deliver it by scanning another QR code by the house. What is good with this activity is that it is primarily physical and the only time the users are required to look at the screen is when they scan the QR codes.



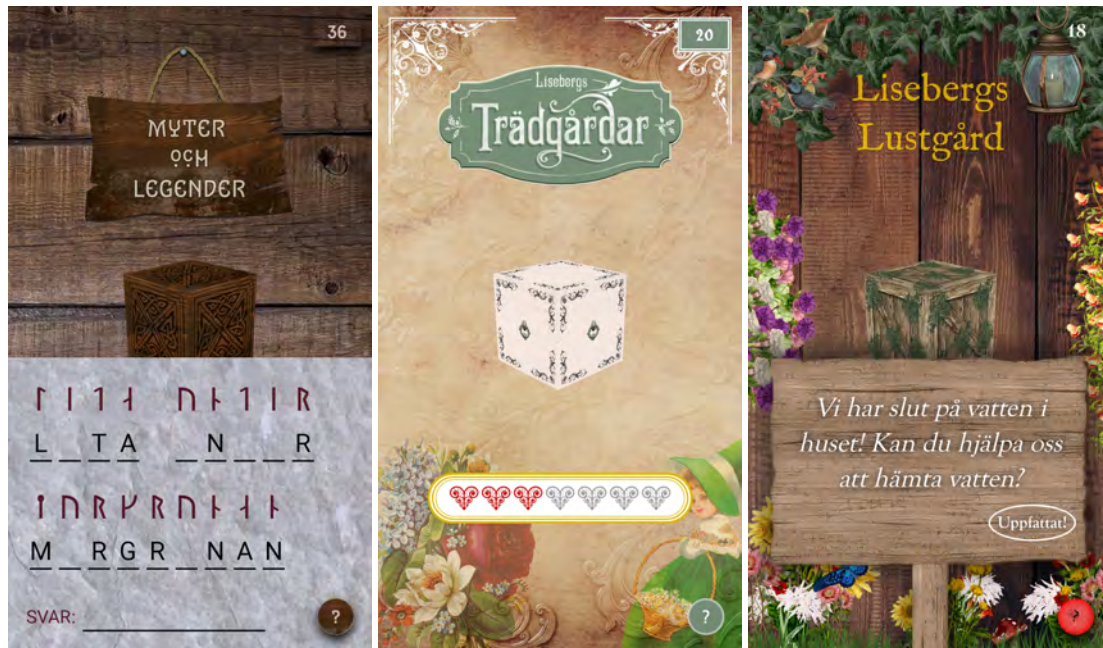
(b) Not following guideline

The *Together* mission does not rely on anything in the physical environment. In this case, the indication bar in the interface was the only thing changing and giving feedback to the user. This resulted in the users' full attention on the screen and not their surroundings.

Figure 45: 'Design interactions and communication using physical objects'.

9. Combine emotions with context to enhance experienced atmosphere

When designing for an enhanced atmosphere, both emotions and the physical context need to be considered. If focusing solely on the emotions without anchoring it into the physical context, the users will not perceive an enhanced connection to the theme represented in physical dimension. If only the physical context is considered and not the emotions it should communicate, this can create a disconnection between experience and theme. Considering both creates harmony between the emotional and physical aspects, allowing users to interpret the themes stronger.



(a) **Following guideline**

(b) **Not following guideline**

(c) **Not following guideline**

In the *Transcribing runes* mission, the emotion and context work well together. In this case, the emotion 'adventurousness' together with the context of rune searching were working well together to enhance the theme of the area. In the *Together* mission, the targeted emotion was reached but the physical context is not anchored in the physical context. In this case, the emotion 'fellowship' was targeted but since there were no apparent connection to the physical context, the theme was not enhanced.

In the *Collecting water* mission, the physical context is considered but the emotions triggered in the activity do not align with the theme. In this case, the activity of collecting water suits the thematic context, but this physical and possibly intensive activity does not match with the target emotion of serenity in the area. The activity might be disturbing to visitors not involved in the digital experience.

Figure 46: 'Combine emotions with context to enhance experienced atmosphere'.

10. Use narrative or scenarios to empathise themes

When designing for an enhanced experienced atmosphere, narrative or scenarios are important. Users report feeling more engaged in the theme when the activity is part of a narrative suiting the physical dimension. When an activity is not part of a narrative, users might question why they are doing what they are intended to do.



(a) **Following guideline**

In the *Collecting water* mission, the users feel like they are part of a narrative, giving them a reason for do something. In this case, the users got a narrative involving a village which was out of water and the users needed to help them collect water. The users expressed that they liked this narrative and would like more of it in other missions.



