How to create a joint VR experience for Droomvlucht

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efteling

Contents

1 Abstract

Efteling is the biggest theme park in Holland focused on families. However, one of their most popular and family friendly attractions Droomvlucht is not accessible for visitors without the ability to walk. Therefore, the challenge was to find a way for them to experience Droomvlucht using virtual reality technology (VR). The solution was to create a joint multisensory VR experience of Droomvlucht with an ability to talk to over distance. This setup was tested with representative visitors during an experiment in the park. The results were that this experience was immersive and created a feeling of togetherness, because the virtual and the real experience were synchronised and the visitors could talk with each other. Their conclusion was that the setup that was tested would be a valuable solution for most disabled visitors. Therefore it can be concluded that a joint multisensory VR experience for Droomvlucht is an opportunity for Efteling to further investigate.

2 Description Graduation Project

The description graduation project describes the research project, the key elements of it and a description of the research question.

2.1 Introduction

Efteling is a theme park located in Brabant with almost five million visitors each year. This park has rides and fairy tales for every kind of visitor, young and old. However, some of these visitors have special needs when they want to enjoy themselves in the Park, because of a disability, fright or other circumstances. **The problem could occur that a visitor cannot experience Efteling like an ordinary visitor. This can happen because the visitor gets separated from its group or because he or she cannot enjoy an attraction or the park like others can.** This is not a good experience and could leave a visitor with a bad memory of the visit, which could have been good. Therefore Efteling is interested in finding a solution for the stated problem because the motto of Efteling is to let every visitor forget their daily struggles and to enchant them for a day. A technological solution could be given by using a new technology called Virtual Reality (VR) because you can immerse a user in a specific environment. Another important vision of Efteling is that visitors are experiencing their day together. Therefore an interesting study would be to find a solution where visitors are experiencing an attraction together using VR goggles, without physically being with each other.

2.2 Personal Motivation

One day a year I was allowed to go to Efteling with my mother and we would even take a day off for it. When I think of Efteling, I think of my youth and the fun moments I had there. That's one of the reasons why I was interested in working with Efteling for my graduation project.

Next to that I think that things could be improved for people with disabilities. I helped people get into their home from a wheelchair and saw how difficult such an easy task could be for someone with a disability. It seems unfair that even 'easy' things are difficult for some people, like getting into an attraction at Efteling.

2.3 Efteling

The client in this graduation project is the Dutch fantasy themed park Efteling. Efteling has multiple attractions, rides and a famous fairy tale forest that has been mostly designed by Dutch artist Anton Pieck. In most of the rides, storytelling is a very important factor that can be experienced during the attraction, in the waiting lines and in the surrounding environment. Next to that, Efteling strives to give every visitor a fun day with its romantic and nostalgic themed

atmosphere. Efteling employs 2600 workers year-round and is the biggest theme park in Holland.

The park has won multiple prizes and awards, of which the most recent one is the 'Leukste uitje van Nederland 2016' which means that members of the ANWB voted for Efteling to be the most fun place to go for a day-out in 2016.

2.4 Importance

This research will try to find a VR solution for visitors who cannot entirely experience an Efteling attraction like an ordinary visitor. It is highly important to do research in this field because of the following reasons.

Firstly, it is important to the visitor. Efteling principally has to make sure that any visitor has a fun day with their friends or family, even if they have a disability or fear. These visitors could get separated at one point when their friends or family members want to get into an attraction or they have to use a special wheelchair entrance. The worst thing is that three attractions at Efteling are completely unaccessible for disabled visitors.

Secondly, this research can be important for Efteling. The vision of Efteling states that they want every visitor to have a good experience and to forget their daily struggles and work. Therefore, making sure that every visitor has a more enjoyable visit and does not feel their usual struggles when they cannot enter a ride with their group, will lead to a better experience. Next to that, happy visitors will visit more often which is needed if Efteling wants to grow in the future.

Thirdly, there is a large group of people in Holland that require special care. Some visitors cannot wait in the regular waiting line: not only visitors in a wheelchair, but also visitors with a mental disability or a particular form of autism. For some people, a waiting line provides too much sensory stimuli for too much time. The following statistics were gathered from the Netherlands Institute for Social Research [64] and from the Autism Organisation in Holland [27]

- Roughly 1,4% of the Dutch population depends on a wheelchair.
- Roughly 0,3% of the Dutch population has serious mental disabilities with an IQ < 50.
- Roughly 1% of the Dutch population has autism.

It can be expected that these numbers also represent the visitors of Efteling, because Efteling is designed to accommodate any kind of visitor. There are no specific statistics of the amount of visitors who need to have wheelchair access at Efteling.

Lastly, it is important for the development of virtual reality to have more applications of this technology in order to grow. In the past, virtual reality had been popular for a brief moment, but the technology was just not there to give the user a good experience. Ever since the end of October 2015 (figure 1)

virtual reality has been extremely popular and according to Google Trends, the public is interested in this technology and especially people in Holland seem to be interested compared to the rest of the world (figure 2). Ever since Efteling is a theme park most visited by Dutch citizens, it could be interesting for them to implement VR in the park in ways that other theme parks are not yet utilizing.

Figure 1: Interest in VR - Source: Google Trends [Retrieved Dec 10th 2016]

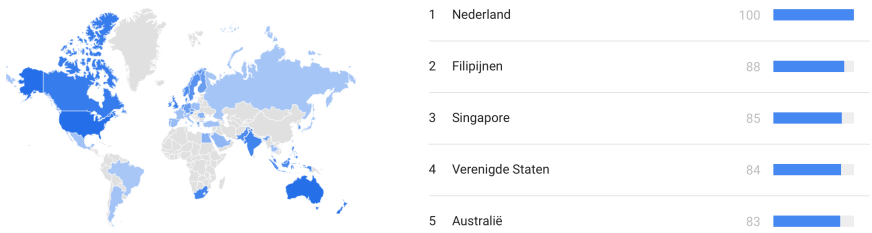


Figure 2: Interest in Virtual Reality per Country. According to Google: "Numbers represent search interest relative to the highest point on the chart for the given region and time. A value of 100 is the peak popularity for the term. A value of 50 means that the term is half as popular. Likewise a score of 0 means the term was less than 1% as popular as the peak." - Source: Google Trends [Retrieved Dec 10th 2016]

2.5 Defining the Target Group

Efteling is interested in a solution for **visitors who cannot entirely experience an Efteling attraction like an ordinary visitor**. This can occur because of multiple reasons:

- A visitor has a phobia and cannot enter some rides;
- A visitor has a physical or mental disability, that prohibits him or her to wait in a regular waiting line or to access an attraction at all.

These users will later be studied in the state of the art research in chapter 3.

2.6 Preliminary Research Question

Based on the clients' wishes and the identified problem, a preliminary research question was formed to further investigate in the next two chapters. The preliminary research question was as follows:

"Could a joint virtual reality help visitors who are missing some part of an Efteling experience?"

3 State of the Art in Virtual Reality

This section will give an answer to the following questions:

- What is the state of the art in virtual reality devices;
- What is virtual reality and immersion exactly;
- What must be done in order to create an immersive virtual reality experience;
- How can a joint VR experience be realised?

To answer these questions, scientific literature was reviewed, interviews were conducted with experts and visitors were observed in Efteling during opening hours. This was done between the period of September 22nd 2016 until November 1st 2016.

3.1 What is a Virtual Reality?

In order to understand how a good VR setup can be built with current technology a small introduction will be given about the history of virtual reality in order to understand how people have been using this technology and to understand the progress that has been made in the technology.

The term 'virtual reality' was first introduced with the development of the Link Trainer in the 1920's and was later used to train pilots in the second world war [6]. However this Link Trainer was more like a simulator and did not use a Head Mounted Display (HMD) we see in VR devices nowadays. Later in 1957 the term was reintroduced by Morton Leonard Heilig, who is seen as the pioneer of virtual reality. He developed the Sensorama, which was the first device where the user could virtually ride a motorbike in Brooklyn. The user could see a 3D image, but could also smell the city, feel the bicycle and the wind in their face. Because multiple senses of the human body were stimulated it was called a multisensory experience. Back then, the device was just used for entertainment purposes.

The first VR experience that used an HMD was "The Sword of Damokles" in 1968 made by Sutherland [14]. This new finding earned Sutherland the title as 'father of VR', because it was the first kind of this VR device that people still use to experience VR content today. Nowadays, virtual reality can be more realistic because of the use of modern day computers and high resolution screens of the HMD. The virtual world only exists within the computer and the sensors in the HMD allows the user to look in all directions [8]. With the HTC Vive, the user is even allowed to walk around in the virtual environment in a specified 'real' space. Other new virtual reality goggles try to eliminate sickness, add more sensory input for the user and increase the screen quality by adding more pixels and with more processing power to create 3D environments.

There is a difference with VR devices nowadays when compared to early versions of VR. The technology was initially created to give the user an experience and feeling of a different location and action, like the Link Trainer and the Sensorama. The Sensorama even combined multiple senses to create a 'real' feeling of driving a motorcycle in a city. Big tech companies in the virtual reality industry are only increasing comfort, display quality of the hardware and input devices nowadays. A device like the Sensorama has not yet been released as a consumer product.

Finding a true definition of a virtual reality experience in today's world is difficult to find and everyone explains it differently. To create a general definition of the term 'virtual reality' articles and definitions given by researchers were reviewed.

Damgrave from the University of Twente gives a general definition in the Encyclopedia of engineering as follows: "Virtual reality (VR) is an artificial reproduction of a potential reality or use condition that enables users to experience and/or modify and/or to interact with. These computer-simulated environments are experienced mainly through the senses of sight and sound. VR systems have the following key properties: • 3D-representation and perception • Spatial interaction in real-time • Sense of presence and immersion" [23]

Chang calls VR a computer system that can show a virtual world to a user [5]. Jose et al. define a virtual reality as "an immersive environment that can be either recorded or created where an individual can use a head-tracking headset display to explore and, in some cases, even interact with the virtual environment" [6]. This definition already seems to fit better with earlier findings in history. Other researchers like Caroline et al. and Paush et al. [7,9] seem to agree and call a virtual reality a system where a generated world can be viewed and where the user has a feeling of owning a virtual body.

The definition given by Chang seems correct, but does not cover all the aspects of a virtual reality, especially not the difference between a desktop view and the 3D stereoscopic VR people know nowadays. The definitions given by Jose et al., Caroline et al. and Pausch seem to agree more with each other.

A general definition could be interpreted as follows:

Virtual reality (VR) is a computer system that creates or shows a virtual world to a user that can be explored using your sight and sound and that will immerse the user in this world.

3.2 Current State of Virtual Reality Devices

Nowadays, virtual reality can be more realistic and immersive because of the use of modern day computers and screens, but it often lacks the multisensory experience.

At the moment there are different VR devices and for the sake of this state of the art review, three different kinds of virtual reality goggles will be discussed. There are many more kinds of VR devices, such as smell machines, body worn devices, wind machines et cetera[16] which will not be investigated

in this report. The reason is that most of these devices are still not released or in development. There are four product groups that will be distinguished by their main characteristics:

- Wired
- Mobile
- Spatial Devices
- VR using projectors

Wired

At the moment, one of the most admired VR goggle is the *Oculus Rift*, which was successfully funded on kickstarter and started a new generation of VR devices [30]. After multiple developer editions, the consumer edition was released after the company was bought for 2 billion dollars by Facebook [31]. A consumer VR setup requires a PC with high end graphics specifications, the *Oculus Rift* goggle and a camera tracker for XYZ axis tracking. Originally there was also an input device announced, which will be available later this year for *Oculus Rift*.

Another wired goggle is the *Playstation VR*, which was released on October 13th 2016 by Sony [32]. This device uses the PlayStation Camera and a Playstation 4 with motion controllers. Different from the Oculus Rift, the Playstation VR has VR controllers, while the Oculus Rift has failed to deliver that in time. Next to that, the hardware is much cheaper than an Oculus Rift setup. However, the image quality is less and therefore the Oculus Rift could still be seen as a better VR experience, purely because it has better graphics.

Other wired Virtual reality goggles are not yet released at the time of writing, but offer different features than previously mentioned devices. For example the *Fove VR* has eye tracking and the *StarVR* has a wider field of view of 210 degrees [33] [34]. More VR headsets will be introduced while this project progresses, but those will not be relevant to use at this stage. However it is interesting to see these VR goggles evolve very quickly every year.

Mobile

Next to wired VR goggles, there are also mobile ones nowadays. The technological advancements in smartphone development stimulated the wireless VR goggles because the same hardware can be used that is available in new smartphones. This also means the quality of the experience is worse because a mobile device does not support the graphical power a PC has.

On of the most low budget and widely used VR devices is the *Google Cardboard*, that supports your own smartphone as hardware [35]. This kind of device is called a 'viewer'. Google wanted to push VR to the masses and therefore developed this 20 dollar VR viewer for people to use at home. An argument against the cardboard is that people get a wrong idea of VR because the experience is

not that good. However, it did deliver VR to the masses with over five million people who have bought a Cardboard[17].

Another low budget VR goggle with more comfort than the cardboard is the *Samsung Gear VR*, which is also used in many theme park rides already[36][18]. The hardware and software work together and offer a decent VR experience on a low budget.

There are many more viewers to give the user a VR experience with a smartphone like *Zeiss VR, Trust VR* and *Homido* [37] [38] [39]. Unfortunately there are no mobile VR headsets that do not use a smartphone inside. An educated guess would be that the development of this will come very soon and Google has already announced they are working on such a project.

Spatial Devices

The feeling that you are spatially located in a digital environment is important for an immersive feeling in VR [11]. The previously mentioned devices fail when it comes to movement in virtual reality, because they use Motion Controllers, while the best controllers could be your own body.

That is why the *HTC Vive* has motion trackers that can track a person in 3D space. With this technology, a person can walk on a small location in a virtual environment [41]. A downside is that these goggles are connected with wires, which makes free movement less comfortable and could result in less immersion [8].

Another piece of technology that can help make the user more spatially present in VR is the *Virtuix Omni,* which is a virtual reality motion platform [42]. The user needs to wear special shoes and can move on a single location, while it feels like walking a distance.

At the University of Twente, HMI has also been using Oculus Rifts in combination with *Optitrack* motion trackers to give the same results as an HTC vive. The downside of this system is that it is costly compared to other VR setups and needs an adapted Oculus Rift in order to work [43].

Virtual reality projections

Another possibility for a virtual reality solution is the use of projectors in a room. The user can stand in the middle of the room and look around. There are multiple options for doing this.

