Bachelor Degree Project

HOW DO AR VISUALIZATIONS IMPACT USERS' COLLECTIVE INTERACTIONS IN MIXED REALITY EXPERIENCES?

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Moa Andersson

UNIVERSITY
OF SKÖVDE

Abstract

This study examines how Augmented Reality (AR) visualizations can impact the collective interaction of users. This research will focus on a multiphase experience with a buildup of different levels of Virtual Reality through the use of panoramas and 3D models. The experience was created using a participatory method with multiple tests and iterations to better create an evaluable product.

The result if this experiment shows that the impact AR has on users is extensive. A properly framed character can even change a pair of two users into a group of three.

Keywords: AR, Panorama, Collective Interaction, Mixed Reality, Impact

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1 Introduction

In my research I begin with a central question focused on how users of Augmented Reality (AR) experience visual content and whether their responses are singular, or influenced by others. My primary question then is: How do AR visualizations impact users' collective interactions in a mixed reality experience?

My research will aim to outline what impact AR visualizations can have on users' collective interaction. Through the artifact that I will create I will be able to view different levels of AR through a multi-phase experience, with a build up from more simple AR to more advanced. I aim to see how users will interact with the AR material presented, both with each other and with the technology.

Understanding the complexities of Augmented Reality (AR) is increasingly relevant and necessary in contemporary society. AR technology has progressed rapidly in the last 2 decades, and what before only existed in science fiction novels is today rapidly becoming a part of our everyday lives. Social media sites and other various websites make use of this new technology, such as Facebook, twitter and 9gag. But currently augmented reality offers a challenge to those researching and designing experiences with the needs of users as a focal point. This is primarily because we have yet to understand how embodiment and visualization are related in the same media form. Embodiment differs from visualization as it incorporates more of our senses, not only our sight. It is a more complex way of "seeing" as it utilizes our entire body.

Virtual reality and its associated principles, as outlined in section 2, is a fairly young form of media, and we don't really understand its full impact and how it might change users' relationship to media and to culture. What uses are there? What sort of experiences can we create? Who would benefit by using them? These are all questions I consider in my research.

2 Background

In my research I focus on the relationship between embodiment and the particular affordances of AR technologies to create embodied experiences. Users will be able to understand and take the knowledge to heart if more senses are involved in the experience. There are numerous researchers, such as Rambusch (2004), Kelan (2010) and Gibson (1979) who have studied and analyzed embodiment in relation with both how we learn, but also our perception.

Gibson (1979) used the term *affordance* to encapsulate the process of perception. He argues that there can be no perception without an action and vice versa. This means that we need to understand the action in order to perceive the object presented. An example of an affordance can be understood in terms of looking at the design of a door. We know that a door is able to open because we understand the action of opening the door; we have performed the action of opening a door before. Therefore, when we see a door, we know that it most likely is able to move and open. This is a form of embodied learning. Such a simple action as opening a door is a task that we do not question, because we've used all our senses to confirm and accept that it is a possibility to indeed, open the door. This concept of learning is powerful and deeply ingrained in our collective knowledge. We do not question it, nor do we often reflect upon it. But this concept can be used in order to convey a story. Not only in the experience that I am a part of creating, but also in games. An embodied gameplay experience often tends to remain longer in our memory as we utilized more senses to relive it. In experiences and games, the designers often create a narration with the intention that it will stick with the user and/or participant. Even though narration might not be in the forefront of the experience, as is the case with my artifact, it is still present and I believe that an embodied experience can help to make the experience stick in our minds for longer. In games what the designer might want to leave with the user is the story and in other cases it might be an educational purpose.

Kelan (2010) makes the parallel of embodied learning and yoga. She explains how Yoga teachers use an embodied approach in their teaching and create an awareness in their students about their own bodies. She argues that: "Bringing the body into higher education allows using the body as a source of insight." Kelan (2010 p.5) Beyond that she also believes that these types of approaches will aid students in their learning and comprehension of complicated subjects. In my research I will draw on similar principles when designing the experiences that form the basis of my design experiments.

When creating my artifact, I want to explore how users' can be connected and immersed in media experiences, similar to how they might be drawn to games, but I wanted to move away from a traditional concept of "gameplay" as I believe that embodiment should be at the core of the experience. At the same time, I want to incorporate and investigate some elements of play and critically explore it. This is especially important with younger audiences in mind, as it offers them a way to engage with media experiences. But my goal is to understand play and its importance within visually-driven AR as it also connected to users' sensory and embodied experiences as they become media users.

2.1 The skybox as an affordance for embodiment

In the experience I will be designing, I will create different types of panoramas based on different locations. The importance here is to allow the user to feel truly transported to these locations. To do this I will utilize a design feature called a "skybox, "which is often also used in games to enhance users sense of immersion in a particular locale. In games this feature is to create the illusion that the game takes place in a restricted world. The skybox serves as the horizontal line, sky, and sometimes even ground. The player is never truly close to the skybox itself as it normally is much larger than the player to create the illusion that they are indeed in another virtual world. In the experience that I create, I will use the skybox in combination with the panoramas, to create the illusion of a 3 dimensional space.

Img 1 illustrates how a skybox generally looks like within a game world. Img 2 is a panorama that works in a similar way. The image is put in a skybox and creates the illusion of a 3d space. The user is placed in the middle of the skybox, which creates the illusion that the image is surrounding them, as seen in Img 3.

Img 1 "Traditional skybox" Reijerse (2006)   Img 2 "Panorama"
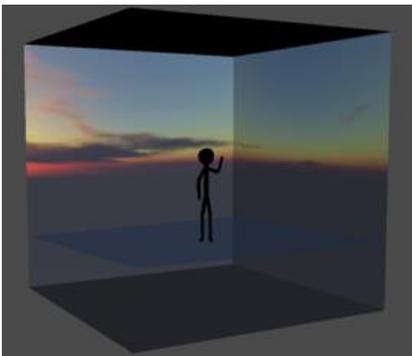
Img 3 "Skybox Illustration"

As the user is placed in the middle of the skybox it will have to move to be able to view the entirety of the image. With the use of a mobile device, such as a smartphone or tablet, the user will have to stand up and turn around with the device to be able to view the entire space. Just like you would need to do in a real life location.

In my artifact, I will add images and 3d objects to a virtual space designed to support an immersive narrative experience to see what best triggers the desired reaction from users. In my case, the desired reaction should be something like a conversation by users about the topic of the object presented.

My hypothesis is that one will have to be quite literal and precise in the choice of images and objects to spark the desired reaction. I believe there will be a very fine balance between being too literal, meaning forcing the conversation and information unto users, and too vague, meaning not receiving any form of reaction at all.

2.2 Virtual- augmented- and mixed reality

To understand and be able to create an experience within the context of virtual reality, one must first begin to understand what virtual reality is. Bolter and McIntyre (2007) describe augmented reality in the context of storytelling:

> **There are two ways** to tell the tale of one Sarah K. Dye, who lived through the Union
>
> Army's siege of Atlanta in the summer of 1864. One is to set up a plaque that narrates how
>
> she lost her infant son to disease and carried his body through Union lines during an
>
> artillery exchange, to reach Oakland Cemetery and bury him there.
>
> The other is to show her doing it.

Augmented reality is a way of adding a virtual element to our preexisting world. Bolter and McIntyre outline the experience they have created and how visitors could to some extent view the event itself and discover the story through their own perspective, instead of having it described to them. They could wear a headset and a pair of glasses that could show them an overlay of images and play sounds to immerse the user into feeling that they really were there. "Virtual reality is immersive, which means that it is a medium whose purpose is to disappear", state Jay David Bolter & Michael Grusin (1999). This is quite an accurate description of a medium that serves to blend into our world as we know it. Although virtual reality creates a literal new reality, both augmented and mixed reality bleed over into our own reality. This makes augmented reality more relevant for my research as the visual cues that it overlays on the world is the source of inspiration for the design of my artifact.