(b) **Not following guideline**

In the *The declaration form* mission, the users do not know why they are doing the activity. In this case, the users should find and fill in the correct address and product in a declaration form. The problem is that there is no presentation of a backstory, leading to some user feeling unmotivated and aborting the activity.

Figure 47: 'Use narrative or scenarios to empathise themes'.

11.2.4 Usability

11. Keep the interface free from unnecessary distracting elements

Keep the interface free from distracting and unnecessary elements. Too many details in the interface that are not necessary for the activity will distract the user from the physical environment. If so, instead of the physical environment communicating the theme, the focus might be unintentionally turned to the interface.



(a) **Following guideline**

The interface for the *Myter och legender* area only has the necessary components and details. In this case, the simple wood background, the sign, the box, the rune-stone to decode and a block to write on were the only components included in the interface. No other components that could distract the user from the physical dimension were included.



(b) **Not following guideline**

The interface for the *Hamnområdet* area has details distracting the users from the physical environment. In this case, the maps and newspaper in the background was interpreted as clues for the activity. Instead of searching for clues in the environment (which was intended), the users stayed in one spot and tried to solve the activity just from staring at the background.

Figure 48: 'Keep the interface free from unnecessary distracting elements'.

12. Use high contrasts when designing for bright outdoor locations

When designing interfaces for bright outdoor conditions, low contrast interfaces may be hard to interpret. The brighter the conditions are, the higher the contrast in the interface needs to be.



(a) **Following guideline**

The interface for the *Kvarteret Storgatan* area has good contrast. In this case, a good combination of light and darker colours.



(b) **Not following guideline**

The interface for the *Myter och Legender* area has many darker colours with similar hues blending together. In this case, there is brown wood texture as background, darker wood texture on the box and even darker details on it. In the sun, the box looked entirely black because of the lack of contrast.

Figure 49: 'Use high contrasts when designing for bright outdoor locations'.

13. Avoid audio navigation in crowded places

Audio navigation and feedback should be avoided if the digital layer is applied to an atmosphere with high volume from people and objects, since it may be hard to perceive. When not perceived by the user, the situation might lead to confusion, misunderstandings and frustration, which may be opposite of the emotions targeted for the experience. Sound might also disturb other people around, if headphones are not used.



(a) **Not following guideline**

The *Visit Sten-Åke* mission uses audio for the user to navigate to. In this case, the user is guided in the area solely based on a voice. This worked fine during hours which was not very busy, but when it started to get crowded, this quickly became a problem since it was hard to hear from the phone speaker. When focusing on trying to interpret the voice, users easily collided with other people.

Figure 50: 'Avoid audio navigation in crowded places'.

14. Keep activity introductions minimal, but enough to prevent misunderstandings

When introducing an activity, the level of instructions should be minimal. Only details that may affect the experience in an inappropriate way if not communicated should be given. Otherwise, users may get frustrated which may go against the targeted emotions for the experience. For instance, if interaction with physical items are done in an indirect way, e.g. by scanning QR codes, this has to be explained. If figuring out what to do is part of the challenge, instructions should be avoided.

15. Coordinate with the existing physical information structure

Coordinate with, or improve, the information structure in the physical dimension. Lack of information, for instances fingerposts that point out locations, may lead to confusion for people not familiar with the locations on those occasions when clear orienting is necessary for the experience.

12 Discussion

This section discusses the process and results of the project, as well as some ethical considerations taken and potential future work.

12.1 Process discussion

Since the design team had great freedom in terms of what concept to design, they spent much time in the understand and define phases. It can be argued that this resulted in a better concept, but it also resulted in less time to create and evaluate the prototype. Another factor also affecting this was the fact that Liseberg opened for the season 27 April, and during the following weeks, the park was open limited time and dates until the 27 May, when regular opening hours started. This meant that the team had limited time for testing in the park. The digital experience required the users to be in the park when testing, hence the limited opening hours became a limitation.

The team needed to test user experience, which is challenging with ordinary prototyping tools. This led to the team deciding to create an interactive prototype, which was more time consuming. In retrospective, this is something which should be considered when designing for physical experiences limited to specific seasons. If the design team would have had access the park during opening hours earlier in the design process, this could possibly have led to more extensive and accurate evaluations, but also more iterations to improve the prototype. Another method which would also have benefited from earlier opening dates is Atmosphere scanning, which would be more accurate when the theme park is in action with all the visitors, movement, music, sounds and smells. In the same way, the ideation the design team did in the park would probably have been better, since more impressions and observations of the visitors could have sparked new ideas.