One of the options would be to use walls, where a projector is presenting a part of an environment on each of three walls. There is also an option for configurable walls, which can be placed in any room and can have any shape. In order to eliminate corners, a curved screen could be used. A company called *Barco* can offer any of these solutions. Barco also offers stereoscopic view with the use of 3D glasses and motion tracking of the person in front of the projection [44].

Another possibility is presented by WorldViz with the *Vizmove projector system* [45]. This system requires a corner of the room with two walls, 3D glasses and motion tracking system to create a virtual reality in a room.

Something that can be experienced in some cinemas is *IMAX*. This is not a virtual reality projection, but a semi immersive experience with a big, slightly curved screen. According to Baños et al. a bigger screen should be experienced as more immersive [46].

3.3 Requirements for a Good Virtual Reality Experience

A feeling of immersion and the technology itself can be seen as two of the most important factors of a VR experience. One of the reasons why VR failed in the 90's is due to the fact that the hardware was not optimal and therefore a feeling of immersion could not be achieved. Therefore, research must be done to understand the feeling of immersion and how this could be created using VR technology. This subsection will first review literature and then an interpretation of the definition of immersion will be given.

Defining 'Immersion' in virtual reality

Brown and Cairns [1] describe immersion in relation to gaming. Immersion is when you do not feel like you are playing a computer game anymore. Your emotions are affected, you feel empathy and the atmosphere of the game fits your mood. Patrick et al. [2] describe immersion differently, but adds a more technical explanation of the feeling. They think immersion is when a persons cognitive and perceptual systems are tricked into believing they are somewhere else than their physical location. The feeling of immersion could also be described as going to a new location and having the emotions and empathy that fit that specific environment [3]. It is like being somewhere and not feeling the emotions associated with your current location. That also fits with the explanation that Pausch et al describe as a sense of being in the virtual environment [9]. A sense of 'presence'.

These findings from literature review all have a something in common: immersion is when you are not in the current moment and state anymore, but present in the virtual moment. Brown and Cairns even think you have to feel the empathy and emotions of the moment. This could mean that immersion is more than just a good looking game or environment, because it has to touch your own emotions and provoke empathy. It does not mean that characters have to look realistic. Pixar characters are an example of a unrealistic looking character that does provoke empathy and emotions to the audience. The way Patrick et al. explain it, could be interpreted as a technological mind trick, an illusion. A sense of presence could also be interpreted as a good story and realistic adventures. Most of the people will recognise a sense of presence when reading a good story in a book as well.

In conclusion, immersion is not just seeing a new external atmosphere. It is a feeling of presence and having a deep emotional bond with the virtual environment and the things you see and interact with. It could be interpreted as not knowing you are in a computer generated illusion. A general definition could be:

"Immersion in virtual reality is a feeling of presence in the virtual world and not actively knowing that you are in this virtual world.

Creating Immersion in virtual reality

Now that a definition of immersion in VR has been given it is interesting to investigate how such a feeling can contribute to a VR experience and how a designer can create an immersive VR experience.

Bangay and Preston [8] wanted to find out exactly what factors contributed to immersion in an interactive VR environment. They tested this on a technological festival with two different setups. One was supposed to create a calm feeling when the user was swimming with dolphins, the other setup was made to induce stress in a roller coaster which they both measured with heart rate and with a survey at the end. They found four factors that play a role in a feeling of immersion in a VR environment: excitement of the experience, comfort of peripherals (hardware) and environment during the experience, quality of sound and images and age. Excitement of the experience was partly because people experiencing the setup were new to VR, therefore new ways should be investigated to excite people who already know VR. Comfort of the peripherals means that when a user is feeling the VR goggles, it decreases the illusion and will therefore decrease immersion. Comfort of the environment is interesting, because a lot of VR games are horror themed and will not have a comfortable virtual environment by design. It could be discussed if this will truly decrease immersion. Quality of the sound and images will create a more realistic experience, which could give a better feeling of presence. The age factor is because younger people were more interested in VR than older people, according to the paper.

Other research indicates that the display technology affects the feeling of immersion[10], which is in accordance with the findings of Bangay, that stated that peripherals are important for a feeling of immersion. In display technology there are a couple of problems that can create a less immersive VR experience for a user. One of them is the Screen Door Effect and the other is vergence accommodation conflict [13]. The Screen Door Effect are the lines between pixels that a user might see. This makes the image you see less realistic, because your eye can clearly see it is made out of pixels and not a genuine view. The vergence accommodation conflict is an off image you see when your eyes try to converge or diverge on an object closely or far away. On a screen this is not possible, which can cause discomfort, eye fatigue and your brain knows it is not looking at a real 3D environment. This problem still occurs in VR goggles that are currently available.

Another important part of creating an immersive VR experience is creating spatial presence [11][12]. This means the VR user has a sensation of being in a different place. This can be done by eliminating as many real life sensory input and replacing them by ones from the virtual environment according to the paper. A multisensory experience is an example of this, which is an experience that replicates the senses that one would feel in the virtual environment.

A good example of a artificially created immersive VR experience could be 'The Void'. They are trying to create the world's first VR entertainment park where a person can walk around and perform tasks in a virtual environment [19]. The walls have contours of devices and furniture that are present in the virtual environment, so a user can actually 'touch' a virtual chair for example. They create spatial presence by letting the user truly 'touch' virtual buttons and walk around in the environment. They also created a lot of excitement for their experiences with example video's online and by having a very interactive game.

In conclusion, immersion can be achieved in virtual reality when the following conditions are met:

- The display technology needs to be good;
- The user needs to get excited for the experience;
- There needs to be spatial presence;
- A multisensory setup;
- Good sound.

3.4 Designing Social Virtual Reality Systems

In this research a joint experience for visitors who are missing some part of an Efteling experience needs to be realised. This means that in a joint experience, there is also a social part of being together or 'co-presence'. Literature research has been done in order to find previous findings in these kind of systems.

A feeling of 'being together' is something that has to be achieved in a joint experience. Some call this phenomenon virtual togetherness that is often linked with studies of Shared Virtual Environments (SVE). Findings from these studies can be interesting for this joint experience project as well. However, several studies already mentions that study into joint-experience in virtual reality is still in its initial stage [25,26].

In SVE's people can interact with each other and perform tasks in a virtual environment. This can be done using different kinds of technology, but the same features for a social experience count for all kinds of technology. Schroeder discusses different research in the field of SVE and the sociology side of this [24]. Schroeder mentions that a more immersive VR system will create a better feeling of co-presence and the person in the most immersive system is often seen as the leader in the environment. Another important thing Schroeder mentions is that 3D sound is not necessary, as long as someone can identify who is talking in a conversation.

Another important feature for more togetherness could be touch. Basdogan et al. mentions that haptic feedback in their test setup for a joint VR experience, increased the feeling of togetherness significantly [25].

A big part of being together in reality is communication through facial expressions. Albuquerque and Velho warn in their report that this makes a feeling of togetherness in virtual reality very complex, because these expressions need to replicated in the virtual environment in order to communicate well [21]. This report also gives two possibilities of replicating this in a virtual environment: with a real image of the user captured from a webcam or an image of the person, with their real voice through a microphone. Or a 3D avatar with animations replicating the users' expressions. Albuquerque and Velho also experimented with these two possibilities and got interesting results. First of all, users who were using a webcam were unwilling to talk with their voices unless there was a webcam image of the person who s/he was talking to. Another important lesson is that trust creates an increased feeling of presence, which means that a person has a better feeling of presence when s/he knows the other person.

Seeing a person move or in a still image could make a difference in a person's emotional state. Detenber investigated how people react to a still image or a video by surveys and by measuring heart rate and skin conductance [28]. The conclusion of this experiment indicates that moving images of a person created a significant more emotional response compared to still images.

Samsung has its own example of a joint VR experience with Samsung Bedtime, where a mother and a child can experience a bedtime story together in a virtual environment. This system is only using voice in combination with a simple avatar to create the joint experience in a multiplayer environment made in Unity [29].

4 State of the art Accessibility Options at Theme Parks

Every theme park is faced with visitors who need special care while enjoying themselves in a theme park. It is interesting to investigate what other theme parks offer for these visitors to see whether they are applying VR as an accessibility option.

To investigate this, a small sample of theme parks was investigated. This sample includes some big theme parks with large numbers of visitors and some theme parks that advertise themselves as 'wheelchair friendly'. To see what they offer, the websites of the parks were investigated and an overview of accessibility can be seen in fig 3.

Park	Total Attractions*	Total rides*	Number of attractions accessible for wheelchairs*	Number of rides accessible for wheelchairs**	Possibilities for wheelchair rental?
Efteling	35	22	32	18	Yes (free)
Disney World Magic Kingdom	41	25	26	15	Yes ($15) (ECV also possible)
LegoLand Windsor	54	27	54	27	Yes (free)
Walibi Holland	34	12	11	31	Yes (free)
Universal Studios	18	12	17	11	Yes ($15)
Morgan's Wonderland	25	5	25	5	No

Figure 3: Overview of theme parks

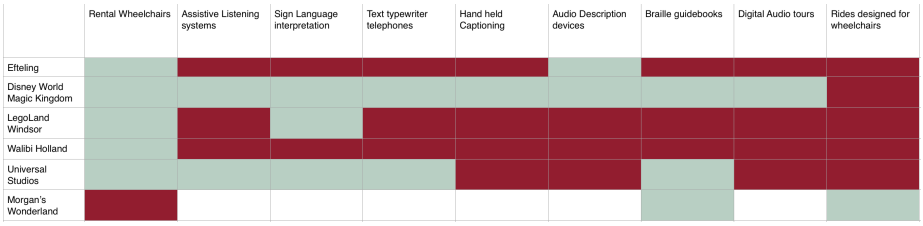


Figure 4: Different options at theme parks. White fields means that the information could not be found on the website.

4.1 Accessibility Options at Different Theme Parks

Some of the mentioned theme parks are actually not as wheelchair or accessibility friendly as they are pictured in fig 2. The different theme parks will be

discussed below and it will be discussed what they are trying to do for people with disabilities.

Efteling

Efteling is the client in this project and is a theme park with multiple rides and attractions [57]. The park tries to serve any kind of visitor with different attractions, therefore rollercoasters, dark rides and shows can be found. There are four attractions that are not accessible by wheelchair: Droomvlucht, Polka Marina, Lavenlaar and the main ride of Villa Volta. The reason for this, is the fact that Polka Marina and Lavenlaar have a staircase and Droomvlucht and Villa Volta are not accessible because of safety reasons. All the other rides and attractions are accessible by a wheelchair entrance, through the exit or via the regular waiting line.

At Villa Volta, the main attraction is not accessible for disabled visitors, however they do offer a movie that shows the attraction. This way, the disabled visitor still knows what the attraction is and how people would experience it.

More information about the accessibility facilities in Efteling and experiences can be read in the report of the field research in Efteling in paragraph 3.3.

Disney World Magic Kingdom

Disney World Magic Kingdom in Orlando has by far the most accessibility features according to figure 4. Their handheld captioning device is an example of an accessibility technology that they are using, that most theme parks are not offering [58]. Disney worked together with a company called Media Access Group WGBH to deliver a handheld captioning device that can describe the environment to a blind visitor.

Furthermore the wheelchair entrances are often next to the regular waiting line and their service gives visitors with wheelchairs clearance to take the fastlane.

The entire service for visitors with disabilities is called Disney ACCESS. And example of their device can be seen in figure 5.

Figure 5: Disney ACCESS Interface

Legoland Windsor

Legoland windsor is advertising themselves as wheelchair friendly on their website [59]. Their website has a special map for visitors with special needs that thoroughly explains what every ride is and where the wheelchair entrances are.

The special map that Legoland offers to visitors with disabilities describes specific attractions and what they include, where a visitor with a disability could enter and which kind of disabilities would not be accepted onto the ride. An example of a page from that guide can be found in the next figure.

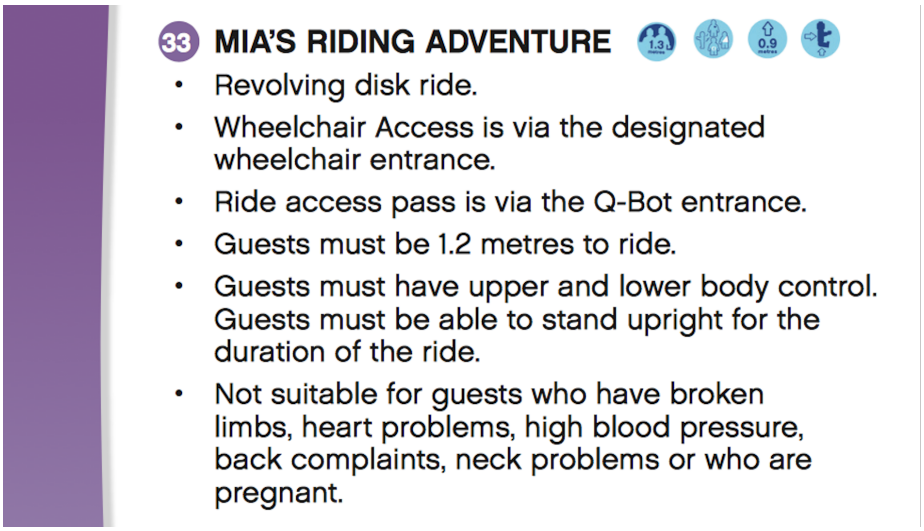


Figure 6: Example description from the accessibility guide from Legoland [From the guide as it was on October 17, 2016]

Walibi Holland

Most of the rides in Walibi have a wheelchair entrance, but a visitor is not supposed to wait there [60]. A disabled visitor gets a flyer with a spreadsheet, where employees can write down the waiting time and then the disabled visitors can wait in the park until it is time for them. Three of the 34 rides are advertised as accessible for wheelchairs, but do have steps that could be impossible for some visitors.

Next to that, a visitor using the disabled regulation also gets a flyer where the visitor can see exactly which rides can be accessed (figure 7). This is something that was not found on other theme park websites. This table does show that fig. 3 is not completely true, because it depends greatly on the conditions.