Augmented reality is when one augments physical and "real" world objects or spaces with digital information, Mixed reality combines augmented and virtual reality. A mixed reality experience is when the physical world and the digital world come together, and it can mix live actors with digital objects. It could be for example when users might have to navigate through a real physical space with the help of virtual objects. It can be a mixture of analog and digital elements that coexists in the design of the experience. Mixed reality's intention is to combine virtual and augmented reality into one. To use the real world as an anchor and *mix in* virtual objects in an as believable way as possible. In my artifact I will utilize this form of design. I will have both analog and digital objects to tie the different realities together in what we consider a unique experience.

Nintendo's handheld console the 3DS utilizes a form of mixed reality in their launch application *AR Games*. In the application, users have a small cardboard card with an image

printed on it. If they turn the console's camera towards the card a 3D object will appear on the screen, as if it was standing on the card. This is a good example of how two different realities can come together. Users have the real world anchor in the card, and it is placed in a real world space. But simultaneously one gets the virtual aspect as an augmentation of the world itself in the software of the console. A game that has used this type of software and concept is Spirit Camera: The cursed Memoir (2012) which is a horror game. In the game players use the manual that is prepackaged with the game as the anchor to the real world. Then using the console's camera, the software recognizes the images in the manual and projects 3D objects onto and around them. This is highly efficient in a horror game, forcing players to look around as the ghosts and monsters can literally be behind them, creating an embodied experience. It is important for me in my work to categorize and understand the different realities so that I can chose which one would best serve my purpose. A mixed reality experience is an experience that makes use of both augmented and virtual reality, which makes it important for me to understand and analyze both of these phenomena.

2.3 Images' Double-Consciousness and Semiotics

There have been several researchers who have contributed to the pool of knowledge surrounding visual information and how it impacts us. W.J.T. Mitchell (2005) analyses pictures and their role in modern society:

> Why do they behave as if pictures were alive, as if works of art had minds of their own, as if images had a power to influence human beings, demanding things from us, persuading, seducing and leading us astray?
>
> Mitchell (2005 p.7)

He questions why we see pictures as alive and why we believe that they have minds of their own. He argues that we have a sort of double consciousness about pictures that allows us to see them as merely objects outside us, but also as "alive" in the way they influence and persuade us. He claims that this double consciousness is very much present in all viewers of images and it plays a major role in how users connect themselves to visual information.

Mitchell's notion of the double consciousness is quite apparent and relevant to the work of Yvonne Eriksson and Annette Göthlund in *Möten med bilder (*2004,2012*)* when they also describe how we read images.:

> Vad man ser beror på hur man tittar på bilden, utifrån vilket ideologiskt och teoretiskt perspektiv man betraktar den och vilka frågor man ställer till bilden i fråga.
>
> Y. Eriksson & A. Göthlund (2004,2012, p. 29)

Translated: What you see depends on how you look at the image, from what ideological and theoretical bias you view it and what questions you pose to the picture in question.

Note how they wrote *to* the picture in question, as if the picture was a living being that was capable of answering. This demonstrates Mitchell's claim that we do treat images as more than they are. This form of the personalization of images is relevant to consider when studying how visual cues impact users, particularly in AR experiences that attempt to connect and immerse users.

Richard Howells and Joaquim Negreiros (2012) argue that we need to *learn* how to read images and visual culture. They compare it to being taught how to read languages and alphabets. They claim we need to learn how to read visual images in much the same way as the written word. For them this is connected to the larger field of *Semiotics*. According to Eriksson and Göthlund (2004,2012) semiotics is a theory based on illustrating how people communicate with symbols. Howells and Negreiros discuss how semiotics can teach people essentially that looks can be deceiving. They write about the signifier (the symbol for a thing) and the signified (the thing represented by the symbol) and discuss how these are not always the same thing. For example, if you present someone with a rose you are indicating attraction. Even though the rose is an actual object, the semiotic symbol of the rose has become a symbol of love.

It is important for me to understand how images work and how users view them. The double-consciousness as Mitchell writes about is important to take into consideration when designing my experience. As in semiotics we view images and items as more than what they are, and that is important to remember when trying to spark an interest and/or conversation about a chosen topic with only the use of items or images.

2.4 Embodiment

Sonesson (2007) categorizes embodiment into three different categories.

Primary Embodiment, which he describes as a subject realizing that he has a body and that this body is able to access and communicate with the world. The body is a primary interface to information.

Secondary embodiment, "… concerns the curious fact that some of the objects of the outside world which I perceive are also minds for whom I am in the same way an object" (Sonesson (2007). This is the idea that we as humans are able to understand that our feeling of embodiment is not exclusive to our self but also to other subjects, such as other people, who can share the same sense of embodiment within their own self.

And finally, *tertiary embodiment*, which Sonesson describes as the way our minds are able to exist independently and receive their own sense of material embodiment.

For my research I am merely interested in *primary embodiment*. I am heavily relying on users' ability of feeling embodied, and I wish to incorporate the use of panoramas to stimulate in this feeling, as they are designed to activate it. Panoramas are intended to "surround" users with information and make them feel immersed. They are highly sensory, and will be used in my artifact.

As Luz et al. (2008) suggests, games already create embodiment by connecting users to fictional narratives and making them interact with it. A gameplay element added to a mixed reality experience can further alter a users' sense of embodiment--not only in the sense of making them feel engaged with the experience but also quite literally in the affordances of the skybox. (See 2.1.)

> To be visible means to be real. When we make ourselves a reality on the screen, our "I" becomes more real. The child becomes aware of its identity and its body when it enters the mirror phase 2 - when it sees itself. Today, the mirror is replaced by the screen

State by M. Filiciak (2003 p. 100)

In other words, we already know that we are able to transport our feeling of "self" through a screen, and my research will rely on this knowledge in moving forward.

2.5 The New Digital Museums

The study of museums and how they are transformed in response to digital media is important to understand the changing contexts for reading visual information. Current research on the "digital museum" and on the so-called "post-museum" has transformed the methods used by museum curators and exhibition designers as they consider images and their impact for users. Museums have always been interested in how we interpret images, and objects, to learn how to create interest in museum visitors, but the inclusion of digital media, which is highly visual and often interactive has furthered that change. Eileen Hooper-Greenhill (2000) is but one researcher who has researched how museums construct their collections to create knowledge and how the relationships with the audiences can be understood. She discusses a change in how museums present their knowledge and claims that the main shift is from showing objects as they are, to presenting how they are used. She calls this the *post-museum*.

The post museum will hold and care for objects, but will concentrate more on their use rather than on further accumulation.

Hooper-Greenhill (2000 p.152)

For my research I intend to explore how users view images, and how they can be designed to create the most interest. I have chosen to view how museums create their exhibitions and how future museums might present theirs, since for centuries museums have aimed to create the very thing I aim to create: Interest. Museums have been using similar forms of exhibitions for a long time. A shift is imminent, however slow it is moving. I believe that the result of my research might prove to be valuable for museum professionals who must consider how to design with contemporary media, like AR. In fact, Russo (2012) defines the contemporary museum as a media space. She argues that we need realize that the view of the museum and more importantly the *review* is taking place in online media. She writes that: "The notion of *media museum* comes about from the rise in the use of new media technologies within the museum environment." My research and artifact are designed to investigate how one can face the challenges of such a mediated museum space as it works to connect to visitors who are more like users. My aim is to explore how AR images and experiences create awareness and interest in the user.

2.6 Collective Interaction

Collective interaction is when multiple and collocated users share both one logical input channel and one logical output channel. The input channel may consist of a number of interaction instruments, which are logically coupled in the interaction.

Krogh & Petersen, (2008)

In other words, collective interaction is when a group of users share the same goal and will have to work together to achieve that goal. Krogh and Petersen (2008) describe the ideal process for designing for collective interaction and discuss its benefits for users in general.