Choice of concept to design

The design team created a game to explore the area of research. This was not given by any objectives of the project, but was chosen since the design team thought a game would suit the playfulness of a theme park. At the same time, the fact that games in general usually have themes and emotions connected to them also suit the area of research. Additionally, Liseberg has tried to create smartphone games in the past as part of their digitisation process, to evaluate if games can be used to extend the experience of the park. This area is of interest to the stakeholders and when doing the first questionnaire, it was realised that a game suited the top five most common words associated with Liseberg well.

Another positive aspect of creating a game, noted in retrospective, was that it was seen as attractive to test amongst visitors in the park. The design team believe that it is easier to attract visitors to test a game at Liseberg rather than an informative application.

Design process: Double diamond

The divergent and convergent stages of the double diamond model helped the team to keep the right mindset in each stage of the process. Examples to this is the understand phase, which is a divergent phase where the team gathered as much information as possible about the context, and the define phase, which is convergent and is where the team was selecting the focus. The design process was mainly considered during the initial planning phase. As the project progressed, this was a tool to keep track of the current stage of the project and a support when selecting design methods.

Analysing themes in the park

During atmosphere scanning and analysis of Liseberg's DNA, it was clear that some areas did not have as well-defined themes as others, and some had no theme at all. This is something Liseberg is aware of, and their goal is to develop stronger themes all over the park in the coming years. The weaker themes are more difficult to design for, since there are no certain emotions or visual designs to aim for. This can also be seen as an opportunity for the design team and stakeholders of the theme park to develop the theme and concepts together, if it would be possible. During the scope of this project, this was not an option and the team had to work with the existing themes and make their best interpretations of them, iterate and improve from there.

Turning points and insights

During the design process, the team had two major turning points. The first one is described in the process section *Change of direction*. At this point, the design team had spent many hours generating and discarding ideas because they were either too extensive or too complex for the scope of the project, hence the design team struggled to continue to the next project phase. The team learned that they are great at generating new ideas but not at selecting and converging them into one concept. This was an insight which came up during the meeting with the academic supervisor. A similar situation occurred before the second turning point. The team had three smaller concept which still were too extensive to be able to prototype and evaluate for all the areas in time. Once again, this reminded the design team that they had to practice more convergent thinking. After the *Stakeholder meeting* and another supervisor meeting, this resulted in the final concept.

Prototype

The process of creating the prototype consisted of planning of the stages, wireframing, high-fidelity prototyping and finally the interactive prototype. This was a great approach since in the early stages, the concepts for each mission could be experimented with using wireframes, which is a really quick way of conceptualising the missions in an interface. When moving on to the high-fidelity prototype, the design team already had a rough idea of every mission from the wireframing, and the mood of the screens could be based on the design of the mood boards. The high-fidelity prototyping gave an almost exact representation of what the interactive representation would look like. This was also a great advantage when the design team implemented the interactive prototype, since all the fonts, colours, images and textures could easily be applied or modified from

the high-fidelity prototype. This process made it possible to iterate the prototype without any major changes in the implementation.

Evaluation

When the prototype was ready for evaluation, the design team carried out a pilot test and the team quickly realised that there were many usability issues which the design team needed to deal with before evaluating the actual user experience. The design team then fixed the usability issues before the real user experience tests, but even during the real user experience tests, the majority of all feedback and observations regarded usability. If the design team would have had more time, a good idea would have been to do a substantial amount of pilot tests in a first evaluation phase to collect and cover the usability issues, then in a second phase test more focused user experience.

When stepping out in the theme park and approaching visitors, the team noticed that it was hard to find suitable candidates for the tests. The most common reasons were groups being larger than four, being too young, did not have time or had food or prizes in their hands. In a real scenario where the application is meant to be used as a complement to the primary experience at Liseberg, the users would be able drop in and out of the digital experience as they like. This would not be a problem, but during evaluation in this project, the design team needed their full attention to be able to evaluate the concept. During rainy days it was even harder to recruit visitors for the tests. Additionally, the tests and each mission took much more time to execute than expected. Taking all these aspects into account, a better approach would have been to invite people beforehand, similar to what the design team did with the test with the interaction design students. This would save time in terms of recruiting people in the park and give more accurate insights, since the invited group could use the application in the scenario it was designed for, as a compliment to the primary experience. This was though not possible in this project, due to limited budget.

In addition to the user experience tests, the design team handed out questionnaires collecting data about the visitors knowledge about the names of the park areas and how they would describe the atmosphere in the area they were currently in. In crowded areas, it was quite easy to find visitor who wanted to participate in the survey. In other areas, e.g. *Lisebergs lustgård*, which is a well-hidden place the typical visitor of Liseberg does not know exist or would like to go to, it was harder to get participants. The areas *Kvarterat Storgatan* and *Hamnområdet* were also quite hard, since in these areas, the majority of visitors eat lunch or dinner, hence the design team did not want to disturb them during their meals.