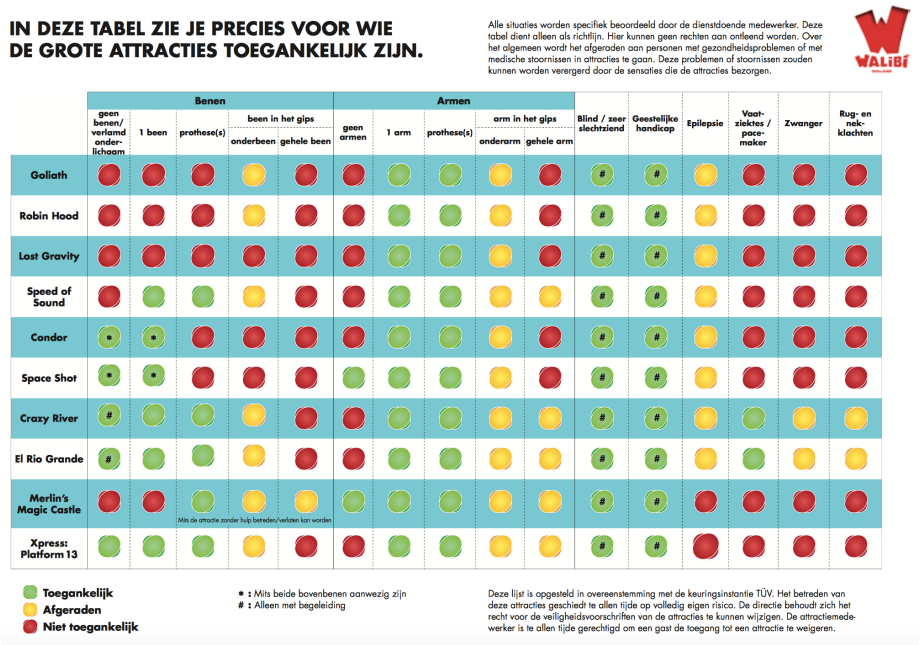


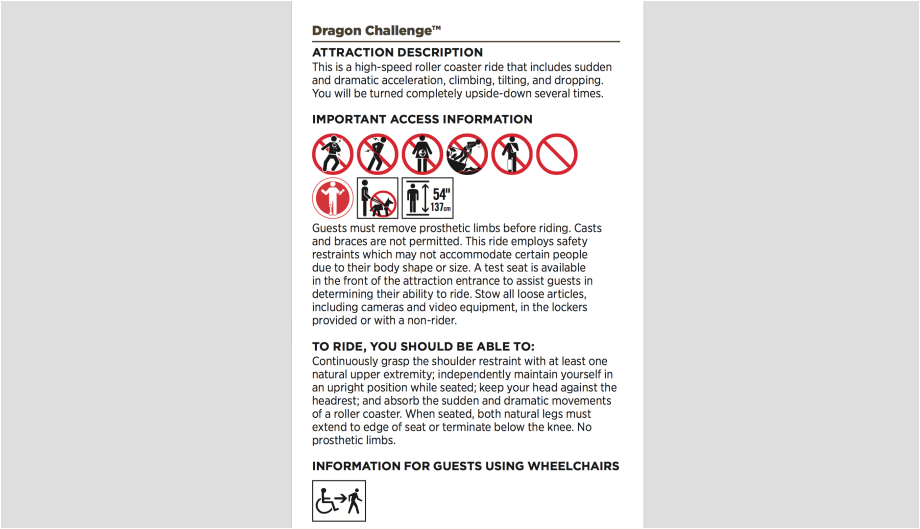
Figure 7: Walibi's table for disabled visitors

Universal Studios

The normal queues in Universal studio are all accessible for wheelchairs, for the exception of one [61]. That means that wheelchair users do not have to use a special entrance. Universal communicates on their website that almost all their rides, toilets and shopping areas are well accessible for wheelchairs. Furthermore it seems that 12 attractions are able to let the visitor remain in their wheelchair.

Next to that, Universal has services for visitors with hearing disabilities, like assistive listening and scripts. For blind people they have show scripts in braille, so they can 'read' what others can see.

Universal presents an extensive guide online with all the details about rides for visitors with disabilities, very similar to the one Legoland Windsor offers. An example of a page from that



Dragon Challenge™

ATTRACTION DESCRIPTION

This is a high-speed roller coaster ride that includes sudden and dramatic acceleration, climbing, tilting, and dropping. You will be turned completely upside-down several times.

IMPORTANT ACCESS INFORMATION

Guests must remove prosthetic limbs before riding. Casts and braces are not permitted. This ride employs safety restraints which may not accommodate certain people due to their body shape or size. A test seat is available in the front of the attraction entrance to assist guests in determining their ability to ride. Stow all loose articles, including cameras and video equipment, in the lockers provided or with a non-rider.

TO RIDE, YOU SHOULD BE ABLE TO:

Continuously grasp the shoulder restraint with at least one natural upper extremity; independently maintain yourself in an upright position while seated; keep your head against the headrest; and absorb the sudden and dramatic movements of a roller coaster. When seated, both natural legs must extend to edge of seat or terminate below the knee. No prosthetic limbs.

INFORMATION FOR GUESTS USING WHEELCHAIRS

Figure 8: Example of Universal's guide for disabled visitors [From the guide as it was on October 17, 2016]

Morgans Wonderland

This themepark was specifically designed for wheelchair users [62]. All the attractions are accessible for wheelchair users, blind visitors or deaf visitors. Their unique selling point is that rides are designed for disabled people. An interesting thing is that they were the only park without an option to rent a wheelchair, which is curious.

Conclusion

Every theme park has its own facilities for disabled visitors and especially Walt Disney World has the most, but their normal queues are not accessible for wheelchairs. Only Morgans Wonderland has attractions specifically designed for wheelchair visitors and other theme parks do not facilitate special attractions for this user group. Most visitors communicate their facilities for wheelchair users via an extensive guide that explains the attraction entirely. Next to that, not a single theme park was found in this research that is using VR technology to create better experiences for disabled visitors. Therefore it can be concluded that the use of VR devices for this group of visitors is new and important to investigate.

4.2 Getting to Know the User Group

To understand the problem stated in the introduction, the target group itself must be investigated. As stated in the introduction the target group is defined as following:

Visitors who can not get the full experience of an attraction or get separated from the group.

To investigate this group, multiple people from the target group were interviewed and asked about their experiences and if they might have solutions. Next to that, employees at Efteling who regularly work with visitors that need special care were interviewed and field research has been done by spending a day in Efteling in a wheelchair.

Interviews at Roessingh

In 'Roessingh Revalidatie Centrum' six people in a wheelchair were unstructured interviewed to gather background information:

- How they feel when they cannot do something, while others can;
- What they have experienced at some point in public areas and attractions;
- What their experiences are in theme parks and in particular Efteling;
- What kind of solutions they would like.

The wheelchair users were overall happy about the facilities at Efteling for wheelchair users. They described that they were able to enter almost any ride. Last time they went to Efteling they went with a group of wheelchair users, accompanied by two strong men who put them in all the rides and attractions.

One of the worst experiences was with Droomvlucht, which is an attraction they could not enter. Next tot that, they remember that they could watch a movie on a television screen in Villa Volta, which they described as a bad experience.

Describing the feelings they would encounter on a day to a theme park is that they are **dependant** on others, both guides that are accompanying them and employees from Efteling. Next to that they described a **feeling of anxiety** and they felt a **burden**.

Another interesting thing was mentioned by a disabled person who was a Herakles Supporter. He told that his friends made a special place for him in the tribune, where he could sit between other supporters. He loved that he was just on the same place as the other supporters and that he sometimes got beer poured on him when people cheered for a goal. "You just want everything to be as normal as possible", as he described.

Interviews with employees

An Efteling guest service manager and a park manager were unstructured interviewed about their experiences in the park with the user group.

The guest service manager described that people with a handicap often ask for information at the beginning of their day. At the end of the day she spoke with the visitors that often described the following issues:

- They felt like animals sometimes, hidden from the other visitors in a small room;
- The waiting rooms were boring and not themed.

The park manager described similar experiences. He said that disabled visitors who cannot enter a ride, should be able to see their company in the attraction. This is the reason why the manager likes Baron 1898, where visitors can see their company on the tipping point of the ride. Next to that, waiting lines should be more enjoyable, also for disabled visitors and there needs to be something cool to see around the attraction.

4.3 Field Research

To understand the user group better and to understand what the problem could be for them, I did my own field research in Efteling by spending a day in a wheelchair at Efteling with two friends.

At Tuesday November 1st, I went to Efteling with two friends. We rented a wheelchair from a revalidation center in Kaatsheuvel, because I did not want to disturb customers in Efteling by lending a wheelchair there. We started around 11:00 in the morning and I left my wheelchair at 15:00. We went in all the attractions we wanted, like the roller coaster Vliegende Hollander that can be seen in figure 5.

Figure 9: Field research at Vliegende Hollander wheelchair entrance

During this experience I discovered good and bad things about the wheelchair entrances and about the experience of using a wheelchair in Efteling in general.

Generally, I find Efteling very wheelchair friendly. Most of the paths, even if they were cobbled, were pretty doable with a wheelchair. The staff was overall friendly and the waiting time for a ride was much less than the normal waiting line, especially at the Baron in the morning, when there were no other wheelchair users before me. The waiting time for other visitors were 25 minutes, according to the information at the entrance, while we had to wait less than 10 minutes. Most of the wheelchair entrances were easily found and there were not many wheelchair entrance users in front of me. The longest I had to wait was fifteen minutes.

Insights and conclusions based on Field Research

This field research taught me some new key insights. I got the following insights after spending a day in Efteling in a wheelchair.

- Waiting in the regular line is way more exciting. Seeing that you are getting closer to your goal is very exciting. I even noticed my company were talking less while they were waiting in the wheelchair entrance on a seat than when we were just standing in line. Others in the waiting space were also not talking much, which was very peculiar.

- When you are in your wheelchair, you have a lot of time to do other things, like looking at a map.
- Part of the fun in Efteling is strolling around, like you would do in a forest for example.
- At the wheelchair entrance, there is no indication of how long you need to wait and sometimes the entrance was difficult to find.
- Wheelchair entrances were often somewhere behind the back of the attraction, that's also how it feels like. Sometimes there were trash bins or other stuff from the employees, like visible hygienic products.
- You see a lot of the same wheelchair users at other locations in the park. You can remember them very well.
- Thematisation of the wheelchair entrances differ a lot. The Joris en de Draak looked like a normal entrance, with a themed lamp. The Vliegende Hollander, was somewhere in the back in a very narrow part without any themed details.
- Waiting times at wheelchair entrances were way shorter than via the normal line.
- Efteling wants to enchant visitors, however a lot of the wheelchair entrances are boring and you need to perform special actions. For example: ringing a bell, waiting until someone sees you or halting an attraction, that makes you feel special in a bad way.
- There was a lot of difference in handling between different employees. Some explained how long we approximately had to wait, others said nothing and just came within a couple of minutes to take us to the ride.
- Villa Volta was one of the worst and loneliest experiences I have ever had in Efteling. I was put in a different room, with a video about the ride. At that time, I was the only one in this room and not even an employee accompanied me, which made me the only person in a big room with a video on a screen. Next to that, a video cannot explain how the ride is and it is boring to look at.
- Employees knew exactly in which train the wheelchair users were, which gave me a feeling of safety, care and professionalism.
- I sometimes felt a little awkward when I was driven to a train and everyone could see me having troubles getting on a train.

I might be very doubtful about the wheelchair entrances, but I can understand it completely that disabled visitors would be very happy about the fact that they can enter a ride at all. However, it does feel like you are left behind because the level of detail you are used of Efteling is much less than usual.

4.4 Summary and Next Steps

From the past two chapters, a couple of important conclusions can be derived to further progress this project :

- Virtual Reality can be immersive;
- Immersion (or a feeling of 'presence') can be created by using a VR setup with a good display technology, excitement prior to the experience, spatial presence and good sound;
- a social virtual reality setup can be created by seeing each others facial expressions, voice and by having an immersive experience;
- The user group defined in the introduction is experiencing a problem;
- At the moment, Droomvlucht is one of the only top attractions in Efteling which is currently unavailable to enter when you use a wheelchair

Therefore, the conclusion is to further investigate Droomvlucht and create virtual reality ride that will enable wheelchair users to experience Droomvlucht like a regular visitor. Droomvlucht is a darkride, where the visitor travels through different scenes with elfs, trolls and a lot of nature, flowers and architecture. This ride is made for the entire family which makes it even more necessary to use this attraction as a case for this project.

For now, the research question will be formed as follows:
"How to create a joint virtual reality experience for visitors in- and outside of Droomvlucht."
The following subquestions are formed to guide the next phases of the research.

- How can a joint VR experience be created?
- How can a prototype be made to test this experience?
- How can this experience be tested?
- To what extent does this solution make the Efteling experience better for visitors from the user group?
- What is the target group exactly?

In the next phase a method will be formed to create experiments and prototypes.

5 Organisation and Techniques

In this section, some preliminary work will be done to prepare for the project. There is a planning, a risk analysis and a stakeholder subsection.

5.1 Planning

The planning within this bachelor project is done using the phases of the Creative Technology Design Process [47]. Therefore there is a ideation, specification, realization and evaluation phase, which can be read in this order in the coming chapters. The ideation phase is where ideas are generated by reading relevant literature, interviewing experts and getting to know the context and the target group of this project. In the specification phase, the ideas will get shape and an investigation will be done to know what is exactly needed to realise a prototype in the next phase. In the realization phase, multiple prototypes will be tested according to the specification phase. These prototypes will probably also be evaluated by employees from Efteling, respecified and realized until a final design can be evaluated by the target group, which are visitors from outside Efteling, in a final evaluation.

5.2 Risk Analysis

During the project there are multiple risks that could cause delay, disruption or can have other outcomes. These risks need to be evaluated to be prepared for the worst scenarios. The next table shows ten risks that are evaluated according to FMEA [48]. These risks are seen as worst case scenarios, which means the impact is as high as possible in every scenario. The RPN is the Risk Priority Number, which is the multiplication of the values likelihood, impact and detection. The RPN will tell which risk is most important.