For example, they refer to how users can benefit from these experiences, by learning to work together and by encouraging social interaction.

In my research collective interaction is one of my main focuses, particularly in relation to embodiment as it offers a way to include social qualities to the design to enhance user experiences. The experience I design for my artifact is meant to be undertaken in groups of two. Users are paired up and will have to work together to solve the clues they are given and to progress in the experience. I chose this method to be able to stimulate conversation and offer reflections that would be hard to achieve if users were to undertake the experience alone.

Petersen et al. (2010) provide a useful evaluation of how collective interactions could be enacted. They made use of pairs of two, all of whom had previous relations with each other. These included mainly married couples, but also friends and co-workers. They placed them in a room and the participants had to work together to reach the goal of the experience. At first the participants were not allowed to talk with each other, then they could talk through a divider, and then they could freely talk to each other. This was to simulate different circumstances that collective interaction might meet. They found that the design, as they put it, "...hold promise for supporting social experiences through instrumentalizing collaboration." (Petersen et al. 2010 p. 9) This illustrates how collective interaction could benefit social relations. By using more than one input device to communicate with the software further interaction was enabled, which they found benefited the experiment.

2.7 Artifact or "experience"

To use the word "artifact" to describe what I am creating is slightly inaccurate as it is in a sense not a physical item. Instead I will henceforth relate to it as "experience" as I believe it better describes the project.

I am working together with a master student in design, Maria Guadalupe Alvarez Diaz, who will be helping me design the experience to incorporate both of our different researches.

In my artifact I aim to create an embodied experience in a mixed reality setting. I will make use of both analog and virtual tools to achieve the desired result. The desired result will be an interest and/or conversation about the subject of the objects presented. The aim of the experience is that it is intended to be open and flexible and is meant to be able to be conducted anywhere.

One of the purposes of this experience was to experiment with the possibility of visiting other locations through technology. With the panoramas and the way that the technology utilizes them my aim is for users to feel transported to a different place than the one they are physically inhabiting. This is something that could later be utilized for example by handicapped people or the elderly to visit museums and other locations without actually having to leave their home. The panoramas should in theory be able to achieve this to some degree as in order to experience them users will have to move around 360 degrees to be able to see the entire image. This creates an embodied experience and should be able to create a sensation of transportation to a different place. Therefore, in conclusion, the location of the place where the experience itself is conducted is irrelevant, as the point of the project is to feel transported to a different location.

I started with creating three conceptual phases of the experience, to incorporate different form of AR. I started by introducing panoramas to the users, and then gradually through the phases start adding more advance form of AR. This being in the form of virtually added 3d models.

Because of the nature of the method I have chosen for this project, being the participatory method outlined in section 3.1, the design process for this experience is iterative. This means that during the course of the project the artifact will change and evolve as the testing progresses. I will try to conduct as many focus groups as possible during the design process to try to customize the experience so that I can better answer my question and so that I can better create an experience that is enjoyable to users.

Phase one of the design challenge is based on an experience called "Where in Skövde?" The user is given a panorama of another space than the one they are currently in. This panorama will have digitally added objects, such as photographs and/or newspaper articles etc. The panorama will be of a location that is easily identified to be somewhere in Skövde, as well as have some sort of anchor in women's heritage. The user will have to guess where in Skövde they are, and after having completed this step they move on to the second one.

Phase two of the design is focused on users finding objects. In the second step of the experience there will be virtual objects hidden in the panoramas. The panoramas used in this part of the experience is the same as the first phase, however I will here have digitally added objects that clearly does not "belong" in the location of the panoramas. The task for participants is to as quickly as possible identify these objects.

When users have completed the first two steps of the experience they will be moved to the final phase of the experience. The users are to create a story in only four images using 3D objects provided in a digital format. I will not regulate any part of the story, as I am interested here to see what they chose to create with the objects that we have presented them with.

The overall design of this project is based on the principles that images have complex identities and connect to viewers (users) in specific and personal ways. According to visual culture researchers like Mitchell (2005), we see images as something more significant than their physical properties. A common expression is "an image is worth a thousand words". In terms of my artifact design, I will take account of this and work to build complex personal relationships for users to images. I will incorporate as much information as possible into the objects, but also make sure that I do not *force* any form of information onto the users, so I can test their personal responses to the experience. For example, img 4 illustrates a piece of cloth I made for the virtual addition of the third step of our experience. In itself the piece holds little significance to my overall topic, but in combination with the other objects, such as img 5, I believe that it can strengthen the suggestion of the topic.

In image 5 I created an embroidery frame, also with women's heritage in mind, and the embroidery I added onto the fabric is intended to spark a conversation. The text reads: "Quinnans plaths äro i kijiöketh". Translated this says: "A woman's place is in the kitchen". The embroidery was created as a part of a contest in 2008 by a Swedish magazine called Wendela. An ironic contribution made to be funny, I found that the text lent itself well to my purpose and chose to use it in my model. We see images, as stated in 2.3, as more than just images. The text in itself is ironic, however as it is embroidered, it can spark the idea that

perhaps it was a woman who had made the piece herself. (Embroidery and handicrafts are typically associated with women, and I draw from that semiotic relationship.) Different people will react differently to the image, as they will have different backgrounds and interactions with similar pieces. Reactions to a piece like this can differ greatly from one person to another based on their different perceptions and affordances, which is why this piece is particularly interesting for my research.

Img 4 "Rölakan"   Img 5 "Embroidery Frame"

This part of the experience is where I believe I will best answer my research question. It is this stage that provides the strongest augmented aspect, being the virtual object being added to the real world. Since this stage also only provides one singular input device users will have to work together in order to complete the challenge. The AR visualizations will impact users' interaction in different ways through their collective experience and it is precisely these impacts that I wish to study.

3 Problem

How does one discreetly attract attention and interest with images without forcing information upon viewers? This is a question posed by museums for decades in their creation of exhibition spaces. As images become more prevalent in society, viewers are more indifferent to them and are harder to impress. In the digital age, images are everywhere and with the increase of technologies like AR in culture, but also in cultural settings, the topic requires more consideration. My research as a whole in this project is to see how the AR visualizations in the experience I have designed can impact the collective interaction of users and stimulate their interest through social interactions. Will they talk about what they see? What will they talk about? Will they read the information presented in the way that is intended, or will they choose another path? These are all possible questions I can consider when analyzing the result.

Further, I am interested in how these visualizations take place within the subject of designing for heritage experiences. These experiences are quite specialized (as compared to advertising or game-design, for example). I draw on the principles engaged by the studies of how museums and heritage subjects may be transformed by digital media to create more personal and open ways to connect to visitors. To this end, I specifically designed an experience based on an historical perspective of handicraft work.

To help investigate my subject based on user experiences, I believe it is important to take into consideration the target groups that I have chosen. It is important to me to have two different target groups, to have a broader span of people, but also to have different people to provide comparisons. So I chose to have a slightly older group, with people in their sixties and over with an interest in the overall topic of handicrafts. I believe it will be interesting to see how this generation of people, possibly less comfortable and less familiar with digital media, interact with the AR and mobile technology presented. The other group chosen is in contrast with the first one. They are younger and more inclined to use technology like tablets and phones. They will also most likely have come into contact with AR and will at least have a basic knowledge about its implications.

Drawing on the work of others like Mitchell, I intend to design interactions that require different inputs and stimulate different responses from users so I can study what kinds of visual stimulations offer the richest responses. Presenting users with images can also spark a conversation among those that encounter them to create different social relationships. as Mitchell has shown. However, I want to be more precise with the use of Mobile AR applications to study the complex relationships they support, particularly within mixed reality designs. In this context users, images, real worlds, virtual worlds and narrative messages are very complex, and I hope to reveal some of the complexity in order to consider effective design strategies. My primary question then is: How do AR visualizations impact users' collective interactions in mixed reality experiences? Secondarily, I hope to understand that within the specialized area of digital heritage.