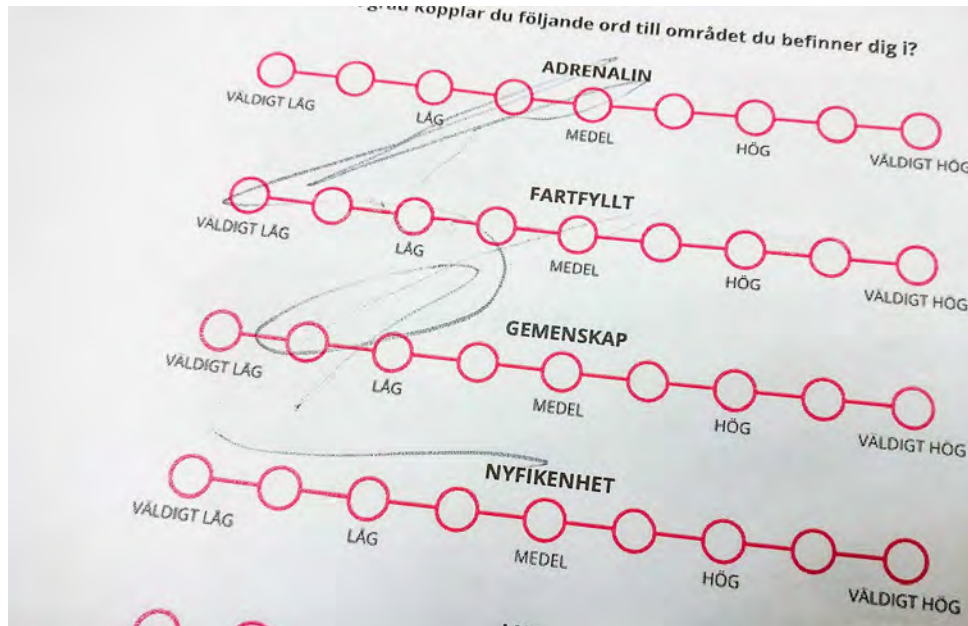


Figure 51: A questionnaire filled in by a child attracted to the biscuits.

When the design team first handed out questionnaires, they had biscuits as a treat for visitors who participated. What the design team did not account for was that a large part of Liseberg's visitors are young children, who are very attracted to biscuits. When walking around with biscuits, the younger audience became very interested and asked if the biscuits were for free. The team told them that they had to fill in a questionnaire to get a biscuit, making them eager to fill in the questionnaire. The problem occurred when the groups of children were very large. Some just filled in something, for instance same values on every factor or only extreme values, without giving it a thought. Some children even just drew lines all over the paper, as seen in figure 51. The team had to discard some of the data, hence the answers were invalid and would skew the data set. The team also noticed that some of the words in the questionnaire were hard for some of the children to understand, e.g. 'adrenaline'. Even if some of the smaller groups of children were fine, because the design team could help them and explain uncertainties, the results could be unreliable do to the children not having an own understanding of the words. Based on these insight, the design team would recommend to tailor the questionnaires if younger children is a part of the target audience. Also use treats appropriate for the audience the researchers want to reach, or not use treats at all. The design team realised that most people would participate without any treat and they think the results are more accurate when participants are not being motivated by treats.

Data collection

The design team realised during the evaluation that the data collection process was too time consuming for gathering a significant amounts of data to be able to statistically draw valid conclusions within the scope of the project. To be able to gather the data needed, many more people would need to be involved in the process. In this project, the design team consisted of two interaction designers, which is what is needed for one test process. If more facilitators would have been involved, more test processes could have been active simultaneously, or questionnaires to

visitors not using the application could have been handed out at the same time. This is basically a question about resource versus time, which is something that needs to be considered when planning projects similar to this. A good idea would be to finish the prototype before season opening of the park and be able to iterate the entire season. Then, the real product could be made ready for the next year.

12.2 Map test

The map test included in the questionnaire handed out to the participants after the user experience tests gave insights on how well the application communicated the names of the areas at Liseberg, which was one of the objectives with the concept. To evaluate this, the map test was also made with regular visitors of the amusement park, visiting without using the application. When analysing the results, the data from the visitors not having used the application was compared to two different groups: those having walked through the area using the application and a subgroup containing those having participated in a mission in the area using the application. What was not considered was the amount of time the participants spent with the application, how many missions they did and how many areas they walked through. These factors may also affect the results, since the different scenarios may affect how well users remember the names. Also, if the visitors had been to Liseberg before could also be a factor affecting the results, which was not taken into consideration in the evaluation.