Table 1

ID	Event	Likelihood	Impact	Impact description	Risk Score	Detection	RPN
RE1	Conflicts with Efteling	8	6	Coöperation is not efficient, does not work properly	48	1	48
RE2	Prototype fails	2	10	Resetting equipment during experiments, test subjects get annoyed	20	10	200
RE3	Expectations client vs researcher are not the same	5	7	The client is not happy with results, demands more work	35	2	70
RE4	Plans cannot be executed	6	7	I cannot make the prototype I would like to make	42	1	42
RE5	Software not working after update	3	7	Software could work unexpectedly different than before	21	6	126
RE6	Unfeasible equipment requirements	6	9	The experiment cannot be done according to plan	54	2	108
RE7	Test subjects cannot handle a VR goggle	4	8	The experiment cannot be done according to plan	32	2	64
RE8	Unfeasible planning	7	8	Plans go behind schedule, do not work properly	56	5	280
RE9	People helping during experiments cannot help suddenly	3	10	The experiment will go slower and subjects might get annoyed	30	4	120
RE10	Delivery issues with ordered equipment	5	5	The setup cannot be made in time according to plan; things have to be bought somewhere else last minute	25	7	175

Figure 10: Risk Evaluation

The three most risky events are RE8, RE2 and RE10 according to this analysis.

RE2 - Prototype fails can include malfunctioning software, hardware or something that breaks during experimenting, because of use. To prepare for this, backups should be made of everything and backup hardware should be available in case something breaks.

RE8 - From experience I know that planning is difficult, especially when working with other people and relying on them. In this case, the people working at Droomvlucht should know what the plans are. Therefore, in early stages big steps should be made, so there is still time in the end to fix problems and to let every stakeholder know what the plans are.

RE10 - Some equipment and parts need to be ordered, which sometimes takes more time to deliver than expected. Especially during Christmas and new year. Therefore, necessary parts need to be ordered as fast as possible in reliable shops.

5.3 Stakeholders

As said in previous subsection, different stakeholders need to know the plans of this project in order to help or be prepared. A difficult thing of a theme park is that there are many stakeholders. For example, doing an experiment with visible and bigger equipment, means that safety, design, protocols, organisation and other factors need to be informed. Every attraction is extremely complicated in the technology, safety protocols and with capacity of visitors. In order to get a feasible working plan, a lot of appointments need to be made with different stakeholders. An analysis will help to get a better overview of all the stakeholders in this project [49].

The stakeholder analysis is done using a stakeholder matrix. This matrix shows interest on the X axis and power on the Y axis. Names in Green refers to supporters of the project, black for neutral people, orange for critics and red would be for blockers. However, no blockers were found for this projects.

Figure 11: Stakeholders

- Richard Bults is the module coördinator of the graduation semester. He works in the background and sends regular emails about project phases, deliverables and presentations.
- The teamleader at Efteling supervises attractions and employees working at a specific part of the theme park. This person has the power to control what happens at an attraction and could potentially grant access to specific rooms or areas.
- Alma Schaafstal is the supervisor of this project and can therefore fail this project at the University when things are not running smoothly or when deadlines are not met.

- Mijke Broeders and Sharon Hellings are the two key supervisors from Efteling. Mijke Broeders supervises the project as a whole and can help find the right people or arrange meetings. Sharon Hellings is supervising the research side of the project and can find respondents and test visitors.
- At Droomvlucht there is a team of employees making sure the ride is safe and that everything is clean. In case the project would be realised, they would have to work with it. Therefore, these people are very important for a potential realisation. Critics and supporters were found in this team. The critics are mainly doubtful about the setup, because they do not believe it will ever be implemented, because it is an experimental setup.
- With the creation of a test setup, multiple employees from Efteling need to help to get me the right equipment and space. For example, in the workshop someone needs to show me where to get wood and how to use the machines. These people have no impact in the outcome of the project nor do they have the power to progress the project, however they are a great help and should be credited for this project as well.
- Preliminary test subjects are people who will help validate and evaluate specific parts of the prototype. They are consultants in the design process.
- The last stakeholder is the group of visitors who will use the setup, with the disabled visitor particularly. The disabled visitors were not able to experience Droomvlucht before, but will now be able to experience it with their company. The company of the disabled visitor was able to enter Droomvlucht, however not with their disabled member. Therefore their interest is estimated to be a little lower than of the disabled visitor itself.

5.4 Most Important Stakeholder

The most important stakeholder in this project would be Efteling as an organisation. They are not able to present a solution to disabled visitors in a wheelchair when they want to enter Droomvlucht. In order to realise the project, budget is needed and an organisational plan on how employees will help disabled visitors get into VR and their company with the right equipment in the attraction.

In the end, Efteling could get a solution for their disabled visitors that is tested and evaluated. This means that a potential investment would have a level of assurance of its outcome.

6 Ideation

This ideation section will explain how the prototype was made, why specific design choices were made and how preliminary tests were conducted to enhance the design.

6.1 Introduction

The Creative Technology Design Process is in many ways a User Centered Design Approach. In the ideation phase, small prototypes were made, related work was found and early ideas were discussed. These steps are explained and evaluated in this chapter.

6.2 Environment

Efteling environment was able to provide a lot of information about the visitors, what they want and how they experience attractions. Especially the employees working at Droomvlucht often knew exactly how the visitors experience the attraction and knew the disappointment when disabled visitors learn they cannot enter the attraction. Next to that, Efteling has a workshop where parts of the setup were created and employees were very willing to help with these kind of projects.

A downside of the environment was the fact that visitors cannot be disturbed for research purposes when they are enjoying themselves in the theme park. This is of course very beneficial for the user experience of the visitor, but made this research project more difficult than it would be on a University. Next to that, the project needs to be as invisible as possible so the park can maintain its atmosphere and feeling.

6.3 Gathering Information About the Problem at Droomvlucht

The first stage was to gather information about the problem. Different methods were used to gather this information. In this case, new specific information was gathered about disabled visitors at Droomvlucht, that has not yet been gathered in the State of the Art research.

One method was to informally unstructured interview employees at the Droomvlucht. They have expressed the wish for a disabled option at the attraction for a long time to their managers. Even though the information for disabled visitors is given at the entrance of Droomvlucht, every day disabled visitors try to enter the ride through the exit, thinking it is a wheelchair entrance. The employees at Droomvlucht do not like to disappoint these visitors, but they have no other choice. When I talked to these employees about plans to create a VR solution for disabled visitors, most of these employees got excited that someone is trying to create a solution using new technology. Their opinion was that a VR solution would be cool, but might not work for some visitors. They would already be happy if there is anything they could present

disabled visitors, like a TV screen with a movie of Droomvlucht. Some employees at Droomvlucht were very critical and did not want to share their opinion, because they did not have confidence in this research.

The reason why disabled visitors cannot enter the attraction was observed during a tour in Droomvlucht. The reason is safety. There are some stairs backstage and it would be very complicated to escape a potential dangerous situation if you are not able to walk. Next to that I realised that capturing a film of the attraction could be difficult, because there is not much lighting and for a good film you need as much light as possible.

Another method that was used to gather information was to observe different visitors while they were in the attraction. This taught me how they experienced it. The results were that visitors mostly just watched the show silently, but some parents were watching their child more than the show. Other parents were even on their phone, while their child(ren) were watching the show.

6.4 Related Work

Some related work was found as a source of inspiration for this project. In this case three Social VR projects will be highlighted in this report and three Multisensory VR projects.

Social

Samsung Bedtime Stories - Samsung tried to solve the problem of long distance parenting with their experimental setup called Bedtime Stories [29]. Using this application and two Samsung Gears, a parent and child can enjoy a bedtime story together, while being apart. The two different users, in this case a parent and a child, are an avatar in a 3D world where stories are told in an immersive way.

Old Irish Virtual Journey to Ireland - As a promotional stunt, the brand Old Irish let users experience Ireland in a virtual environment while a team of people surrounds them in a real set [53]. This means the user is first on the street, than in a virtual environment and when it takes the VR goggle off, the user is on a special set in Irish style. It is a combination of 'reality' and 'virtual reality'.

Oculus Hangout Rooms - This is a virtual environment where users can gather together to be with each other on VR [63]. These users create an 'avatar', a 3D character representing the user that can do different tasks in VR. It is supposed to be a social place to hang out with your friends and family.

Multisensory

Diesel 5D Experience - This experience is according to information from the creators, 5D because it uses smell, wind, vibration on the chest and bottom, binaural sound and a virtual environment [55]. This should transport the visitor from the store to a 'fur wonderland' that fits with the marketing campaign from Diesel: Fur me Fur you.

The Personal Holodeck - This is an open source project, that is meant to create a peaceful atmosphere for the visitor [56]. It should be able to replicate nature therapy in your own home, using PC fans for a small breeze of air, a scent of dirt, a VR goggle with a peaceful lake and sounds of birds.

Dubbed Omnipresence - This is a device that looks like a telephone box with a VR goggle inside and different ways to stimulate the senses. It uses smell, heat and a fan to create immersive multisensory spaces [57].

6.5 Early Ideas

This subsection will present five early ideas and sketches for the early prototypes and evaluations of them. Most of the early ideas did not make it into the final prototype and reasons for that are explained below. In all these ideas, a multisensory immersive experience is added as a requirement. Later it was experimented how these multisensory additions could be made and the impact of it.

In early stages, random employees at Efteling I brainstormed with were not all very fond of the idea to use a virtual reality headset. Therefore other options were explored and finally the use of a curved semi immersive screen, with a large enough screen so a user can still look to different parts of the different scenes of Droomvlucht. According to Albuquerque and Velho [4] people need to see each other to have a more social experience, therefore the idea was to use a FaceTime video connection where users could see each other. If there are more than one wheelchair visitors, they can see each other and can sit next to each other in front of a projection screen

Figure 12: Test setup with a Curved screen and a Facetime video connection

The only problem with this setup was to create a truly 180 degree projection screen that would be transportable to a test location later. After research into curved projection screens, it became clear that three identical projectors would be needed. A setup like this can be see in the next figure.

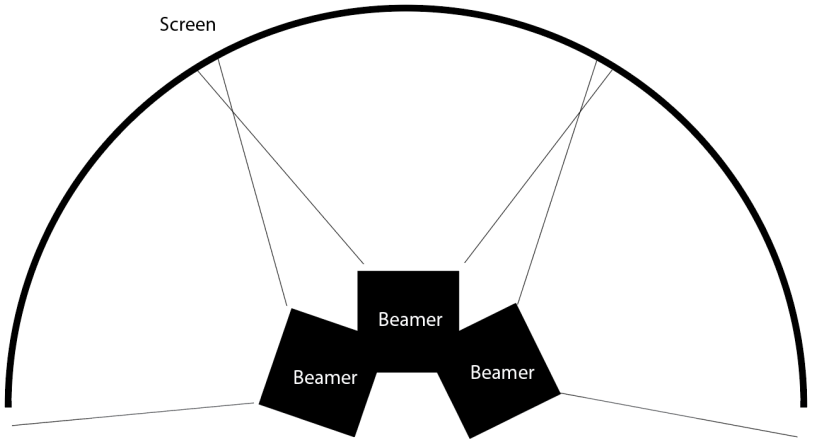


Figure 13: Curved 180 degree screen setup with three projectors

I was not able to gather three identical HD projectors to truly test out this kind of setup. However I did manage to create an 'IMAX' like projection display that could use one HD beamer and would still be more immersive than a regular screen. An IMAX screen is a big slightly curved screen.

Another idea was to install a 360 camera in the gondola of Droomvlucht with a streaming connection to a VR goggle. This way, the visitor outside of Droomvlucht would get a realtime vision of the space where it can see its company and the attraction with sound.

Figure 14: Test setup with a 360 livestream and a VR goggle

After investigation it became apparent that a stable real-time streaming of a 360 video would require a lot of bandwidth and a fast internet connection. The problem is that Droomvlucht does not have a WiFi network in the attraction, therefore it would have been necessary to install WiFi hotspots first, which would have been an operation too big for this experiment.

The third early setup would use a pointer device that the disabled visitor could use to point their company to a specific location in the attraction. A thing I discovered while watching other visitors behave in Droomvlucht, is the need to point out specific parts of the attraction to company and especially children. This led bar would act like a pointer and could fulfill the need to point to something from a distance. An example can be seen in the next figure.

Figure 15: Test setup with a pointer

In the end, this idea was not realised nor tested because of the lack of internet connection that would be required to connect the pointers with each other. Next to that, the gondola of Droomvlucht would need to be adjusted, which is something Efteling rather not do to an existing ride.

The fourth setup would use a projection screen and a voice connection. This is very similar to the fifth idea, which was to use a voice connection in combination with a VR goggle. An example can be seen below.

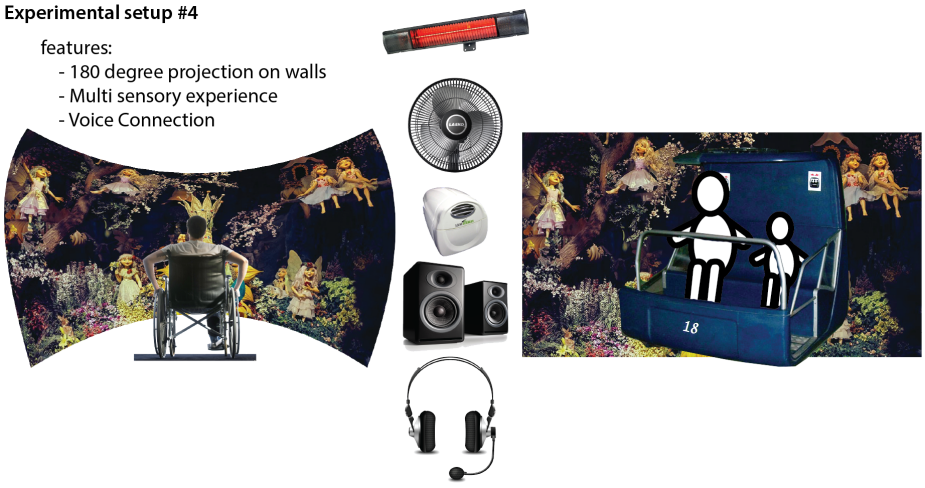


Figure 16: Test setup with a curved screen and a voice connection

Figure 17: Test setup with a VR goggle screen and a voice connection

6.6 Early Prototypes

In early prototypes, experiments were done with screens, VR goggles, VR movies and software. These early prototypes will be explained in this subsection.

One of the first prototypes was meant to find out a way to display a VR movie. An iPhone 6s, a Sony Z5 premium and an iPhone 6 plus were used for this in combination with a Homido viewer and the app Mobile VR Station on iOS and VR Player on Android.

A conclusion was that a 2D video projection in a VR viewing app was a weird experience, because it looks a lot like watching a normal television screen. Therefore the conclusion was drawn that a setup like this one could work, but should have a 360 degree film.