3.1 Method

The participatory method, so called by Nina Simon (2010), is a method that utilizes iterative testing throughout the project, not only in the end to test whether the artifact that has been created works or not. The method Simon describes was created for museums in the design of

their exhibition experiences, and so I believe it will lend itself well to my project. The experience that I am designing is very similar to the ways that museums present artifacts, as outlined in section 2.4. Because my primary content is drawn from a heritage-based experience, I believe it is relevant. Img 6 illustrates how I have chosen to execute my design process.

The participatory method is based on the theory that knowledge is built collectively. If more minds related to the target group are involved in the design of a product, the product will serve its intended target better. To incorporate this notion into my project I will create focus groups containing the target audience.

I will start with a pilot test where the initial design of the artifact is created based on my initial hypotheses. I will then move on to the focus groups where I will test the initial design. Finally, I will take the result of the group, analyze it and incorporate the ideas and thoughts that the testers had into a new and improved artifact through a design meeting.

When I have gone through the processes once, I will then restart and have a new focus group, followed by analyzes and design meetings. I will repeat this process as many times as we can to achieve the best possible artifact/experience.

I have chosen this particular method to make sure that the experience is truly customized to the intended target group, as well as making sure that it will serve to answer my question. Because of the iterative design the artifact will change and evolve during every stage of testing. This means that the artifact, or experience, may look very different at the end of this project than it had in the beginning.

This method was designed by Simon (2010) for museums and even though my project has little to do with museums directly our intentions of conveying a message of history of heritage remains the same. This is why I believe that the method lends itself well to my project.
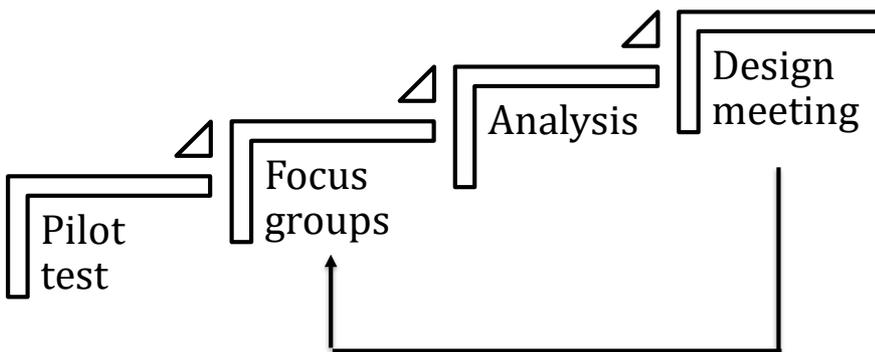
Img 6 "Participatory Method"

In our current Internet society, we have developed a collective way of creating knowledge. Henry Jenkins (2006) refers to several different phenomena that embody how our collective internet society works. He discusses the TV show *Survivor* and explains how the internet and the show's fans come together to, in essence, *spoil* it. The fans use their numbers and geographical positions to find clues about who will be off the show in the coming weeks. They become a community based on their shared experiences online. This is but one example of how our participatory society works, and it is one of the reasons I chose this particular method. It offers me a way to take advantage of the collective thinking that has developed around new forms of media as they engage viewers.

According to Alan Bryman (2016) it is generally more suitable to have a smaller group of participants in a study of this kind as the moderator, meaning the person in charge of the interview, might face difficulty in responding to each participant in a larger group. He also reminds of the importance of limiting the moderator's involvement in the conversation. A moderator should steer the conversation but should not affect it in any way.

Focus groups for my experiences will contain 3-7 members who have been carefully selected from my target audience. I will present the test group with the artifact as soon as possible to find out if my initial design is valid and serves the purpose of the project. The result will then be carefully reviewed and the artifact will be modified according to the feedback given by the testers. As soon as this is done, a new focus group will be found and another test will be conducted. This will be my process to create the best and most usable artifact and content possible, not based only on my own needs and ideas, but drawn from the users who will eventually make use of the product.

4 Implementation

The implementation of the design aspects has been made with Mitchell's (2005) double consciousness about pictures as a primary influence. As my artifact changes through an iterative design process during the course of the project there is a learning curve to take into consideration when designing the graphical aspects. Because the content of the artifact is based on heritage and women's labor it is important for me to tie the graphical cues to the topic, since the desired reaction is to spark an interest or conversation about this topic.

In a collective experience, such as the one I propose, it is important to remember that there will be more than one participant to take into consideration. The graphical cues need to be discrete but also obvious enough so that they are able to be found. As the experience is a form of competition, this is also important to remember when creating the graphics. It is vital that the images will create a challenge to the users and not be too obvious.

The first phase of the artifact experience requires very few graphical cues, since they are merely panoramas of a particular location. Users explore the panoramas to determine if they can identify the locations. In this phase the users are provided a real "reward" in the form of information about the place that they are "visiting" when they explore the panorama. Embodiment comes into play here as the user needs to move around and thoroughly examine the panorama in order to find out where in Skövde they are. They must use more than their eyes to uncover the information embedded in the panorama. This is intentionally designed to create the feeling of transportation to another location, without actually moving from the spot.

The second phase is where I will manipulate the images by adding hidden objects around the panoramas. The task for users is to find these objects, and when they do they receive a "point". The group with the most points at the end of the phase wins the challenge. I will choose objects that are closely tied to the chosen topic of heritage, but with Mitchell's double-consciousness theory in mind. The double consciousness is however not as present in these objects, as the purpose is not to analyze them, but rather to find them. Their real identity has little importance. Rather the collective interaction in relation to the competitive aspect. The objects themselves were technically irrelevant as the only purpose of this phase was to win.

For me the third phase of this experience is where I will truly be able to test my research question as well as study the collective interaction in a true mixed reality setting. The phase, as outlined in section 2.7, is the phase that heavily focuses on augmented reality. The users are to create a story in only four images using 3D objects provided in a digital format. These objects are designed by me, and this is where I implement what previous researchers have taught me, such as Mitchell's double consciousness theory and Gibson's description of affordance. What will users think when they see my objects? Will they make the connection to heritage? Will it spark a conversation?

4.1 Pilot study

4.1.1 Pilot Study: Phase one

The pilot study was conducted in two steps. First I had a focus group containing the first target group of the older demographic. The first focus group was conducted not only to test the experience itself, but also to test the technology to see if it was understandable and easy to use. This focus group was based on a smaller test with only one panorama and none of the steps

previously explained. The panorama presented, see img 7, had a digital addition of a photograph to see if users would react and interact with the topic that the photograph presents, see img 8.

Img 7   Img 8

The group contained three participants and was recorded to ensure that I did not miss any nuances of the reaction to the experience. The participants were each handed a mobile device containing the panorama. Incidentally during this particular session, I only had two tablets and had to use a phone for the third participant. Initially I did not believe that this would have much significance but soon realized that it was impossible for the third tester to participate in the experience as he was unable to see the panorama in such a small format. For the next test I would have to give all participants the bigger screen that a tablet provides.

During the course of the test I quickly realized that the main focus of the participants wasn't to discuss the photograph we had added, but rather they were purely amazed over the fact that they could physically move around and that the panorama surrounded them. It was interesting to see such amazement over something that I had come to take for granted, and it taught me that I needed to change the experience so that it would be less about the panoramas and more about the digital additions of images and objects. As well as I needed to add the augmented reality to the experience as I had yet to do that.

4.1.2 Pilot Study: Phase Two

The second focus group of my pilot study provided a more in-depth method to test many of the elements proposed for my final implementation. It incorporates all previously explained phases. This time the participants was from the second demographic, the cosplayers. My intentions were to make two focus groups during the same session, however a lack of time prevented me from achieving this. Therefore, only the second demographic were represented during this focus group.

Learning from the first group I had prepared four tablets for our four participants this session. We divided the participants into two groups, one with Amanda and Alex and the other with Joel and Jesper. Henceforth I will refer to them as the competitive group (Alex and Amanda) and the reflective group (Joel and Jesper).