In addition to the comparison made in the results section about the map test, it would be interesting to compare users using the application for a long time in several areas with those only using it in a smaller amount of areas for a shorter period of time. In the comparison included in this report, all cases were grouped together, without distinctions.

The people visiting Liseberg without testing the application were not asked if they had been to all of the areas in the park or if they had been visiting Liseberg before. If they had not visited all of the areas and were completely new to the park, it would not be surprising if they did not know the names of the areas they had not been to. Despite this, they were challenged to fill in all area names. The design team did not have a way to check what areas they had actually visited. Many visitors could not even themselves tell if they had been to all of the areas. This can be seen as a flaw with the map test.

In the map test, the results of the application were positive, with Hamnområdet as an exception. This area name was known to several visitors not having used the application and the results from those having used it were not better than those without. The reason for this might be that Liseberg has used the name 'Hamnområdet' quite frequently in marketing and that visitors walk through a portal displaying the name when entering the area. The reason why users of the application do not perform better cannot be confirmed by the test results, but the design team has a couple of suggested reasons. One could be that the Hamnområdet interface is more cluttered with details than any other of the other screens, making the name of the area be less dominant. Another is that the small amount of participants in the test do not represent the general user of the application.

To get more reliable data, more participants would be needed. This goes for all of the areas.

12.3 Factors

As mentioned in the process, the factors are a combination of what the design team wanted to know before the design process and the insights gained during the process. Almost all of the factors mentioned were confirmed, except 'Queue and waiting time', which was something the design team was not able to observe due to limited access when users were standing in queues. Even though the design team could not confirm it, they thought that it is important to consider based on the information gathered from the stakeholders at Liseberg, along with the findings from the report by Danielsson et al. (2011).

The user experience test gave insights to two additional factors, *Natural borders* and *Existing information structure*. The list of factors together with the guidelines presented in this report will provide good foundation for designers who are unfamiliar with designing for theme parks. The factors gives an overview of what should be considered when creating a digital theme park experience.

12.4 Guidelines

The guidelines defined in this report are based on the insights gained from the results of the application created in the project. The insights are, as mentioned in the *Insights* chapter, just indications on what should be considered when designing digital artefacts for enhanced experienced atmosphere in physical experiences. This means that there is no guarantee that they work as intended. If the design team would have distributed the time in the project in a different way, more time could have been given to analysis of the guidelines. To verify their reliability, more tests with both the application designed in this project and with other applications for physical experiences would be needed. Further insights might lead to reformulation or removal of the current guidelines. The guidelines should because of this be used with caution, since they are based on indications rather than verified facts.

Even though the major part of the project, in terms of time, was spent in the two initial phases of the double diamond model, the majority of insights, which later became guidelines, came from the evaluation in the explore phase. This may seem obvious since this is the phase where everything is tested, but also all process related insights were almost exclusively from either preparation or execution of the evaluation. This also indicates that this is the most critical phase when designing for an enhanced experienced atmosphere.

Regarding the guideline 'Do not force users into activities that are not within their field of interest', the concept presented in this report allowed for a great range of different types of activities to target a greater target audience. The concept also allowed for options to abort and/or skip the missions.

12.5 Ethical considerations

12.5.1 Privacy

During the project presented in this master thesis report, a number of user experience tests were carried out and anonymous data was collected and used to draw conclusions. The data was not used to track back to any individuals without permission. The data was not shared with any others than the stakeholders of the project and was only used for the research.

Since children needing parental consent were not involved in the research, consent forms were not handed out to anyone regarding participation. Consent forms were though handed out to people identifiable in photos and videos used in this report, presentation and for research. The consent forms included two questions: one regarding usage for research and one for public usage. All people participating in photos and videos signed the consent forms without being forced.

12.5.2 Risks concerning research

When doing user studies and evaluation, participants were not facing any bigger risks than they usually do in their daily life. Participants had the option to resign from the activities at any time, which was clearly communicated to the participants prior to the tests.

12.5.3 Environmental awareness

An issue with the usage of location-based interfaces is the risk of losing awareness of surroundings. *Pokémon Go* is another application taking use of location tracking and reports of several accidents have been published by media. This includes incidents when people are walking and playing at the same time, for instance when a man had his leg amputated after falling on to a railway track when playing the game (Baynes, 2018).

The issue of walking while interacting with the application is something that was considered. The design team tried to design the activities in a way that people were not running or walking around without awareness of other people and objects.