Later, the choice was made to try out a curved screen setup, because people testing the mobile VR prototype were not convinced it would work for every visitor. From the state of the art review, it can be concluded that a big curved screen could also create a feeling of immersion [46]. A problem that occurs when using curved screens is a warped image, because the projection is made for a plane surface. Research was done to find out ways to 'warp' the image to project on a curved screen. The first prototype was with a single projector and a curved piece of paper. An example of the image can be seen in the next figure.

Figure 18: Lo-Fi test to see how warped the image is on a curved surface

In this case, the image was warped using After Effects and rendered. This is not the best way, as it is pure based on feeling how warped the image should be. Another conclusion was that a 180 degree curved display would need multiple projectors, because the edges will get out of focus when using only one projector.

Another Lo-Fi prototype was made using a 360 camera from Giroptic [64]. This camera was used in Droomvlucht to capture it in 360 degree video. The results were disappointing, because they were dark, blurry and noisy. An example of this result can be seen in the next figure.

Figure 19: Example of 360 image with a very dark result and noise

Another early prototype involved using a social mediated touch device. A magic wand that is sold at Droomvlucht shop was changed to include a vibration motor and a shake sensor. The idea was that two wands would be connected with each other and when one user would shake, the other would vibrate. According to Basdogan, haptic feedback can increase the feeling of togetherness [2]. However, this prototype was rejected in a later phase because it was not possible to create a stable version that could work in Droomvlucht without internet. Next to that, colleagues feared it would distract visitors from the attraction when they were playing with the wand.

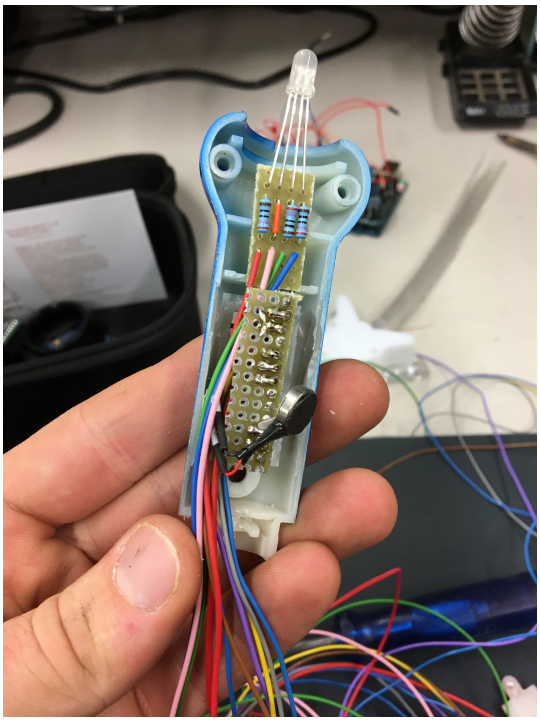


Figure 20: A prototype of the adjusted magic wand with motion sensor and vibration motor

A video streaming connection using Apple Facetime and Skype on an iPhone was tested in Droomvlucht to find out if the 4G internet strength was good enough for streaming. This was tested by audiocalling another person while sitting in the ride. After an entire ride the results were that the connection sometimes stopped for a second, but it was stable enough to be used in later prototypes.

The conclusion after testing the smaller prototypes was as follows:

- Search for a better way to use mobile VR (at the moment of writing, a Gear VR would be the best option);
- Create a small slightly curved screen, so that one projector can be used and the edges will not be out of focus;
- Create a setup with multisensory stimuli;
- Streaming using Apple Facetime or Skype is good enough for future use;
- Create a VR movie with sharp images using a good camera.

7 Specification

With all the gathered information, requirements can be derived and technology can be chosen to use in prototypes. This requirements specification will be used to create prototypes to explore the design space.

7.1 Preliminary Requirements

The task was to create a joint virtual reality experience prototype for Droomvlucht. The next requirements were derived from the state of the art review and earlier prototypes. The setup should:

- be an immersive experience;
- create a feeling of togetherness;
- be a good visual representation of Droomvlucht;
- not interfere with the experience of other visitors or change the current experience;
- create a spatial feeling;
- use comfortable hardware;
- be a multisensory experience.

To create an immersive experience, visitors using the VR setup should feel and sense the same as they would in the real attraction. Therefore, a fragrance machine needs to be used, an infrared lamp, a fan for a small breeze and good speakers for the music. All these devices need to be precisely timed according to the ride, so the visitors inside the real attraction and inside the virtual substitute have the exact same feeling and are able to talk about it at the same moment in time.

A VR movie for this project is difficult to get. There is no recording of Droomvlucht using a 180 or 360 degree camera. Recording something like it is also not possible, because it will become a very expensive production. Extra lighting will be needed or a camera with a highly sensitive sensor, safety measures and the camera needs to be able to record in a high quality capture mode. Therefore the current 4K onride video of Droomvlucht will be used and transformed to be useful with a VR goggle.

Creating a spherical Droomvlucht onride video for VR

To be able to view the 2D 4K onride film of the Droomvlucht with a VR viewer, there needs to be some sort of spherical mapping of the image. A 16:9 film needs to be mapped to be able to watch it as if the person is seeing it in a front dome. This way, the person can look in all directions to see the film. After some testing and trial error, a 'Langrange Projection' seems to perform the required effect [50][51].

In the next image you can see how a still from the onride is transformed using the Langrange Projection. To achieve this, the 'bezier warp' effect with Adobe After Effects is used in combination with a 'roughen edges' effect to create the image that can be used to view with a VR viewer app with a 2D front dome playback type. The application used is in this case Mobile VR station on an iPhone 6 plus in early prototyping. In other prototypes, the Gear VR in combination with a Galaxy S7 was used.

Figure 21: Langrange Transformation of a still image of the Droomvlucht onride video

The perfect Droomvlucht video for this project

One of the questions asked when making the Droomvlucht video was: "Should the video of Droomvlucht be an 'onride' video? Or should there be another way of filming it? To investigate this, the documentary 'Dromen met open ogen' was watched. This documentary shows how the attraction was built and what the ideas were from the creator Ton van de Ven. The following translated quotes could help create the perfect Droomvlucht movie:

- "Flying is something unusual for people, but very usual in dreams. In 'Droomvlucht' the person should have a feeling of flight";
- "People can steer their own dreams";
- "The visitor experiencing Droomvlucht should realise that it has become part of the fairytale-like environment around him. It should make him feel small and he should not have the need to think about what he sees [...] and he almost drowns in this world"
- "Droomvlucht is an immersion in a warm and gratifying path. [...] It should be remarkable and emotional. Droomvlucht is pure romance and lovingness."

From these quotes from the creator Ton van de Ven, it can be concluded that the world that you can see is big, should have warm and rich colours and create a feeling of a flight like in a dream. Experimenting with the image was not done in the end, because another requirement was that the experience should not change too much.

7.2 Prototypes

Through an iterative process, multiple prototypes were tested, evaluated and improved until a final design.

In the ideation phase, I tested small parts of the setup first by myself and then small tests with employees were conducted to find out if the prototypes were enough for a proof of concept. Next to that, I wanted to find out how people experienced the different solutions.

A test among colleagues at Efteling was conducted to get an answer for the questions: "Is the prototype using the VR goggle and screen good enough to test with visitors?" and "Which of both setups would be better?" This test was done in a room where both setups could be tested after each other. First people experienced the wide semi immersive screen, then the VR setup. Colleagues who tested the two different setups reported different experiences. The overall opinion was that the setup using the VR goggle was more immersive and more fun to experience, because it was something they didn't experience at home Overall, the colleagues found the screen more ordinary and usual.

However, some colleagues had a strong opinion against using the VR goggle. A fear was that the VR goggle was less practical, would induce fear, create nausea. Another fear was loneliness. Colleagues thought using a screen would make visitors feel more social, because they could see each other in the room.

Other colleagues were impressed with the VR goggle and could see potential in using this technology when a better video would be used. According to comments, the worst thing about the video is that it is not 3D and that it feels much closer to the eye than in the actual ride, which is because of the recording.

Every person reported that using warmth, music, wind and the safety handle enhanced the experience and made it feel more realistic.

7.3 Final Requirements

After prototyping and testing, the final requirements are made following the MoSCoW method to prioritise requirements. The MoSCoW method prioritises by 'Must Haves', 'Should Haves, 'Could Haves' and 'Won't Haves'. This way, a designer can work on the prototype and focus on important requirements first and later work to increase the quality of the design by delivering less important requirements. The 'won't haves' define some requirements that would be really nice, but were outside the scope of this project. The following table shows the requirements for this project using the MoSCoW method.

Must haves:

- A Gear VR;
- An adapted version of the Droomvlucht onride;
- FaceTime ;

- VR player for Android;
- A headphone
- Jack splitter to microphone and headphone;
- A headphone splitter;
- Earpods;
- An omnidirectional microphone.

Should haves:

- A fan;
- A fragrance machine;
- A warmth lamp;
- A safety handle;
- A way of turning the devices previously mentioned on and off.

Could haves:

- A plate for the wheelchair that moves according to the ride;

Won't haves:

- A styled room with a Droomvlucht theme.
- A 3D 360 video of Droomvlucht

8 Realisation Phase

During the realisation phase, a final prototype will be made that can be used to evaluate whether the setup works to deliver a good experience for disabled visitors visiting Droomvlucht.

8.1 Goal and Scope

The prototype has now only been tested within Efteling with employees already working there. To evaluate whether the setup would work with disabled visitors, a real user test was done in Efteling with the target group, as defined in the third section of this report. Therefore the goal was to make a prototype that can work with these visitors and to get information about the experience during interviews. These interviews were meant to answer the question: "To what extent would this setup be a valuable solution for disabled visitors at Droomvlucht".

The scope in this case is to only test the method of the concept, not to give a thorough plan for implementation nor is the prototype of a High Fidelity nature. A better prototype should be tested after the validation of this user test, with a test of organisational nature. The organisation at the moment is that visitors wait in line and enter the ride, however this waiting line cannot be used for disabled visitors. Therefore new ways of organizing waiting and entering for disabled visitors should be created in order to realise this. That will highly affect the guest experience and how the employees working at Droomvlucht can do their job.

8.2 Realisation Process

In order to keep a level of quality, the final prototype was made in stages. The first stage was to gather all the must have requirements from the requirements list and test them. Then different parts from the should have requirements were built and tested until all the parts were together in the end. Some of the parts needed to be custom made, like the safety handle and the fragrance machine.

Hardware

Most of the hardware was already tested during the specification phase. Only two parts needed to be fabricated in this phase: a fragrance machine and a safety handle.

The fragrance machine was built using a lasercut box, with a cotton bud soaked in Droomvlucht fragrance and a computer fan than would let the air with smell of the fragrance travel to the user.

A safety handle was built using a PVC pipe and some wooden boards, as can be seen in the next figure.

Figure 22: Safety handle

Connecting the parts together

The whole setup with the fan, fragrance machine and infrared lamp works using a device called KlikAanKlikUit, which is a set of power sockets with a remote control. I would control the remote and manually turn off and on the fan, fragrance machine and the infrared lamp on specific moments during the VR experience. I would turn specific devices on and off by listening to music, that differentiates between scenes in the attraction. Per scene I knew from experience which device should be turned on or off.

The following interaction was created to be used on the test day with participants:

- First the participants would get information about the setup and what they are about to do.
- A connection would be made with an iPhone at the test location and with an iPhone that could go with the participants into Droomvlucht. This connection was set up and tested beforehand.
- Non-disabled participants who could go into the attraction, would be asked to put an iPhone in one of their pockets. The connection was tested one more time and the participants were asked to put the microphone on their lap to record all the sound from themselves and the music of the attraction.
- The non-disabled participants were asked to leave and go to the Droomvlucht entrance and wait for further instructions. I would test the VR movie for the disabled participant and calibrate the lenses until the participant could see a sharp image. I would ask the participants at Droomvlucht to enter the attraction and to tell me when they would arrive in the first scene of Droomvlucht. That would be the signal for me to manually start the movie of the disabled participant, that would start at the beginning of the first scene.

- During the movie I would listen on a distance to what the disabled participant would tell and what music I heard. Every scene in Droomvlucht has a different soundtrack. During the first three scenes, the infrared lamp would be turned on the whole time and the fragrance machine would be turned on for about 10 seconds during the second and third scene. In the last two scenes, the user would see space and a forest with trolls. The warmth lamp would be turned off for this and in the last scene, the visitor would fly in a spiral down into a troll forest. Here the fan will be turned on, to create a small breeze.
- At the end, the participants in Droomvlucht were asked to return to the test room and the disabled participant would turn off the headset.

9 Evaluation

The evaluation section will describe the process of doing research and the results of the research that has been gathered for this project.

9.1 Research Method

To be able to carry out a useful research in the use of the prototype, a plan for a qualitative research was made to prepare and experiment for visitors.

Experimenting with visitors is a highly social and emotional moment for visitors who could never experience Droomvlucht before. Therefore the choice was made to do a qualitative research instead of a quantitative [52]. Qualitative research is suitable because more rich and personal information can be gathered that could later be used to enhance the final design for real implementation in Efteling. Next to that, only with qualitative research were we able to collect data about their experience.

9.2 Participants

Participants from the target group were recruited using Efteling network 'Raad der Wijzen'. This is a database with people who have signed up to be asked for user tests in Efteling. In return for their help, they can bring a maximum of four family members and/or friends to Efteling for free on the day of the test. Only wheelchair users with an ability to talk and with enough cognitive capabilities to evaluate their experience were asked to participate, in order to gain relevant information from them during the interviews. In appendix B, the recruitment ad can be found.

For this experiment, eleven different groups signed up and based on the group size, age, how they relate to each other and availability, six groups were invited to visit Efteling for a user test. The following table shows the different groups and their characteristics.

Rounds	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Time spent in wheelchair
Round 1	Woman (34, wheelchair)	Man (63)	Woman (64)	x	x	> 5 years
Round 2	Woman (13, wheelchair)	Woman (53)	Woman (11)	Man (12)	x	> 5 years
Round 3	Woman (61, wheelchair)	Man (68)	x	x	x	> 5 years
Round 4	Woman (11, wheelchair)	Woman (adult)	Woman (child)	Man (child)	Woman (child)	Entire life
Round 5	Woman (71, wheelchair)	Woman (adult)	Man (9)	Man (4)	Woman (8)	> 5 years
Round 6	Woman (36, wheelchair)	Woman (32)	Man (adult)	Man (adult)	Woman (adult)	> 5 years

Figure 23: Participants

At the beginning of the experiment, the six participants were informed and asked to sign a Dutch consent form, which can be found in Appendix A.