During the first phase, "Where in Skövde?", the participants were clearly excited and slightly nervous. Due to the need for me having to manually change the panoramas during the test however the excitement soon turned to restlessness and slight irritation as they had to wait

between the panoramas without much stimuli. This was a limitation that I was aware of, and unfortunately had little control over. I believe however that this impacted more greatly than I had first thought as it disrupted the flow of the competition. After each group of panoramas, in this focus group I had two groups, I provided a very small presentation of the different panoramas containing some information about the history of the locations. This was far more appreciated than I had initially thought as the participants found it interesting and rewarding to take part of the history.

The personality of the participants impacted more than I had initially thought. The competitive group tended to look more at the concrete aspects of the panoramas, the bigger picture so to speak, with the sole purpose of delivering whatever task we had given them. On the other hand, the reflective group tended to look more at the details and reflected upon them. For example, Joel, a member of the reflective group, commented on a statue that was in the background of one of the panoramas and even tried dating it.

The second phase was more fast paced and competitive than the first one. It was also obvious here that the competitive group liked the second phase far more than the reflective group did as they were more active and excited than the other group. The reflective group seemed more inclined towards irritation rather than enjoyment. One of the participants in the reflective group did not enjoy the phase at all since his preference in game mechanics were not compatible with the mechanics presented.

The third phase was, as previously stated, the most important phase for me and my research. However, the toll that the previous steps had taken on the participants were starting to become apparent as they were starting to show signs of fatigue and, quite frankly, boredom. Indicating that the session had already been too long.

Again the differences in the groups became apparent as the competitive group was more invested in creating the story of the four images than the reflective group. Not that the reflective group were not having fun, but they were far less excited than the other group and did not invest as much time and effort.

The AR element did however entice and interest both groups as they were excited over the fact that they were to interact with the objects themselves. The digital element seemed to contribute to the collective interaction of the groups as they played around with the objects and took pictures of each other interacting with them.

After the session there were several things that I had learned. For example, the session was far too long. The participants were tired after about half of the experience and showed a lack of enthusiasm and involvement in the second part. Also I believe that I had provided too much information before the actual test. I had told them that the reason they had been picked for testing was the fact that they were cosplayers, and created their own costumes. However especially one of the participants were very hung up on the cosplay correlation of the experience and tried constantly to find connections, instead of objectively participating in the experience. I believe that for future tests it will be beneficial to ask participants to join without giving a reason for picking them.

Generally across the groups, among the three phases, their preferences quite surprisingly, leaned towards the first one. I had believed that this would be considered the most relaxed phase and seen more as a warmup than an actual preference. But the reason they liked the

phase was because of the "reward" they received. Knowledge. They found it interesting and enlightening to find out more about the places that they essentially had visited and found this more rewarding than the "points" they had received during the other phases.

For the bigger study it will be interesting to compare both of the target groups to see the differences between them. Will they interact differently with the technology and will they prefer different parts of the experience?

There are other changes in the experience that will be made in preparation for the real study. I believe a redesign of the experience is in order. Drawing on the positive feedback but also trying to perfect the more negative points the first focus groups had made. For example, there were too many different phases. Three turned out to be too many and I believe that two is enough. A clearer red thread is also needed, I believe, as the three phases were too spread out and inconsistent. The fact that all of the participants in the second focus group preferred the first phase as it was the most informative should also be taken into consideration. I will add information as a reward for future iterations.

4.2 Progression

As previously outlined in section 2.7, the artifact will consist of three different phases. During the first phase the users are given a panorama on a mobile device, such as a tablet, and are asked "Where in Skövde?" Basically they are to tell us exactly where in Skövde the panoramas are taken. The idea of this is to create an embodied experience so that the user feels transported to a different location than they currently inhabit.

The second phase serves to create a stronger competitive angle to the experience, and is designed to be fast paced. However, a problem surfaced during the initial testing as due to the technology's limitations we were unable to maintain a higher pace. Therefore, I believe that this phase should be removed completely from the experience.

The third phase is however the phase that serves to answer my question. It is designed to utilize both real world and digital 3d aspects to create a mixed reality setting. The users are to use augmented reality to create four different images with the purpose of telling a story. It is here I will have the opportunity to study how the AR visualizations impact the collective interactions of our users in a mixed reality setting. I will be able to study how they interact, both with each other but also with the visualizations they are presented with. With the result of the pilot study in mind I believe that this phase will have little manipulation and change compared to the other two phases. This part of the experience is important for my research and will persist in a similar way in the study. I believe that this phase would be far more appreciated and favored by users if it had appeared earlier in the test. As it were in the pilot the testers were fatigued when they reached the phase and therefore could no appreciate it to the extent that I believe they could have. As it stands at the moment I also think that this form of design serves to answer my research question in a satisfying way which is why I do not believe that much modification is needed.

The objects themselves all have strong ties to heritage, this being intentional as the purpose is to spark a conversation about the topic. I created a spinning wheel (img 9), an embroidery frame (img 10) and a tapestry (img 11). The semiotics of these objects teach us that they can mean something quite different from their literal definitions and intentions for use. They have abstract identities that allow us to see their literal and symbolic meanings. For example, a

cross can symbolize Christianity for Christians but can also be used to indicate hospitals. The embroidery frame I used for example encompasses a controversial quote, which I chose in order to see how participants would react to it: "Quinnans plaths äro i kijiöketh" or, "the woman's place is in the kitchen". In relation with the other objects I chose, this one is far more direct and provocative and creates a counterpart to see if the reactions became stronger with this more direct approach to attach meanings and stories to objects.

The other two objects were created to be more discrete in their message. The spinning wheel is of a simple design with a flat texture. The spinning wheel itself doesn't say much specifically in terms of heritage, but it generally symbolizes crafting and is associated with a traditional woman's role in making handicrafts. When one thinks of a spinning wheel one might recall old photographs of women working in the comfort of their homes and creating beautiful art in this traditional, handmade way. Since in modern times, the spinning wheel does not have a current association with it (as we no longer use them), I want to see the level at which it can evoke different associations or responses from viewers when they see it, or if it appears rather generic. As a form of visual cue, this would be interesting to know in my research.

Img 9   Img 10   Img 11

I also try to engage collective interactions as a part of my design experiments. They are apparent as, like Krogh & Petersen (2008) explain, there will be only one logical input channel and one logical output channel in my artifact design. By this I mean that the participants will have to share one input channel from the media I create and interact with each other in order to create a "result." I will be observing how they analyze and how they interact together, especially in relation with the mixed reality element as I want to see them engage with digital and actual objects and if there are any distinct differences.

In light of what the pilot study taught me I wish to add another evaluation method to my research to better understand exactly what the users thought of the experience. I believe that mere observation of users will not be enough to understand and properly answer my question. Therefore, I will after the focus group itself conduct qualitative interviews with the participants. As Bryman (2016) discusses in Social Research Methods there are advantages of qualitative interviewing in comparison with participant observation. He argues that there are

issues resistant to observation, that one cannot understand exactly what happens with a participant merely by observing them. In addition, he argues that the reconstruction of events from a participator's viewpoint can be beneficial as it outlines what the user understood of the experience. There is also a greater breadth of coverage: "In participant observation, the researcher is invariably constrained to his or her interactions and observations to a fairly restricted range of people, incidents and localities." In other words, the research will be able to have a broader result rather than the narrow gaze of a researcher's observations.

5 Evaluation

The study will be evaluated based on two evaluation methods, systematic observation and semi structured interviews.

The preparation for the evaluation demanded very little practical changes to the artifact itself. Several changes were however made in the execution of the experience. Instead of writing a formal invitation to testers we solely asked them to come and: "Test how some AR apps work".