12.5.4 Inclusive design

Since the application designed in this project utilises the physical environment and requires the users to move around in the park, it can be harder or impossible for people with disabilities to use if the environment is not accommodated to their needs. If the application would be developed and released to the public, this is something that should be considered and evaluated.

12.5.5 Consumerism

The concept designed in this master's thesis project requires the users to walk to different locations, interpret information and interact with physical elements. This can be used to entice the users to discover new places in the park but also distribute them to less crowded areas where for instance the queues are shorter. In the same way, this tactic can be used for product placement and advertising, e.g. leading the users to close proximity of food, sweets or other merchandise. Designers have much power and responsibility in these situations and it is important to evaluate the motivations behind design choices and the ethical consciences.

12.5.6 Addiction

When designing a game for a large target audience, addiction is something important to consider. To avoid this, the design needs to be evaluated if it contains mechanics which can trigger addictive behaviour. It can be a fine line between designing a very fun game and an addictive game. In this project, the design team focused on designing with the physical dimension in focus, to prevent the visitors from just looking or engaging with their smartphones.

12.6 Future work

The guidelines and factors presented in the report need further revision and testing. In this project, the guidelines were never tested explicitly, meaning that it is not ensured that they work as intended. To ensure their reliability, the guidelines have to be tested on other applications for enhanced experienced atmosphere. To this date, they are only indicating to work.

If the application presented in this report would be designed and developed further, the missions would first of all be improved using the guidelines presented. The overarching concept of the application was not given much focus in this project, and that would need much more time and development. The design team have thought of several ways the application may be customised or further developed by the theme park, including the following:

- Publishing new missions every now and then, to entice visitors to come back.
- Add rewards, for instance discount in shops and restaurants in the park or fast track tickets, when completing a number of missions.
- Categorise missions by type, and let users select the kinds of missions they want to take on.
- Give users achievements based on the way they solve the missions.

- Include a history of already solved missions, and let users do them again.
- Connect multiple missions using an overarching narrative, and publish new 'episodes' containing a bundle of missions every now and then.

The stakeholders of the project presented objectives including enticing visitors to come back to the park during low season and make queues to attractions more entertaining. These objectives were decided not to be main focus for the project, but if the concept would be developed further, it would be beneficial to work more towards these two goals. Some of the ideas presented in the bullet list may lead the concept fulfilling these objectives.

13 Conclusion

During this master's thesis project, the design team carried out the process of designing a digital artefact for an enhanced experienced atmosphere, to gain insights and answer the question:

- *Which guidelines should be considered when designing digital artefacts for enhanced experienced atmosphere?*

To answer this, the complementary question 'Which factors from the physical dimension should be considered when designing digital artefacts in the context of a theme park?' was added. The design team started with a few problem/goal statements gathered from the stakeholders at Liseberg. Since the design team had no previous experience with theme parks except as visitors, an extensive background research was done through literature and looking at related work to gain understanding of this domain. In the beginning, the goal statements were seen as separate from the research question, but was later aligned after a change of direction and when developing the final concept.

The design team executed the entire design process from problem statement and concept development to final prototype and evaluation. The team followed the design process of a version of the double diamond model and discovered all of the four phases, i.e. *understand*, *define*, *explore* and *create*. Most of the guidelines were derived from the explore phase of the double diamond model, indicating that this is the most critical phase when designing for enhanced experienced atmosphere.

After the final evaluation, the process, prototype and the results from the evaluation were analysed. This analysis resulted in a list of insights, acting as a backbone when the design team extracted and formulated factors and guidelines. The first set of guidelines were then sorted and refined, and some guidelines were replaced with new ones, which resulted in the final set of fifteen guidelines.

The fifteen guidelines (see *Final results* section) basing on what the design team has gathered during the design process, are the design team's answer to the research question. The design team extracted what they thought is important to consider when designing a digital artefact for an enhanced experienced atmosphere. These guidelines have not been validated outside of the design team, which would be the next step. Also, the prototype would need more evaluation to statistically prove how the digital artefact affected the experienced atmosphere. Taking this into account, the design team thinks these guidelines would be very helpful for designers who are new to this field, like the members of design team were before this project. Even more experienced designers, though, can use this as a reminder to avoid the same mistakes and consider the design team's insights to create a better physical user experience.