9.3 Research Design

The method of doing this qualitative research is a user test with the target group at Efteling with semi structured interviews. There were six different groups of participant that all included one disabled participant. These groups were divided over the entire day and were asked to get to the test location at a specific time. Before they did the experiment, a personal pre-interview was conducted and there was another interview after the experiment, which was all recorded using a voice recorder. This way, I did not need to take notes during the interview. These recordings were later listened to in order to evaluate them and to draw conclusions. During the experiment, the group was separated and the disabled visitor stayed in the room where the interviews were conducted and at least one person from the group would go to Droomvlucht with equipment to set up a Skype call. In the room where the VR experiment was conducted, the researcher would stay to observe the disabled participant and another researcher observed the participants in Droomvlucht. These observations were also recorded and evaluated.

To be able to evaluate, subquestions were derived to answer the main question: "Is the current setup able to create a joint virtual reality experience for visitors in- and outside of Droomvlucht?". Next to this question, we wanted to find out if the presupposition where the whole setup was built upon was correct : it needs to be a joint experience, because Efteling has a vision that visitors experience Efteling together with their group. The vision can be read in chapter 1.1. Efteling does not intent to divide groups, however this setup will intentionally divide groups. Therefore this research tried to find an answer to the next subquestions:

- How is a day at Efteling in a wheelchair?
- Do groups separate during their day and how is this experienced?
- What is the prior experience with VR of the participants?
- Did they experience Droomvlucht already?
- How is the ability to talk over distance experienced?
- How is the multisensory setup experienced?
- How is the entire setup, as a whole, experienced?

10:45-11:00	Introduction morning group
11:15 - 12:00	Round 1
12:00 -12:45	Round 2
12:45 -13:30	Round 3
13:30-14:00	Lunch
14:00-14:15	Introduction afternoon group
14:30-15:15	Round 4
15:15-16:00	Round 5
16:00-16:45	Round 6

Figure 24: Groups divided in rounds

The interviews will be semi-structured with some standard questions that will be asked to every respondent, in order to compare the answers. The questions can be found in appendix C.

9.4 Interview Instruments

The interview before and after the experiment was recorded using a ZOOM H6 audiorecorder. These recordings were later transcribed into notes that can be found in appendix D .

9.5 Setting and Environment

On January 18th 2017 between 11:00 and 17:00, a user test was conducted with visitors from the target group. This was done in the wheelchair room of Villa Volta, which is very close to the entrance of Droomvlucht (around 100 meters according to Google Maps). This room was chosen, because it would fit all the respondents of the test and there was enough room for the setup. A downside of this room was a constant Villa Volta theme music that was playing from ceiling speakers and some noise from the attraction that was in the room next to it.

The room itself was considered cold by the researchers and the participants. This might have influenced the use of a fan in the setup and the experience of the infrared lamp. Multiple participants mentioned that the fan was very cold and the infrared lamp warm and comfortable.

Figure 25: Setup as it was on the day of the user test

9.6 Research Questions

The questions that were asked before the participants did the experiment were meant to introduce the research and the group and find out how they experience Efteling, what kind of group it is, if they experienced Droomvlucht before and what they know about virtual reality.

The following questions were asked unordered before doing the experiment:

- Can you tell something about yourself?
- How often do you come to Efteling?
- Can you describe a typical visit to Efteling?
- Do you stay together as a group the whole day?
- What is your usual company when visiting Efteling in a wheelchair?
- What is your biggest surprise for wheelchair visitors in Efteling?
- What do you do when someone in the group cannot access the attraction?
- Have you ever experienced Droomvlucht before?
- Do you miss visiting Droomvlucht?
- What kind of experiences do you have with VR?

The questions after the experiment were as follows:

- How would you evaluate the experience you just had?
- How did you experience the ability to talk with each other?
- What could be better with this setup?
- Did you have the feeling you experienced it together as a group?
- How does this experience compare to the Villa Volta wheelchair experience?
- Would this setup be a valuable solution for disabled visitors who cannot enter Droomvlucht?

9.7 Data Analysis Strategy

This experimental design gathered voice recordings and observations. To evaluate this data, the recordings were transcribed into notes that can be found in the appendix, observations are evaluated within the chapter.

To analyse the notes and observations, they were categorized in which results from the interviews and observations will evaluated. These categories are the following:

- Category 1: Experiences with Efteling in a wheelchair;
- Category 2: Talking over distance;
- Category 3: Multisensory setup;
- Category 4: Experiences with the setup.

9.8 Results

In this results subsection the categories stated in the Data Analysis Strategy will be used to evaluate the interview results.

Category 1: Experiences with Efteling

All of the participants had experience with Efteling and knew the attractions and the park well. However, some participants mentioned that the park was disappointing when they became disabled. With some disabilities, it is not possible to enter any ride if the person cannot walk a bit. Most participants were aware that safety is the reason why Droomvlucht is not accessible, but some thought there had been a wheelchair entrance once. Another participant also tried to convince the employees at Droomvlucht to let her enter through the back, but she was refused.

Some participants were doing the experiment with company they would not normally have when going to Efteling. The experiences of earlier visits of the

wheelchair participants vary widely. One participant came with a group of other disabled people to Efteling last time she visited. She told that this group was divided in smaller groups and with that group they only did all the attractions they could do together. Now she came with her parents and family. Other wheelchair participants also came with family, children, friends or husband/ wife. The people in the group for the tests were different from usual, however they all knew each other very well.

Other widely different answers were given when asked what their group decisions were when visiting attractions. Some participants only visit attractions with each other when every member of the group can visit, others decided to let the disabled member wait outside until the others came back from the attraction. Especially older wheelchair participants seemed to be waiting outside and let others enjoy a specific attraction, while families with a younger child in a wheelchair seem to stay together the entire visit in Efteling. These families also stated that it would not be nice towards the sibling in a wheelchair, when his/her brothers or sisters would come back from an attraction very excited, while the disabled brother was not able to enter. A translated quote: "We go to Efteling together and we visit everything together". Another older participant cannot enter any attraction anymore, therefore she visits Efteling with her husband to only stroll around in their spare time. Other older participants did not want other non-disabled company to miss out on any attraction, so she waited if it was not possible for them to enter.

All the disabled participants have tried Droomvlucht before except for one, who has been in a wheelchair for a very long time and did not have the chance to try it before. Three disabled participants mentioned they missed going into Droomvlucht, the others were able to somehow enter with difficulties or did not care, because waiting in the waiting line while not being able to stand up took too much energy. One disabled participant was a child that could go into Droomvlucht because her parents moved her on the railing of the waiting line to the entrance of Droomvlucht. However, this experience was not good because other people in the waiting line complained when an employee helped them and let them enter sooner than other waiting visitors. Therefore, they only do it like this when there is no waiting line. Other disabled participants mentioned they could walk a small distance with the help of the railing, so they could enter with help when it was quiet at the attraction.

Three participants were not able to give an answer when asked about surprises for disabled visitors. Other answers mostly include that the employees were very helpful and it was sometimes a surprise that they were able to enter an attraction when they thought they could not, like the steam train where it was a surprise it had a piece of board they could use to roll onto the train.

To summarise, the groups participating in this experiment were not usually the groups the participants would be on an typical visit in Efteling, but the participants knew each other well. Some disabled participants were not able to enter Droomvlucht anymore, but not all of them were missing it. Groups with a disabled member sometimes divided, depending on the age of the disabled member. A group with a younger member only went to attractions they could

experience with the whole group, missing out on attraction like Droomvlucht. The best thing for disabled visitors in Efteling is difficult to point out, however some pointed out that the employees were very helpful and made their day more enjoyable.

Category 2: Talking over distance

One critical part of the experimental setup was the ability to talk over distance, using Skype. This was supposed to help create a feeling of a joint experience. Therefore this was observed and asked during interviews. The initial thought was that the audio connection would help create a better feeling of togetherness [24].

All the participants, both the disabled participant and their company in the real attraction, mentioned that the ability to talk over distance helped create a feeling that they experienced it together. All of the participants answered they had the idea that they have experienced Droomvlucht together, when asked in the interview. Some participants specifically mentioned that feeling was made because of the ability to talk to each other. One participant said they did not have the feeling they were experiencing it together, until the disabled participant said something. Most participants in the attraction behaved like a tour guide and were confirming with the disabled participant if they saw the same or if the participant missed something.

One non-disabled participant mentioned they would like to have the ability to also see each other during the ride, however that feedback is contradictory with feedback from another participant who stated that only a voice connection is needed, because a live visual connection would distract from the attraction and the attraction is something to watch. If people are watching each other, they would miss the attraction.

An observation was that participants who heavily talked with each other had a stronger feeling of a joint experience than participants who did not talk much. Next to that, observations from Droomvlucht teach us that one group of participants in the Droomvlucht was enjoying the ride less, because they were talking so much using the Skype call. Another group of participants consisted of two non-disabled children and their disabled sister. This group were all enjoying Droomvlucht best in their own way. A reason for this might be, because they were children and more used to communicate on distance using technology.

Another participant mentioned he would like to see earphones in the attraction for blind people as well, with a voice over of what they would be seeing. Describing what people see is something blind people are used to and something that would enhance the Droomvlucht experience for them.

One non-disabled participant who went in Droomvlucht mentioned she experienced the attraction differently. She looked at more details in order to talk about it with their disabled participant who was seeing it through a VR goggle.

To summarise, the ability to talk made the experience more social than we initially thought it would. However, the ability to talk did change the regular experience for both the non-disabled participants and the disabled participants.

Category 3: Multisensory setup

When participants entered the room they could already see the setup with a visible fan, a heat lamp, a laser cut box and a handle, as shown in figure 25. Not a single participant mentioned it or asked questions about, however it might have revealed to some participants that they were going to sense things.

Participants were asked if they felt different sensory input after their experience. An answer that came back almost every time was that the fan made the person feel very cold. This is probably because the room itself where this experiment was done was already cold. All the participants except for one stated they felt the different sensory inputs.

Two of the disabled participants even talked about the smell and breeze with the participant in the attraction. It was probably used to confirm if the experience was really the same on both places, not only visually but also sensory.

All of the participants, except for one who did not feel any sensory input, said that the extra sensory input helped create a more realistic experience. Some participants literally said it felt exactly the same as in the real attraction, because they could remember how it was in the real attraction. The one person who had never experienced Droomvlucht also stated it made it feel more realistic and she liked the warmth.

One participant stated that all the sensory input was good, however the safety handle was not necessary according to her. During the test, she was also not holding it while the other participants held the safety handle with at least one hand.

To summarise, the extra sensory input was felt by five of the six participants and participants who felt the sensory input said it helped created realism. Only one participant did not think the safety handle added any value.

Category 4: Experience with the setup

The final question to the whole group was if they thought the setup would be a good solution for disabled visitors at Droomvlucht. All the participants stated they did think it would be valuable for them and most disabled visitors. Some disabled participants stated they rather have the VR experience, because it was less stressful and easier than waiting in line with other visitors.

One participant stated she liked that Efteling was experimenting to create better experiences for disabled visitors. Another participant complained that disabled visitors have to pay so much money, while they cannot experience all the attractions like others. It seems that some visitors might think it is unfair that disabled visitors have to pay the same fee, while less attractions are accessible.

The visuals of the setup were not optimal, which was mentioned by some participants. One participant saw everything very blurry, probably because she had a visual impairment that did not work with the VR goggle (which is also stated by the manufacturer). Others had the problem their VR visuals were behind from what the people in the attraction saw, which resulted in frustrations. However, it did make people talk about what they saw.

One non-disabled participant mentioned he would like to have the ability to

use these VR goggles at roller coasters, to show the people who cannot enter what it is like. This could be a solution for disabled visitors who cannot walk a single step or are afraid to enter rollercoasters. One participant was a lady who was afraid that she could not be helped if she went into the Python and it got stuck. This woman had never experienced the Baron, because she also thought this would not be accessible for her. When we showed her the Baron in 360 from YouTube, she had a heavy physical reaction and she said she liked that better than the Droomvlucht VR. This could be explained, because the Baron was filmed with a 360 camera and she said she was an adrenaline junkie before she became disabled. It could indicate a possibility to use a similar VR setup at other attractions.

One participant thought that the setup would be perfect for a lot of people and it was very immersive and fun. She also thought it could be a good solution for other attractions as well.

A disabled girl participant found the VR experience just as fun as the real attraction and the goggle was very comfortable. For this girl, the VR goggle made it possible for her to see much more of the attraction, because she had a muscle impairment that made it difficult for her to raise her head forward. This meant she could not see everything of Droomvlucht, while the VR goggle could be calibrated to show everything well while facing downwards, as illustrated in the next figure. This means that the possibility to calibrate has to become a requirement for this VR setup to be useful for an even larger group of disabled visitors.

One older participant, said she liked the VR experience better because it was more relaxing for her. She completely forgot it was a virtual reality. Another participant suggested to make a 3D movie in a 'Panda Droom' kind of experience.

One person who could not participate in the real user test was interviewed on the telephone. He had an insight that older visitors in a wheelchair do not really care about going into the attraction to experience it, however they want to see their children experience it. Therefore he suggested an option that an older person could see their company in the attraction and not the attraction itself.

To summarise, every participant overall liked the setup. Some participants had some remarks about the technology and some participants suggested to implement it in other attractions. For visitors who cannot look straight ahead, the VR goggle could prove to be even more useful, because it can be calibrated to show the attraction well.

9.9 Summary

This summary looks at the results with a 'helicopter eye' to explain some phenomena and results that were gathered during the experiment.

Visitors go to great lengths sometimes to enter Droomvlucht while it is not accessible. Apparently, these visitors find it so important to enter this ride, that they will do very uncomfortable maneuvers to still enter it. Some visitors only

enter the attraction when it is quiet and go through the waiting line by using the hand rails, others are just dragged and held by their company to the attraction. The attraction actually requires visitors to be able to walk on their own in case of an emergency, therefore it can be discussed if this is safe for them. This could also mean that some wheelchair visitors would have to decide whether they are gonna experience it the 'easy' and safe way using VR or the more difficult way by going into the real attraction. This might mean that the VR setup should work very well, otherwise some wheelchair visitors are still gonna try to get into the real attraction anyway. It could also mean that the VR setup would be most valuable to visitors during busy opening hours.

Compared to the Villa Volta experience, this VR setup was not boring according to the participants. A TV screen is something that can be experienced at home and none of the participants were used to using VR at home, which makes it special at the moment. However, VR might be available in more households in the future, because these devices are targeted at consumer use for gaming and entertainment. That could mean that the unique selling point of the setup should be the connectivity with each other while separated and the multisensory experience. Then the setup would still make an impact in a potential future where everyone is used to VR.