One of the early changes I had made referred to the downtime I had experienced during the pilot test. Meaning the time testers spent waiting for me to change settings and load the next section of the phase. This time I gave each of the testers one mobile device, in this case an iPad. The participant would then get to hold onto the iPad and treat it as their own during the remainder of the session. I would explain to them how to change the panoramas and interact with the apps presented. Therefore, the down time where I had to help them make the settings is gone as the participants are instructed how to do it themselves.

The other change from the earlier test I had made is that I will remove the second phase completely and rely on the first and last phase of the experience. So the two parts of the artifacts that remain are "Where in Skövde?" and "Tell me a story!". Both containing two different kinds of AR to get such a broad result as possible.

During the first phase, "Where in Skövde?" testers were given the instructions to open the "Argon" app. I guided them into the first panorama where they got aquatinted with the application. Once I believed that they were ready I guided them to the first panorama of a specific location and they began guessing where in Skövde we were. Once they had given the correct answer I provided them with a capsule of information about the location as a price/reward. Previously I had already divided them into two groups for the first phase, but this time I intended to provide the opportunity of partnership as a reward for correctly naming the final location. Thusly ending the first phase of the experience.

To start the second phase, I instructed them to go to the app Augment and from there guided them to the models I prepared for the session, as outlined in section 2.7. Before giving them a task I let them play around with the models and get used to the application. Once they seemed to fairly freely move around the 3D objects I gave them the task to "Tell me a story!". The testers were instructed to tell a story in four images using the Augment software. They were required to use the four models I created for the experience with the addition of two characters to interact with from the Augment library.

5.1.1 Target groups
For the study I chose to have two different target groups. The reason I chose this is to have contrasting testers to see if there is a difference in reactions and preferences in the two groups. The first group I have named "the cosplayers". This group contains younger participants, from 20-30 years old with an interest in cosplay. The art of cosplay is when fans of a series or movie create the outfit of their favorite character and then dress up as them. The reason I have chosen them as participants is because of the overall theme of the experience. The theme of handicrafts can suit well with cosplayers as they typically rejoice in learning new techniques to better hone their skill as crafters and tailors.

The second group is slightly older, 65-75 with an interest in handicrafts. The biggest difference here is the age gap as well as the general comfortability and habit of mobile technology.

5.2 The Study

This section will be split in two to accurately give a detailed explanation of the two different target groups. See 5.3 for a more in depth analysis between the two groups.

5.2.1 The cosplay group

The study started with our four participants from our first target group, the cosplayers. The four members of the group were, Rebecca, Viktoria, Matilda and Julia. This time, in contrast with the earlier focus groups we had four girls participating, instead of even distribution amongst the sexes. See 5.2.3. Two of the participants had a previous friendship and the other two knew each other to a certain extent. The pairs did not know each other however. This was intentional as it better enabled a collective interaction with the technology. If they knew each other the awkwardness of meeting a new person would be removed and only the impact of reacting with the technology would remain.

Systematic Observation

The testers were invited in and each given an iPad. The session was recorded in order to make sure that I would be able to properly observe the participants after the test to ensure that I would not miss anything.

They were all excited, albeit a bit nervous. Immediately as they received the iPads they were engrossed in the technology. I found early that it was a good decision to let them do all of the work, as they did not become irritated or bored in between the panoramas. I had to instruct them to hold the iPad vertically and wait until all the panoramas had loaded before they started looking around. They were eager and ready to start exploring as soon as possible. They moved around almost immediately and were able to appreciate the panoramas. Even though there were some minor technical difficulties, the fact that they were able to work though the problem really helped to minimize the frustration.

Already at the end of the first phase of the experience they were interested and were actively turning around, trying to find all that was presented in the panoramas. The competitiveness that I had noticed from the earlier tests were much more relaxed and more focused on the panoramas and the details within, rather than winning a competition.

The transfer between the apps were smoother also than earlier test as the testers had to transition from one application to the next without having to sit down and wait for me to do it. The excitement came right back as they started playing around with the 3D models. They moved around and laughed as they realized they could place them in the environment. I deliberately let them explore before I gave them their task. This to ensure that they were comfortable with the models before having to do anything specific with them. They were titling the characters as "him", giving the model more of a real character, rather than an inanimate object.

In contrast from the previous test sessions these participants were not shocked or uninterested in the exercise, but instead seemed quite frankly thrilled at the instructions. They separated into two groups quickly and started whispering about the story they wanted to do. One of the

teams, containing Viktoria and Rebecca, immediately begun posing and acting with the models. However, the other group seemed less happy to actually feature in the pictures, but instead only used the models in their sequence. Again it was very evident by the way they talked about the characters that they were more than just models. They referred to them as "him" instead of "it" constantly. During the phase they kept laughing and moving around the room, seeming to thoroughly enjoy themselves.

Img 12

Semi structured interview

After the session I sent three out of four members out to wait outside, while one stayed with me in the recording room to answer some questions. I only had two. "What was the experience about?" and "what message did the content of the experience give you?" I also asked which of the two different phases they enjoyed the most. The openness of these questions were deliberate as it was important for me to hear what they actually thought the test was about. Did they get the intended subject of heritage? Did they believe that it was about the AR?

I got very different answers from each of the participants. Some of them weren't quite sure what the experience was about, but all were in agreement that the experience was enjoyable. Matilda answered on the first question: "...incorporating history into everyday life. To see how it was before and how it looks now in the same period of time." It was an interesting answer as it almost exactly describes my intended message of the experience.

Julia on the other hand believed it to be more about technology. She was thinking about how it could be used for narration. Interestingly enough she related to what it takes from a picture to be classified as "good quality" in this context. Just like Miller's (2005) theory of double consciousness she referred to the importance of the pictures used being interesting and captivating.

5.2.2 The golden age group
The golden age group, with participants over 65 years, were the second and last focus group of the day. There were supposed to be four participants, but one of the testers were unable to attend so we only ended up with three. So for this groups there were one woman, Marita, and two men, Rune and Kent.

Systematic Observation

Testers were initially much more reserved and laid back in comparison with the earlier group. They were even more reluctant once handed an iPad, since they were not used to handling mobile devices. They started the first phase carefully and were obviously rather unused to the technology. They looked around trying to find support in the other participants and in us, indicating that they were quite unsure. But as they started to become more comfortable with the device, they started slowly moving around, looking at the panoramas and trying to figure out where they were. With this group I prepared another panorama so that they could practice with the device and the panoramas before actually being given a task. This worked well as they were more comfortable with the app when it became time for them to tell me where the locations of the panoramas were. One participant, Rune, was particularly fond of this exercise since he was very familiar with Skövde and its locations that we presented. This meant that he truly scrutinized the images to find all the identifiable landmarks.

When it became time to start the second phase of the experience, testers were much more relaxed and comfortable. They were not as excited as the first group, but were interested in the exercise. They were given time to start getting acquainted with the application and started playing around. They were deeply engrossed in the devices and wanted to look at all of the models. In contrast with the first group they were more inclined towards seeing the objects as *objects* instead of *models*. For example, they identified all of the different 3D tools that were given and started conversing about them.

Img 13

After a little while they started giggling when they were interacting with the models. Especially when they realized that they could actually interact with the characters. When given the task to create a sequence they looked excited and happy, albeit slightly overwhelmed. Due to the fact that there were only three testers I could not split them in two groups but instead they had to create one sequence together all three of them and then show it to me and my colleague so that we could be the one guessing the story.

Semi structured interview

Following the structure of the previous set of interviews, I asked one of the participants to stay with me in the test room for the sole purpose of being able to record the answers. The questions were the same, however the contrast of the answers in comparison with the previous group was interesting.

One of the testers was completely certain that we were creating a game. None of the testers made any sort of connection with the theme of heritage, nor did they ever deviate from the subject of the technology. One of the testers, Marita, was so overwhelmed by the technology that she had no real answers to the questions I asked at all. She found it interesting, but was unable to make any more reflections upon the experience other than that of the technology being new to her.