References

- Babich, N. (2017). Prototyping 101: The difference between low-fidelity and high-fidelity prototypes and when to use each. Retrieved February 19, 2019, from <https://theblog.adobe.com/prototyping-difference-low-fidelity-high-fidelity-prototypes-use/>
- Baynes, C. (2018). Man has leg amputated after falling on to railway tracks while playing pokemon go. *The Independent*. Retrieved January 28, 2019, from <https://www.independent.co.uk/news/uk/home-news/man-fall-train-tracks-pokemon-go-leg-amputate-railway-track-salisbury-district-phone-a8665741.html>
- Cambridge Dictionary. (n.d.-a). Meaning of atmosphere in english. Retrieved February 11, 2019, from <https://dictionary.cambridge.org/dictionary/english/atmosphere>
- Cambridge Dictionary. (n.d.-b). Meaning of atmosphere in english. Retrieved February 19, 2019, from <https://dictionary.cambridge.org/dictionary/english/look-and-feel>
- Cambridge Dictionary. (n.d.-c). Meaning of physical in english. Retrieved February 11, 2019, from <https://dictionary.cambridge.org/dictionary/english/physical>
- Cassidy, T. (2011). *The mood board process modeled and understood as a qualitative design research tool*. Fashion Practice. doi:10.2752/175693811x13080607764854
- Chang, H.-M., Díaz, M., Català, A., Chen, W. & Rauterberg, M. (2014). Mood boards as a universal tool for investigating emotional experience. In A. Marcus (Ed.), *Design, user experience, and usability. user experience design practice* (pp. 220–231). Cham: Springer International Publishing.
- Creative Bloq. (2015). 5 rules for visual direction in interaction design. Creative Bloq ART and DESIGN INSPIRATION. Retrieved February 20, 2019, from <https://www.creativebloq.com/netmag/5-rules-visual-direction-interaction-design-31514304>
- Danielsson, J., Hallgren, E., Lindgren, M., Lázaro Morales, C., Pernemalm, P. & Young, S. (2011). Upplevelser i världsklass - en rapport för parks and resorts scandinavia.
- Design Kit. (n.d.-a). Extremes and mainstreams. Retrieved February 18, 2019, from <http://www.designkit.org/methods/45>
- Design Kit. (n.d.-b). Rapid prototyping. Retrieved February 14, 2019, from <http://www.designkit.org/methods/26>
- Disney. (2018). First-of-its-kind 'play disney parks' mobile app debuts this week at walt disney world resort and disneyland resort. Retrieved February 13, 2019, from <https://dpep.disney.com/first-of-its-kind-play-disney-parks-mobile-app-debuts-this-week-at-walt-disney-world-resort-and-disneyland-resort/>
- Fokkinga, S. & Desmet, P. (2012). Darker shades of joy: The role of negative emotion in rich product experiences. *Design Issues*, 28(4), 42–56. doi:10.1162/desi_a_00174
- Fokkinga, S. & Desmet, P. (2013). Ten ways to design for disgust, sadness, and other enjoyments: A design approach to enrich product experiences with negative emotions. *International Journal of Design*, 19–36. Retrieved from <http://studiolab.ide.tudelft.nl/diopd/library/publications/ten-ways-to-design-for-disgust-sadness-and-other-enjoyments-a-design-approach-to-enrich-product-experiences-with-negative-emotions/>