The biggest impact of this setup was the ability to talk, which was not initially expected. The groups were intentionally divided, but being able to hear each other made them feel really close. However it did divide the group into different roles: the participants who are able to visit the real attraction had a leading or guiding role. The reason could be that participants in the real attraction do not have the feeling that the person in VR is really experiencing the attraction the same way. That could also explain why the participants were often checking with each other if they were seeing and feeling the same together. This might be a phenomenon that could change when these visitors have more experience with this setup. It could also be interpreted that the visitors in the real attraction, who are not disabled, have more experience with the attraction and are guiding the visitors in the wheelchair because of this reason.

Another insight is that some participants were not moving their head to look around in the virtual environment, probably because they were not really used to VR. This is a phenomenon that will probably change when more people have experience with it or when visitors have experienced the Droomvlucht setup more than once. It could also be that the setup itself should challenge the visitor more to look around, maybe it did not feel entirely real at the moment.

Participants were from different groups and it was observed that they had different relationships. It was noticeable that some groups were more at ease with each other and especially the children participating in the experiment were at ease. Some were talking a lot with each other, others were sometimes quiet, which is probably cause by excitement or by the fact that these people are family and already talk a lot. The child participant in wheelchair was more quiet during the test and might have been scared by the researchers in the room listening to her. However the parents of the child participant in a wheelchair was very happy that their child was able to experience Droomvlucht now. This

setup does not only have an emotional value to the visitor in a wheelchair, but also its company joining him or her in the VR room.

10 Discussion

The discussion section is here to discuss to what extent the results are significant and how this research could have potentially been influenced by different factors. Next to that it will give some ideas for potential future research and recommendations.

Technology

The test setup could have been better, if it used a 360 video of Droomvlucht. This way, participants could see the full potential of a VR movie of Droomvlucht in combination with extra sensory input. This would have verified the realism of the entire setup and to what extent even technology driven participants would be fully immersed.

A more hidden piece of recording equipment for the participants in the real attraction would have made the experiment more realistic. This would make the participants less focused on the technology and more focused on the fact that they are able to speak with their disabled company.

The setting of the experiment

The experiment had strong and weak points that a potential new research could account in for.

On one hand, tests were done with real visitors from the target group at Efteling at the real attraction. These participants are from the group 'Raad der Wijzen' which is a group of people Efteling can use for experiments, that represent the standard visitors of the park well according to their own research. This means it is as real as it could be made at this point. The setup itself can be considered a low fidelity prototype and it could test interactivity and all the important factors of the project. Next to that, the target group consisted of different groups of people, with different ages, different experiences with VR and different prior experiences with Droomvlucht. Therefore, there is no reason to think this research would not be applicable to other visitors as well.

On the other hand, there was a high amount of excitement and energy during the experiments, because both the researchers and the participants were excited about this experiment. This level of energy and excitement could have influenced the participants in a way that they were less objective about the setup. However, multiple times the researchers mentioned that any answer would be correct and participants were able to point out weak points of the project as well. The interview was also meant to make the participants think critically about the project.

10.1 To What Extent is This Research Transferable to Future Implementation?

The experimental setup was made in such way that it could be made into a professional setup later. The only difficulty of this project at the moment is

implementation in the Efteling organisation. At this moment, there is a fixed number of employees at Droomvlucht and there is a fixed space at the attraction to built a setup like the one that is tested in this report. Next to that, there is a big difference in doing this test with six people on one day or with six to 10 people per hour. For a real implementation in the park, not only the setup needs to work properly, but there needs to be a system for visitors to get the equipment, return it and a way to control the waiting line. However this was not within the scope of this project to realise a plan for this.

10.2 Future Work and Recommendations

More testing needs to be done with different kinds of disabilities. The setup has not been tested with psychologically disabled participants or with highly physically disabled participants. The results of these tests could be implemented in a future design. However it is more difficult to test with psychologically disabled people, because they cannot provide useful answers.

It would be recommended to let a researcher test the setup who was not actively involved in it or has any common interest, to keep it even more objective. Next to that, it would be recommended to use random participants from the park and to use even more participants. Therefore a recommendation would be to test this prototype with better equipment and with a high quality 360 3D VR video for a representative amount of time in the park to fully test the potential. This means the setup would be actually implemented in Efteling for a specific amount of time and according to those results, Efteling can decide to keep the setup, change it or to get rid of it again if it does not prove to be successful in that period.

11 Conclusion

In twenty weeks time a project has been made and investigated to help disabled visitors experience Droomvlucht in a joint VR project. Not only did I test the themepark in a wheelchair for difficulties in a field research, a thorough investigation into the state of the art of virtual reality technology was conducted and an important problem statement was generated. In this case, the problem that some visitors with a disability cannot experience Droomvlucht.

A prototype was realised using user centered design principles and tested and evaluated with employees working at Efteling, who have daily interaction with visitors. Using iterative design methods, small parts of the final prototype were tested and improved in iterations.

The main research question was "How to create a joint virtual reality ride for visitors in- and outside of Droomvlucht". It can be concluded that a joint virtual reality ride can be created by using state of the art technology. By creating an immersive multisensory VR setup for visitors outside of Droomvlucht and an audio connection between the visitors in- and outside of Droomvlucht, a joint experience can be created.

This has been tested in a real life scenario with users from the target group in Efteling theme park. These target users were all different from each other and represented a large group of disabled visitors who visit the park every day.

In the end, it can be concluded that the setup is a great solution for visitors who cannot enter Droomvlucht. Not only was a joint experience created, but some participants were able to forget that they were using technology. I would be recommend Efteling to further investigate this solution and actually implement this in the future, because it will enhance the Efteling experience a lot for visitors in a wheelchair.

12 Acknowledgments

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14 Appendix A - Original Consent Form

Kaatsheuvel, 18 januari 2017

Geachte heer/mevrouw,

U zult vandaag deelnemen aan een onderzoek van de Efteling. Wij danken u hiervoor hartelijk!

Tijdens het onderzoek worden geluidsopnames van uzelf en uw gezelschap gemaakt ten behoeve van een onderzoek. De geluídsopnames worden eigendom van de Efteling en zullen niet aangewend worden voor promotionele doeleinden. De opnames zullen strikt vertrouwelijk en anoniem behandeld worden.

Door middel van ondertekening van dit document verleent u hierbij aan de Efteling de toestemming om van uzelf opnamen te maken van de interviews die door de Efteling bij u worden afgenomen. Tevens wordt hierbij door u aan de Efteling het recht verleend om deze opnamen enkel voor onderzoeksdoeleinden te gebruiken.

U stemt geheel vrijwillig in met deelname aan dit onderzoek. U behoudt daarbij het recht voor om op elk moment zonder opgaaf van redenen uw deelname aan dit onderzoek te beëíndigen.

Voor de goede orde vragen wij u dit formulier te ondertekenen. Hiermee geeft u aan dat u het eens bent met deze bepaling.

Naam:
Straatnaam:
Postcode + woonplaats:
Geboortedatum :
E-mail:
Handtekening:

Wij danken u hartelijk voor uw medewerking.

Met vriendelijke groet,
Efteling Onderzoek

15 Appendix B - Translated Recruitment Ad

Invitation Mail wheelchair users

Subject mail: Efteling looking for Councillors in a wheelchail
Dear [name and surname]!

Efteling wants to be a theme park for everyone. For young and old, for fairytale lovers and daredevils. But also for people with disabilities. Therefore, we have devised an idea which will make Efteling (hopefully still) more fun for people in wheelchairs.

We'd like to test this idea and discuss with some people who are, due to a disability, in a wheelchair. Therefore, we are looking for participants who sit in a wheelchair or with a close relative or close friend in a wheelchair. The wheelchair user is allowed to come together with up to 4 others to Efteling to take part in the test.

Who are we looking for?
We are looking for curious wheelchair users who would like to participate with family and / or friends to a test in Efteling. The wheelchair user should be able to speak well and not find it annoying to have or to share her thoughts with us.

The test day will take place on Wednesday, January 18th. It starts at 10:00 and will last all day.

Are you who we are looking for?
Then you can sign up via the registration form: [LINK] Be quick, because you cannot sign up later than Monday, January 9th.

Please note that we can only invite a certain number of people. A selection is made from all entries. After registration you will hear as soon as possible if you are invited.

Regards,
Research Team Efteling

Nice of you to participate in the test for wheelchair users. You can sign up for the test by answering the questions below. You hear as soon as possible if you are selected after the registration period.

V1. Those who wish to sign up for the test day in the Efteling? Enter your details and the details of the people you'd like to take the examination in the Efteling. This may be at least 2 and up to 4 people.

Name: Age: Sex: Wheelchair User:
(Person 1): Yes No
(Person 2): Yes No
(Person 3): Yes No
(Person 4): Yes No

This question per wheelchair user
V2. How long (name of person wheelchair user) already in a wheelchair?
1 His her entire life
2 More than 5 years but not his her life
3 Less than 5 years

V3. Are you on Wednesday, January 18th the entire day (+- 10: 00-18: 00) available and do you have the opportunity to come to the Efteling?
1. Yes, we are available and have the opportunity to come to the Efteling.
2. No, we are not available on January 18th does not belong to the target group, the final text.

V4. To what extent are you familiar with the term VR (virtual reality)?
1. Never heard of
2. Well heard, but never come in contact with it
3. Well heard, and sometimes it comes into contact
4. That I know well and I use it regularly

V5. Fill in your top 5 most popular attractions of Efteling! <Fill open field>
1.
2.
3.
4.
5.

V6. Write the telephone number and email address you are best reached at?
1. Mail Address: <open>
2. Phone: <open>

<End Screen Complete> Thank you for your registration for the examina-

tion on Monday, January 18th! You will hear as quickly as possible if you are selected.

16 Appendix C - Translated Interview Questions

Originally the interviews were conducted in Dutch.

Qualitative Research preparation

Date: January 18th 2017 from 10:00 until 18:00
Location(s): Villa Volta MIVA space
Sample: 6 groups of which each group has one wheelchair user

Opening talk:
Objective is to give a sense of the situation and the problem. So the participants need to understand that Droomvlucht is currently unavailable to be entered by wheelchair users and a solution could be to be separated and have a virtual and a real experience, simultaneously.

Interview before experience *Opening*
Tell something about myself
Ask the participants to tell about themselves.
Do you go to Efteling often?

General questions:
Describe a day at Efteling/ themepark.
With what kind of company do you usually go?
What is the biggest surprise at Efteling?
What do you do at other attractions when someone can't enter?
Do you find it important to stick together with the group the entire day?
Explain about Droomvlucht project and what they are about to do.

More questions: How long have you been in a wheelchair?
Have you ever experienced Droomvlucht?
How do you solve the problem that you cannot enter? Have you been with other wheelchair users as well?
Have you seen an onride video of Droomvlucht before?
Do you miss going into Droomvlucht?

VR questions
Do you have experience with VR?
What have you tried before?

Last question: How are you feeling at the moment?

Interview after the experience

The experience

How would you value the experience you just had?

What did you think about the the ability to be able to talk with each other?

How would you value the different sensory stimuli? Did it add any value, realism or did you even feel it?

What could be better according to you?

Emotions:

How do you feel at the moment?

Do you have the feeling that you have experienced Droomvlucht together?

Relating it to Villa Volta

Have you even seen the Villa Volta video for disabled visitors?

How would you value that?

Or: why haven't you seen it before?

Last question

Would this entire setup be a valuable solution to disabled visitors? Why?

17 Appendix D - Interview Notes

These are interview notes that are translated from original dutch notes.

Group 1

General experience and life

This interview was done with a familie and a girl who has been in a coma and is therefore now in a wheelchair.
They like that there are initiatives for new accessibility options at Efteling. Their last visit was a big disappointment because she could not enter any attraction. Fata Morgana was her favourite attraction.

They do not often go to a theme park. They do go to zoo plankendaal, which is very accessible. They are busy with accessibility progress themselves, the man was helping with festivals like Pinkpop. They are helping to make theaters more accessible for the visually impaired. The girl in the wheelchair had protested against buses, because they are not accessible. She made a movie about it and helped others.

General questions

- With what kind of company do you normally go to Efteling? Last time she was with a group of other patients who had brain damage. They are not all in a wheelchair, but do require help and support. They will only go to attractions that they can do all together in small groups
- What is your biggest surprise? She did not really had a big surprise, they did have a nice day! What do you do at other attractions? At attractions they split up and see who can enter. Everyone should have his own enjoyments.
- Do you find it important that you are together all day with your group? Sometimes they split up, but she does not mind that she does not see the other equally. They split because a number of not can be included in a particular type. The disappointment in her is that she can not walk, so she can really almost nowhere. And dinner was cozy.

Questions Droomvlucht

- How long have you been in a wheelchair? 6 years already.
- Did you ever experienced Droomvlucht? Yes experienced this Droomvlucht. It was her favourite attraction at first.
- How do you do it with a company? What do you do with people who are not in a wheelchair? They go out, they can actually almost nowhere.
- Have you seen a Onride? Movie of Droomvlucht. Or rather a Onride.
- Do you miss it? Yes

VR questions

Have experience with virtual reality? What kind of experiences? She had seen VR goggles, just never used one.

The experience

- How do you evaluate the experience you have had net? Blurry, she saw colors and thought pillars were people who walked in front of the image. They particularly looked at colors, it seemed that she might have tunnel vision. The company in Droomvlucht was ahead of the movie she was seeing. She was also a little bit dizzy. Some unexpected movements made the images unclear.

- **How did you like the opportunity to talk to each other?** It sometimes disconnected and there was a lot of noise, so sound was less understood. Sound may be hard in the attraction. The ability to talk to each other was experienced as good. Nice to talk to each other. The people of the attraction found it cozy. Disabled visitors might be a little anxious and hearing mom and dad can be reassuring for them.

- **How do you evaluate the different sensory experiences?** The fan was really cold, however it still felt like Droomvlucht. She only could not feel the heat.

- **What could be improved?** Sharpness was not good, otherwise okay just a little cold because of the blower. The participants would prefer to have better sound. They would like a sensor to the microphone, which ensures that the VR movie is precisely timed.

Emotion
Is your emotion differently now than before the test? Emotion did not really change. She was glad she experienced Droomvlucht from the seat, better than nothing. She would prefer to be in the real attraction.