5.2.3 Missing values

There were a few missing values, ~~but few~~ that had a real impact on the test as a whole. In an ideal setting I would have liked to have an even distribution of the sexes represented in the groups. Specifically, in the cosplay group where only females were represented. But since what I was interested in was the collective interaction in relation to the impact of AR it made little difference.

The second value missing was that the experience is designed to be executed by four participants. However, during the second focus group only three were able to attend. This made a difference, but not drastically so. The first phase no longer demanded teams, as the testers were able to execute the task one by one. The second phase was trickier, but I solved it by just letting the three work together and then me and my colleague being the ones who would have to guess the story. I could still easily study the collective interaction between three participants and it was in fact interesting to see how the technology impacted a larger group.

5.3 Analysis

The impact on the users were quite evident immediately as they got in contact with the augmented 3D models. Users started moving around, trying to interact with the models, and even started directing each other's poses to better match what they saw on the screen. What's more, is that they from the beginning started referring the characters as "him" or "his". Mitchell (2005) talks about double consciousness in images, but I believe this becomes even more apparent in moving 3D models. We see them as far more than what they are, which makes them almost living breathing beings. Something that is even more evident when testers were actually able to interact with them to some extent. During some parts of the test they even started talking with the characters. They were starting to call to them (the 3D characters) when they were out of frame, or started reprimanding them when they were doing something the tester did not want them to do.

The difference in familiarity of mobile technology served as a bigger focal point than I had first anticipated. This is why having two so very different target groups became interesting. The cosplay group had very little problem adapting to the technology and interacting with the AR environment, while the older target group took a bit longer to get used to and comfortable with using the iPads. I believe that the addition of AR into an experience such as this might have been slightly overwhelming for the older test group. The first phase of the experience was more suitable with the theme and delivered the message of heritage more clearly. However, when it

comes to my research of how the AR visualizations impacted their collective interaction it made little difference.

As previously mentioned in 5.2 it was a good decision to let the testers do all the work. With this I am referring to the issue I had with previous focus groups frustration at the technology and the wait for things to load. It greatly disrupted the flow of the experience and it created a constant undertone of irritation during the course of the test. I believe this greatly impacted how users reacted to the technology and the AR. But during these final tests the frustration was all but removed completely which led to a purer reaction. The flow of the experience was relaxed and exciting instead of dull and frustrating. This meant that instead of becoming irritated at the technology when it faltered, testers were able to work around it with a smile on their face. It also meant that they were more open to the images presented to them, and were able to interact and use their imagination on another level.

In relation to the collective interaction of the users I looked at the research of Petersen et al. (2010). They had utilized pairs of two where the testers had previous relations. My testers were all previously acquainted, at least in the individual pairing. This is something that truly enhanced their collective interaction in that they were far more relaxed than they had been if they had been paired with complete strangers. They interacted freely with each other and worked together to achieve the intended goal. What was interesting was that they interacted more with the AR technology than I had anticipated. Instead of being just two in a team, the participants made the 3D characters a part of the group as an individual rather than an object.

5.4 Conclusions

In conclusion, I believe that the notion of Michell (2005) that we have a double consciousness about images is entirely true. In an experience where two users utilize the technology, the impact a well framed 3D model can create is that of a pair of two users becoming a group of three. With this I mean that the use of AR technology can truly make a character come to life. We already have a double consciousness of images, but the ability to actually put them into our world with the use of AR technology can truly make them real.

An important part of this experience was the incorporation of embodiment. It was evident that testers used their whole body to fully experience the panoramas. They had to move around and physically look through the images to understand and adapt to them. This created a more embodied experience and I believe that it helped in creating the impact of the AR visualizations. They had to move with the 3D models and could physically interact with them. This added to the experience as a whole.

I believe that my research has narrowed down the target group of mixed reality experiences. I believe that the first phase of the experience that I was a part of designing is suited for an older demographic. That is not to say that a younger one would not enjoy it. The second phase is better suited for a younger demographic. A demographic where users are familiar with mobile technology and are used to interacting with pictures. In our modern society through the use of social media young people are used to communicating through images. They tell stories of images all the time on the internet and I believe that the addition of AR into this will be a natural progression.

The older demographic that I had for this particular research were not completely unsuitable for the task, as they did not dislike the exercise. I believe however that they became

overwhelmed and therefore found it hard to think of anything but the technology. The younger demographic had an easier time understanding the application and was therefore able to more quickly move on to the actual content of the exercise.

6 Concluding Remarks

6.1 Summary

How do AR visualizations impact users' collective interactions in mixed reality experiences?

The short answer to that is that through collective interaction a pair of users can make AR visualizations come to life. Mixed reality experiences creates a setting where users can create additions to our world. I believe that giving a task to users better help their ability to adapt and utilize the technology that has been presented. For example, just the task of creating a story enables users to think further about the material and use it to their advantage in a more creative way.

I believe that the same test conducted in a non-collective way would not create as big of an impact on users as it did when they were able to converse and interact collectively with the material. However, to fully answer the question one would have to conduct more tests, and include more variables to better understand the nuances of the testers' experiences. A more in-depth analysis on this will be outlined in section 6.3.

The most important piece of observation that came from these tests were that AR seems to be not only new but also a bringer of joy. All testers were happy with the test and had a lot of fun conducting it. There was laughter and happiness during the test when users moved around the AR components and, for example, danced with a dancing skeleton.

I found that users of AR are heavily influenced by each other in the interaction with AR technology. Especially in the type of experience that I have conducted it clearly shows that in a collective experience users are heavily relied on each other, not only to be able to perform the task given, but also to work with the technology presented.

The embodied aspect of the experience became a central part of the result as without being able to move with the characters and interact with them, both body and mind, the impact would have been less significant.

6.2 Discussion

The study I conducted clearly showed that AR visualization is something that creates a big impact on the collective interaction of users. Further study is needed to better understand the extent of this impact. I believe that the way I conducted the test, with the earlier mentioned learning curve, see 5.3, was beneficial to the actual impact of the AR. The mixed reality had already been established with the first phase of the experience, which made the transfer to AR softer and more progressive.

The use of the participatory method in this particular project was useful as it enabled me to create different iterations of the experience, to better see what exactly could create the environment where I could test the impact of the visualizations. I believe that the final iteration created a suitable learning curve. From a soft introduction to virtual reality through the use of panoramas, and then presenting testers with augmented reality through 3D models. This allowed me to see the impact of their collective interactions in a mixed reality experience, but still not overwhelm testers with too much information.

AR visualizations are also interesting since it tests users ingrained knowledge of affordance, as described by Gibson (1979). For example, a chair does not always have to be a chair in the context of virtual reality. Since material does not have to follow our real world physical laws, users can literally improvise with new ideas with the objects.

In relation to the before mentioned iterative process this project does not show more iterations than a normal project would, however that is because of lack of time. The biggest difference this project presented was the introduction of the testing so early in the design process. As soon as we had any form of material we immediately began testing, instead of waiting with the testing until the end of the project when we had a finished product.

6.3 Future Work

An interesting test to do in the future would be to create the same type of experience but removing the AR elements. It would be interesting to see the differences between that experiment and the one I have conducted.

It would also be interesting to utilize semiotics, as described by Howells and Negreiros (2011) to a larger degree. Perhaps by presenting one group of testers with material that was in sharp contrast with the presented theme of the experience. During the test that I conducted only material that suited the theme were presented, with the exception of the characters. Perhaps also in a bigger study a wider range of characters and material could be created both in conjunction with the theme, but also in contrast to it. The impact these visualizations could have would most likely be different than the impact that I saw.

The experience that I helped design is part of a bigger research of digital heritage. I believe that the research conducted here could serve as a base and help in the further research of incorporating heritage and history into our digital world. AR could do wonders in showing what has changed over centuries in a simple way. Both with the help of panoramas, as I did in phase one, but also with the help of adding 3D models as I did in phase 2. The impact shown in my testers clearly proves that AR is something eye catching and interesting, which makes it an ideal tool for creating interest. Be that history, or be that cooking, I believe that it can be warped and changed to light interest regardless of the them.