- Gaver, W. (2012). What should we expect from research through design? *Proceedings of the 2012 ACM annual conference on Human Factors in Computing Systems - CHI 12*. doi:10.1145/2207676.2208538
- Gibbons, S. (2018). Empathy mapping: The first step in design thinking. Retrieved February 14, 2019, from <https://www.nngroup.com/articles/empathy-mapping/>
- Gkouskos, D. (2016). User experience insight: Steering experience design through meaningful incorporation. Chalmers University of Technology. Retrieved from <https://research.chalmers.se/publication/231604>
- Google. (n.d.). Crazy 8's. Google. Retrieved February 14, 2019, from <https://designsprintkit.withgoogle.com/methodology/phase3-sketch/crazy-eight>
- Hamm, M. J. (2014). *Wireframing essentials: An introduction to user experience design* (1st ed.). Birmingham: Packt Publishing Ltd.
- Hawley. (2009). Design research methods for experience design. Retrieved May 30, 2019, from <https://www.uxmatters.com/mt/archives/2009/01/design-research-methods-for-experience-design.php>
- Hellweger, S. & Wang, X. (2014). What is user experience really: Towards a ux conceptual framework. doi:10.6084/M9.FIGSHARE.1319576
- Hunicke, R., Leblanc, M. & Zubek, R. (2004). Mda : A formal approach to game design and game research.
- Interaction Design Foundation. (n.d.). How now wow matrix. Retrieved May 30, 2019, from <https://public-media.interaction-design.org/pdf/Now-Wow-How-Matrix.pdf>
- International Organization for Standardization. (2010). Iso 9241-210:2010 ergonomics of human-system interaction — part 210: Human-centred design for interactive systems. Retrieved June 4, 2019, from <https://www.iso.org/obp/ui/#iso:std:iso:9241:-210:ed-1:v1:en>
- Liseberg. (n.d.). Liseberg. Retrieved February 11, 2019, from <http://www.lisepedia.se/2018>
- Lundgren, S., Fischer, J. E., Reeves, S. & Torgersson, O. (2015). Designing mobile experiences for collocated interaction. In *Proceedings of the 18th acm conference on computer supported cooperative work & social computing* (pp. 496–507). ACM.
- Martin, B. & Hanington, B. M. (2012). *Universal methods of design: 100 ways to research complex problems, develop innovative ideas, and design effective solutions*. Retrieved from <https://ebookcentral.proquest.com/lib/chalmers/reader.action?docID=3399583>
- Mesibov, M. (2015). How visual design makes for great ux | ux booth. Retrieved February 19, 2019, from <https://www.uxbooth.com/articles/how-visual-design-makes-for-great-ux/>
- Milicic, A., El Kadiri, S., Perdikakis, A., Ivanov, P. & Kiritsis, D. (2014). Toward the definition of domain concepts and knowledge through the application of the user story mapping method. *International Journal of Product Lifecycle Management*, 7(1), 3–16. PMID: 65456. doi:10.1504/IJPLM.2014.065456. eprint: <https://www.inderscienceonline.com/doi/pdf/10.1504/IJPLM.2014.065456>
- Norman, D. A. (2004). *Emotion design: Why we love (or hate) everyday things*. Basic books.
- O'Keefe, B., Slutsky, B., Iulicci, N., Nalbandian, A., Thanedar, A., Mokey, S. & Mival, O. (2013). Mobile experiences for tourism: Brick city tours. In *Chi'13 extended abstracts on human factors in computing systems* (pp. 1413–1418). ACM. Retrieved from <https://dl.acm.org/citation.cfm?id=2468608>

- Phillips, B. J., McQuarrie, E. F. & Griffin, W. G. (2014). How visual brand identity shapes consumer response. *Psychology & Marketing*, 31(3), 225–236.
- Pine, B. J. & Gilmore, J. H. (2011). *The experience economy*. Harvard Business Press.
- Preece, J., Rogers, Y. & Sharp, H. (2015). *Interaction design: Beyond human-computer interaction*. John Wiley & Sons.
- Roest, H., Pieters, R., Koelemeijer, K. et al. (1997). Satisfaction with amusement parks. *Annals of Tourism Research*, 24(4), 1001–1005.
- Schade. (2015). Pilot testing: Getting it right (before) the first time. Retrieved May 31, 2019, from <https://www.nngroup.com/articles/pilot-testing/>
- Schneider, J. (n.d.). The double diamond: Strategy + execution of the right solution. Retrieved February 12, 2019, from <https://www.thoughtworks.com/insights/blog/double-diamond>
- Shaer, O., Hornecker, E. et al. (2010). Tangible user interfaces: Past, present, and future directions. *Foundations and Trends® in Human-Computer Interaction*, 3(1–2), 4–137.
- Ünlüer, A. A., Baytaş, M. A., Buruk, O. T., Cemalcılar, Z., Yemez, Y. & Özcan, O. (2018). The effectiveness of mime-based creative drama education for exploring gesture-based user interfaces. *International Journal of Art & Design Education*, 37(3), 353–366.
- Usability.gov. (n.d.). High-fidelity prototype. Retrieved February 19, 2019, from <https://www.usability.gov/what-and-why/glossary/high-fidelity-prototype.html>
- User Experience Professionals' Association. (n.d.). Stakeholder meeting. Retrieved May 30, 2019, from <https://www.usabilitybok.org/stakeholder-meeting>
- Vasilis, J. (2016). Liseberg tar apputveckling till nya höjder. *Mynewsdesk*. Retrieved February 11, 2019, from <http://www.mynewsdesk.com/se/liseberg/pressreleases/liseberg-tar-apputveckling-till-nya-hoejder-1422827>
- Wejlid, G. (n.d.). Snabbskrivning. Retrieved March 27, 2019, from <https://www.huvudsidan.se/kreativitet/snabbskrivning/>
- Zondervan, Q. Y., Umair, Z., Khan, U. A., Raman, L. & Marian, R. (2008). Voice applications and voice-based interface. US Patent 7,334,050. Google Patents.
- Zuckerman, O. & Gal-Oz, A. (2013). To tui or not to tui: Evaluating performance and preference in tangible vs. graphical user interfaces. *International Journal of Human-Computer Studies*, 71(7-8), 803–820.