Do you feel you have experienced the attraction together? Really the idea that they have experienced together attraction. Even the fact that she could not see a thing, it does not even matter, because you get feedback from your company. They felt that they were in the attraction with the three of them. Because the blind say they: Look at that, even so it does not even matter whether you really see jet. They also see the options for the blind to both of them, a sort of recording everything you see record. Then the blind can sit in the trolley with ears to explain exactly what they would see.

Last question
Would this setup is a good substitute for the real experience for visitors who cannot enter? With the goggles you will experience more and you're connected to each other. Also an older person likes to hear his family. They think it is a good replacement, they would like to see the small step that blind people would be given a description of what they see. The feelings that can be created are fun.

Group 2
This interview is done with a group of friends and family who do not usually go to the Efteling with this group. Normally it is just the family and they go to Efteling once a year. The young girl in the wheelchair is paralysed for half of her body.

Questions before the experiment
Describe a usual day at Efteling. She brings her own wheelchair and they make sure they have a specific piece of paper to make sure they can use the wheelchair entrance. They find it a good arrangement and the employees are very helpful. At the steam train they put down a piece of board that the wheelchair user can use to roll onto the train.
With what kind of company do you usually go to the Efteling? With her family together.
What is one of the biggest surprises in Efteling for wheelchair users? Their biggest surprise is how good everything is arranged. They go into every attraction, except for Villa Volta. Because she cannot enter and the parents become sick from the experience.
Do you find it important that you stick with your group for the entire day? No, they sometimes split for a short time to go into specific attractions.

From what age have you been in a wheelchair? Already for 7 years in a wheelchair.
Have you ever experienced Droomvlucht? Yes, she enters Droomvlucht when it is quiet. She uses the railing and some help from the parents to move forward.
What do the non-disabled people in the group do when someone in a wheelchair cannot enter? They split up and go their own way in smaller groups.
Do you miss experiencing Droomvlucht? No, because she can enter.

What are your previous experiences with virtual reality? She has never experienced it.

How do you feel at the moment? She feels very normal, not unusual.

Questions after the experiment
How would you judge the experience you just had? The entire group liked it. Especially when they saw there was an ability to talk, they liked it more. The child who was experiencing it was a bit quiet, but she could hear her parents and she did see the same things as they were talking about.
How would you judge the ability to talk over distance? She had the feeling they were able to share their experiences together. Experiencing it together is meant in this attraction. They were glad they were able to talk to their disabled child. The participants in the attraction were waiting for response from the child. If they were able to do it again, they would be more relaxed and they would talk more. The parents were waiting for response and were thinking about what their child was seeing and experiencing. (They do not trust they are really seeing the same)
How would you judge the multi sensory experience? Was a nice extra feeling, she likes it. The VR setup was more exciting than the real attraction.
What could become better in the future? They want to hear their child already when they enter the attraction, not just when the attraction really begins. It felt like suddenly they were connected, which is something to get used to first.
Do you have the feeling you have experienced the attraction together? As soon as they are both talking they have the feeling they are experiencing it together. They are very curious what the child has experienced. The child in the wheelchair was not feeling lonely, because he could hear her parents. They were all very curious how vr would be for roller coasters. The disabled child did not feel alone because she could hear voices.

Would this setup is a good substitute for the real experience for visitors who cannot enter?
Yes, it makes you able to share and it gives a feeling that you are together in the attraction. They would certainly use this solution if it was available. However, they do have the feeling this is different from the real attraction, because you are divided and you cannot see the real attraction. So the parents think it is different, however they would still make the choice to use this setup.

Group 3
This was a couple of husband and wife of which the wife was in a wheelchair. She has a muscle disease which became worse over time. The woman knew well that she could not enter Droomvlucht because of safety issues, but she still tried to talk to the employees to be allowed in. She did not really care about safety, in case something happens she is ok with it that it becomes difficult.

Questions before the experiment
Describe a usual day at Efteling. She cannot enter any attraction anymore, so she goes to Efteling in summer with her husband once a week. She has a muscle disease. When she did not have a disability she liked the roller coasters.
With what kind of company do you usually go to the Efteling? With her husband mostly.
Do you find it important that you stick with your group for the entire day? This does not really apply to her. She told she goed to Efteling with her husband and they both just do not enter any attractions.

Have you ever experienced Droomvlucht? The woman has never experienced it, the husband has but she became stuck to her wheelchair a couple year after Droomvlucht opened.
Have you seen the onride video of Droomvlucht? Yes, because it is a beautiful scenery that she saw on YouTube.
Do you miss experiencing Droomvlucht? Yes, she would like to see Droomvlucht because it seems very beautiful.

What are your previous experiences with virtual reality? She has never experienced it.

How do you feel at the moment? She was excited to try it all out.

Questions after the experiment
How would you judge the experience you just had? It was beautiful to see. They think it will be even better when you experience it more often. The disabled woman really had the idea that she was in the attraction and she could not hear the researching surrounding her. It was like she has truly experienced Droomvlucht. She really enjoyed it.
How would you judge the ability to talk over distance? They like to talk and therefore they really liked being able to talk with each other. She thinks it is not important to see each other, most important that you can see the attraction and being able to talk, that is what they would normally also do in the attraction.
How does this experience compare to Villa Volta? Villa volta was boring, this setup is more fun.
How would you judge the multi sensory experience? It was nice and warm and she could feel the cold wind later. She could not identify the smell to be from droomvlucht, she thought it was a perfume.
What could become better in the future? She did not say anything about it. She liked it a lot and she would use this a couple times a year.
Do you have the feeling you have experienced the attraction together? Yes, this combination of technology made them feel they were together.
Would this setup be a good substitute for the real experience for visitors who cannot enter? Yes very good, she thinks everyone would like to use it. Because its immersive and it feels like you are in the world and you are able to see everyone. The husband adds that wheelchair users are now going to great lengths to enter the attraction while they should not do that out of safety, so this could be a good solution. During the experiment I noticed the woman really looked everywhere and could see the things the husband was pointing out.

Group 4

This group consisted of parents and children. They were all Efteling fan and usually first go to the Baron or the python. Before they go home, they want to see the fairy tale forest in the dark.

Questions before the experiment

Describe a usual day at Efteling. Normally the grandma also joins and then there are two people in a wheelchair: the child and grandma and the others change during the day the one who pushes them around.

With what kind of company do you usually go to the Efteling? With the family, the children parents and grandma.

What is one of the biggest surprises in Efteling for wheelchair users? They really liked how employees treat them and how friendly they are. They also liked it that the Baron coaster has an elevator for wheelchair users. The biggest disappointed was at Droomvlucht that they could not enter it. At Polka Marina they tried to pick her up by hand and get her up the stairs, however visitors behind them thought they were slow and were pushing them to move quicker.

Do you find it important that you stick with your group for the entire day? Yes, they only go into attractions that they can all enter. Otherwise it is not fun for the sister when her brothers come out of Droomvlucht and enthusiastically saying it was amazing. Next to that, they once split up so some could go to some more roller coasters and then later they lost each other. So now they want to stick together.

From what age have you been in a wheelchair?

Have you ever experienced Droomvlucht? Yes, she has experienced Droomvlucht. Her parents would put her on the hand rails and pushed her forward.

Do you miss experiencing Droomvlucht? They won't go into Droomvlucht when it is busy, but she can experience it when it is quiet.

How do you feel at the moment? The child was very quiet but her brothers were very enthusiastic en energetic.

The family knows VR, they have seen it in an attraction with dinosaurs in 3D. They like 3D movies a lot and they have a 3D television at home.

Extra information: the sister of the disabled girl was a little sad, because she also wanted to experience the VR goggle. She wanted to see that, instead of just talking. The boy took the lead

The mother really liked the idea that the Efteling is experimenting with this. She thinks Efteling would help a lot of people with this solution .

Questions after the experiment

How would you judge the experience you just had? Very good, the girl in the wheelchair liked the stars most. She could identify different characters and saw king Oberon. She really had the idea she was with her brother and sister and they were talking to her about how beautiful everything was. The girl in the wheelchair had the idea she saw the same things as her brother and sister. The mother and brother knew the sister was enjoying it, because of small movements and the fact that she said 'yes' multiple times. This girl participant did not talk much because of her condition, so when she did use some words they meant something. Next to that, this girl had a muscle condition that made it hard for her to keep her head up. However, because of the VR goggle she could just lower her head and the movie was calibrated so she could see the ride as if she was looking forward. She found it a comfortable way of wearing it. The girl in the wheelchair liked this just as much as the real attraction.

How would you judge the ability to talk over distance? The brother took the lead in the conversation and was talking continuously. They liked it that they were able to talk to each other.
How would you judge the multi sensory experience? Yes, the girl in the wheelchair had the feeling this added some value. The people in the real attraction also asked her a couple of times if she could feel the same thing.
What could become better in the future? Wireless. Next to that , the mother thinks this could be a solution for elderly as well, so they don't have to go into the real attraction.
Do you have the feeling you have experienced the attraction together? Yes, they had the feeling they were experiencing it together.
Would this setup is a good substitute for the real experience for visitors who cannot enter? Yes, this family would choose the goggle when it is busy at Droomvlucht, because it was always a hassle to put her on the hand rail. The girl said she would just prefer this goggle instead of using the rail.

Group 5

Questions before the experiment

Describe a usual day at Efteling. This family usually goes to Efteling twice a year. The children like Baron most. One of the children cannot go into Baron, however he does know the story well.

With what kind of company do you usually go to the Efteling? With family and other people, usually about ten people in a group.

What is one of the biggest surprises in Efteling for wheelchair users? At Fata morgana there is a very friendly person that knows them well. Their worst moment was when they were refused
Do you find it important that you stick with your group for the entire day? They split sometimes when they are with a big group. They do stick together closely, so they go to a specific area and each group choose their own attractions to go into.

From what age have you been in a wheelchair? Since 1996.
Have you ever experienced Droomvlucht? She has experienced it once in her life.
What do the non-disabled people in the group do when someone in a wheelchair cannot enter? They only go into attraction they can all enter, otherwise someone has to wait. They al like to go with the wheelchair participant to Vliegende Hollander, so they do not have to wait so long.
Do you miss experiencing Droomvlucht? She does not miss it, because last time she had to wait so long and she was so tired, she could not really enjoy the ride. She would not know how the experience is like when she does not have to wait. This woman gets tired very quickly.

What are your previous experiences with virtual reality? They all tried it at a demo at KPN. Children liked it, the person in a wheelchair liked it as well to try, but she was a little scared because of what she was seeing.

Questions after the experiment

The boy did not really understand if he was hearing the music from the attraction for the attraction itself or on the headphones. The volume was apparently too low, so they could hear other but very silently. They did not understand how to adjust the volume on their own.

Another insight, they did not know that Villa Volta was offering a video to their disabled visitors instead of the real attraction.

How would you judge the experience you just had?
The VR experience was a little behind the real experience, which they did not like. The participant in the wheelchair liked this experience better than what she remembered last time, because she was not tired now. She did think it is different now than the first time. She forgot she was in VR, she could really enjoy it this time because she did not have to wait so long.
How would you judge the ability to talk over distance? They liked it very much, found it a funny addition. They were discussing whether they wanted to see each other as well, however they concluded it is a ‘show to watch’ not each other, therefore only audio is sufficient. They thought being able to see each other on a screen could distract from the real attraction.
How would you judge the multi sensory experience? The participant did not feel anything. A reason could be because she was wearing very thick scarf and jacket.
What could become better in the future? They would like to have a separate entrance. Maybe a 3D movie would also be nice, however the VR was better.
Do you have the feeling you have experienced the attraction together? Absolutely, because they were able to talk with each other and they could confirm that they were seeing the same thing (however a bit behind, because it did not synchronise very well). The boy in the real attraction had the idea that his grandma in a wheelchair could really see the same things.

Would this setup is a good substitute for the real experience for visitors who cannot enter?
They like it very much. They already like it that the Efteling is experimenting new ideas for disabled visitors. The found this setup beautiful and a good solution. The boy who went into the real attraction also suggested this might be a solution for some roller coasters as well.
Questions before the experiment

Group 6

This group at this moment consisted of family, friends and an extra person (‘aanhangsel') This was not the usual group they would normally bring to Efteling.

Describe a usual day at Efteling. The person in the wheelchair was a woman and was married. She and her husband would go the Efteling together with another couple.
With what kind of company do you usually go to the Efteling?
What is one of the biggest surprises in Efteling for wheelchair users? She did not know. She could not find a surprise, however she was shocked that she was able to enter Droomvlucht once and now could not anymore.
Do you find it important that you stick with your group for the entire day? No, they would split and see where they could enter or not. She did not know a lot about all the facilities at Efteling. For example, she did not know that roller coasters are accessible for wheelchair users. In the fairy tale forest, some paths were very small and difficult with a wheelchair. She also did not know she could enter the steam train, or Gondoletta or fata morgana. She thought Droomvlucht once had a wheelchair entrance, which it does not.

Have you ever experienced Droomvlucht? Yes, before she became disabled she always entered it and liked it most.
What do the non-disabled people in the group do when someone in a wheelchair cannot enter? Others go in and she stays behind and wait sometimes.
Do you miss experiencing Droomvlucht? Yes, because it was one of her favourite attractions.

What are your previous experiences with virtual reality? Never tried it, only heard of it before.

The woman seemed not very energetic and she and her company were critical about some things in Efteling.

Questions after the experiment
How would you judge the experience you just had? She really had the idea she just experienced Drromvlucht and she did not have the idea it was very different from the real thing. At fast parts of the movie, things became a bit blurry which she did not like.
How would you judge the ability to talk over distance? Funny to be able to hear each other and talk with each other. The participantts inside the attraction described that they were watching the show differently for details. They had the idea that they were not only watching for themselves, but also for another person. They thought this project would be very feasible and would help a lot of disabled visitors. Everyone thought talking to each other was a fun a good thing to do. They did have a warning about the fairy that goes up, if that would be something the disabled visitor would also see every time, because sometimes this fairy is hidden. The participants were mostly explaining what they were seeing —> *The experience might have changed here a little*
How would you judge the multi sensory experience? The participant knew very well when specific parts of the multi sensory experience were on or off. The participants in the attraction were also asking here about it, one question was: “Do you smell flowers as welll?” and then the participant in the wheelchair could also smell it. She did not think the safety handle added a lot of value.
What could become better in the future? That would like to be able to see each other on the sides. They don’t know how, but it would make it more realistic.
Do you have the feeling you have experienced the attraction together? They did not have the idea they were in a train together, but they did think they experienced it together.