To understand exactly how big of an impact AR visualizations can have in collective interaction a larger study with the incorporation of more variables should be conducted. As previously mentioned both semiotics and affordance could make a big difference in the way the impact would be received by users. During my research I only had time to create one set of objects, correlating with only one theme. But a bigger study could be conducted where the objects could both be in unison with the chosen theme, or in contrast with it. It would be interesting to see testers reaction if let's say the overall theme is cooking and all the provided material would be in relation to dinosaurs. The impact would be more towards shock than anything else, which could serve as an interesting contrast to that of joy that I encountered.

Further research should also incorporate sound into the experience. Due to the limitation in time and competence I was unable to add sound to the artifact. This is something that I believe could greatly add to the embodiment of the experience. Just having ambience sounds in the background of the panorama, as well as the augmented sections could greatly contribute to the experience.

In conclusion I would say that Virtual Reality and its associated principles, as outlined in section 2, does need more research. We've only scratched the surface of what we can create with this type of technology and there are so many more different ways of utilizing it.

So what uses are there? What type of experiences can we create? Who would benefit from using them? My project has not been able to definitively answer any of these questions as a larger study would be have to conducted. However, I believe that the result of this research has proven that the uses and impacts are bigger than one might imagine. I also believe that I have been able to prove that AR can be used by a wider range of people than anticipated. Not only "younger" or "technologically familiar" users can take pleasure and find uses for this technology. But as with most types of technology the experiences and artefacts created would have to be tailored to the intended target group.

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7 Appendix

Interviews with the participants of the study.

Viktoria

Vad handlade detta om ?

Viktoria: Wow, eftersom det var cosplayare som... Eh... kolla lite hur man kan använda sig av augmented reality för att eh... utveckla cosplay?

Känns ju kanske lite aktuellt då...

Interviewer: Det är mer liksom, vad tyckte *du* det handlade om. Inte vad du tror att *vi* tyckte det handlade om. Utan vad tycker *du*.

Viktoria: Ja men det är ju alltså det det typ känns mest. Eftersom ni informerade även om sånt här och så vidare. Så känns det som att det liksom är en grupp som ofta håller på med att skapa olika grejer och sånt där och kanske så att man kan använda sig utav mönster i Augmented reality och sånt.

Vad för budskap tyckte du att upplevelsens innehåll gav dig?

Viktoria: Augmented reality är roligt.

Vilken fas tyckte du var roligast?

Viktoria: Jaa alltså du såg ju våran fantastiska...

Jaa det var verkligen att man ville fälla en tår... aldrig berättat en så bra berättelse förut med fyra bilder... (detta var sagt sarkastiskt)

Matilda

Vad handlade detta om ?

Matilda: Ja men inkorporera historier i vardagen. Att kunna se hur det var förr och hur det ser ut nu i samma skede.

Vad för budskap tyckte du att upplevelsens innehåll gav dig?

Matilda: Ta vara på det som har hänt.

Vilken fas tyckte du var roligast?

Matilda: Den första var mest intressant, men den andra var roligast.

Julia

Vad handlade detta om ?

Julia: Teknik tror jag. Och kanske... ja jag vet inte. Nej men typ såhär alltså det är ju lite mer virtual reality liksom. Så det var väl mest tekniken jag tänkte på och visa vad den kan och sen också hur man kan använda den för berättande. Också kanske lite vad som krävs av en bild för att man ska känna att... ja kvalitet på bilder typ. Vad man behöver för att kunna använda den här tekniken på ett så bra sett som möjligt.

Vad för budskap tyckte du att upplevelsens innehåll gav dig?

Julia: Menar du första eller andra nu?

Interviewer: Alltihopa.

Julia: Alltihopa? Eh... jag vet inte riktigt alltså för att... första delen tyckte jag var, det var ju lite typ såhär visa lite om Skövde och lite sådär att man ska kanske bli lite mer intresserad. Eh men som helhet kändes det mer typ såhär mycket för att visa upp typ det här kan man göra och även se i spel för att vara kreativ och sådär.

Vilken fas tyckte du var roligast?

Julia: Eh jag tyckte nog andra delen var roligast. Det är roligt att kunna göra någonting och inte bara titta.

Rebecca

Vad handlade detta om ?

Rebecca: Eh... jag är fortfarande lite osäker men... det var... alltså man fick ju liksom en känsla att man var på en plats samtidigt så jag vet inte om man kanske skulle kunna... om man gör cosplays och så, eftersom du frågade efter cosplayare så kanske man har sin cosplay så kanske man kan ta bilderna när man liksom har en annan plats runt sig, eller så. Skulle jag kunna tänka mig? Vilket vore ascoolt! Men...

Vad för budskap tyckte du att upplevelsens innehåll gav dig?

Rebecca: Nej men jag vet inte, jag har inte reflekterat så jätte mycket av hela den här grejen (tittar på skärmen med bilden av Lilly) det var ju såhär, det var ju spännande för jag hade ingen aning om nåt av det. Det låter ju super coolt:

Interviewer: Det var en ganska cool tant alltså

Rebecca: Ja det... verkar så.

Interviewer: Hon var väldigt entreprenör... missionär...

Rebecca: Mmm, mmm. Men men hur jag ska sätta ihop det med det vi gjorde sen vet jag inte riktigt.

Vilken fas tyckte du var roligast?

Rebecca: Ja men jag tyckte det var jätte kul med den där göra historia grejen. Men det var spännande också för jag har aldrig gjort en såndär grej när man liksom snurrar och så är man på en annan plats sådär det var ju super häftigt det med men... den andra delen var väldigt rolig.

Kent

Vad handlade detta om ?

Kent: Vad det handlade om? Ja... det har väl lite med det här med IT-teknik att göra. Kan man väl säga?

Vad för budskap tyckte du att upplevelsens innehåll gav dig?

Kent: Det var ju en klurigare fråga... men det är vad det går att göra idag med 3 dimensionella bilder. Och hur man kan illustrera olika saker.

Vilken fas tyckte du var roligast?

Kent: Ja... nä men det var väl roligt att laborera lite med bilder och fixa till de där så att säga.

Rune

Vad handlade detta om ?

Rune: Ja grunden till ett spel.

Vad för budskap tyckte du att upplevelsens innehåll gav dig?

Rune: Ja det var ju ytterligare en bra fråga. Vad budskapet var från din sida eller från min sida.

Interviewer: Vad för budskap uppfattade du?

Rune: Vad jag uppfattade det...? Ja... Ja... Jag uppfattade det ju som att det var någonting som ni sökte. Någon typ av kärna som ni sökte.

Vilken fas tyckte du var roligast?

Rune: Det är klart att eftersom jag är en gammal Skövde bo så kan jag ju stan va. Och den andre delen eh den är ju svår för att ha en fantasi som med dessa bilder går att göra en historia i samband med en levande produkt. Det var ju enklast för mig var ju första bilden.

Marita

Vad handlade detta om ?

Marita: Oj... eh... Jag vet inte. Jag har ingen datavana över huvud taget eller jag är ingen spelmänniska eller så. Så att jag vet inte faktisk

Vad för budskap tyckte du att upplevelsens innehåll gav dig?

Marita: Mmm... Jag vet inte men jag tänker så här kanske att... att du ska kunna eh jag tänker på när vi körde runt då med de här så du kan se hela Skövde och såvidare eller var du nu är. Jag tänker mig såhär att om en person som själv inte kan ta sig ut kan ändå vara med lite. Så tänker jag.

Vilken fas tyckte du var roligast?

Marita: Alltså eh... ja.. jag vet inte om jag tycker att någon... det var roliga bägge två. Det var en ny upplevelse för mig helt enkelt.