Monsters at the Museum

A medialogy master thesis in 2011

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Abstract:

The design of an enabled space at Kunsten, museum of modern art in Aalborg, has been explored with the aim to provide a pervasive experience for teenagers, who are not interested in museums. Various design methods have been utilized iteratively to create a proof of concept. During the iterations, prototypes have been created and tested to ensure the best design choices were made.

Contents

1 Preface

The following report contains the documentation related to the project Monsters at the Museum, a Medialogy Master Thesis. The project was developed at Aalborg University, department of Architecture, Design & Media Technology at the 10th semester of Medialogy with Specialization in Design.

The report assumes that the reader has a basic understanding of the courses given on previous semesters on Medialogy. During the report, sources will be cited by a [] containing a number corresponding to a source in the bibliography. Figure references, if not created by the author, will be cited by a [F] with a number corresponding to a reference in the list of figures. References to the appendix will be cited by a [A] with a number.

The appendix contains most material utilized during the project, a PDF version of the report and the hi-fi prototype compiled for Android. Unfortunately, a certificate is needed to test the iOS version of the prototype because of Apple's licensing rules. A compiled iOS version can be requested by sending an email with the device's UID number to contact@chrishjorth.com. The appendix contains screenshots and a demo video of the app.

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2 Introduction

"*Museums are the sum of all the platforms in which they are present*" [1, p. 3].

In the 21st century museums have finally realized that visitors need more technological approaches to their exhibits, and thereby interactive experiences, to shed away the reputation of being a dusty, old and dull place. Of course not everyone in the 21st century share this opinion as many people attend museums regularly and show interest to art, history, culture and natural sciences. The problem is that the younger generations tend to have this opinion as shown by a report from Kulturarvsstyrelsen, a board at the Danish Ministry of Culture [2]. Figure 1 shows the results of the report.

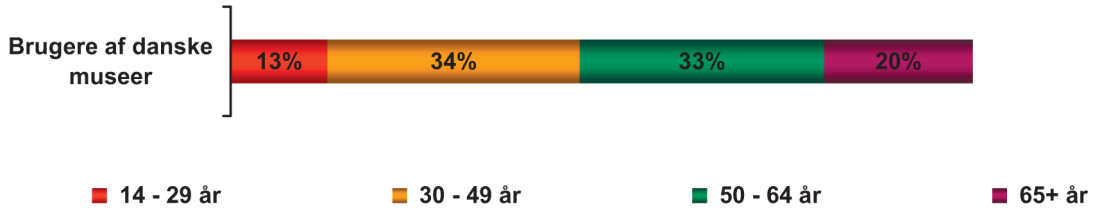

Figure 1. Visitors in Danish museums by age groups [F01].

The goal of museums is to store and convey information about topics strongly relevant to culture such as art, history and science amongst others. They offer visitors the possibility to gather new knowledge, find comfort in memories, participate in engaging activities, socialize and immerse themselves into topics they find interesting [1]. These are important experiences that can open peoples' eyes towards topics that maybe were not taught in school or only briefly mentioned, are not presented in mass media and that people do not search for by themselves. These experiences also enable the visitor to reach a greater understanding about herself or himself as an individual that is part of a culture [A2]. Without museums, the passing of important information about cultures to future generations degrades and it is not possible to predict what effect this can have on society. The movie Idiocracy [3] presents a scary and extreme example of a future society that lost all humanity's accumulated knowledge. Such a future will hopefully never happen but the point is that knowledge of the past through history, of how the world functions through science and of other peoples views of our existence through art are needed in order to better understand our existence as a society and as an individual.

Being a part of the educational and informative channels in society, museums are embracing their responsibility in conveying information to the younger generations by changing themselves, moving from being a passive experience towards becoming an engaging and immersive one. The younger generations are not to blame for finding museums boring since they have become used to extensive exposure to interactive and immersive experiences through computer, console and mobile platforms. As seen in figure 2 an Xbox Kinect game is a hard match for a painting from the realism period, seen from a young teenagers point of view. Imagine being a teenager full of energy and lots of interesting stuff you like to do and become dragged into a museum by school or family and all there is to do is to simply look at paintings that have no apparent relevance to your interests. After such a boring experience, you would probably avoid museums as much as possible.

Today museums present visitors with participatory experiences to engage the visitors and to create personal relationships with them, providing good experiences [4]. The desired outcome is that the visitors feel they achieved something by visiting the museum, and then share their experience with friends and

Figure 2. (a) Kids playing an interactive game on Xbox Kinect [F02]; (b) An artwork from Kunsten [F03]; (c) Kids trying the news reporter experience at the Newseum [F04].

relatives, thereby attract others, and possibly return to the museum in the future. These participatory experiences range from workshops focusing on exploring certain topics to interactive installations to events such as concerts and role-play. Figure 2 shows examples of such activities. A benefit of getting visitors to participate is that this creates an ideal setting for learning and remembering as presented in the theories of play [5], which fits perfectly with the purpose of museums of conveying information.

Besides the participatory activities museums have also embraced the powers of web 2.0 by updating their websites with interactive experiences such as games, virtual tours, blogs, user commenting and are also exploring the possibilities of social networks such as Facebook and Twitter. The web 2.0 technologies enable the museums to reach out to past, present and future visitors regardless of the physical walls of the museum building. Past visitors can keep themselves updated about new exhibits and events, present visitors can enhance their experience by being more informed about the current events and future visitors can get an idea about what the museum has to offer and thereby come to the museum with the right expectations. All these features benefit the people who already are interested in and visit museums. To appeal to the younger audiences museums have started to incorporate games on their websites which can serve to give kids a better opinion of the museum as well as keep them as well as the parents returning to the website.

One of the biggest trends that have emerged in the last couple of years is smartphones and their apps. In Denmark in the first quarter of 2011, 33% of homes own a smartphone according to Danmark Statistik, a Danish statistics organization [6]. The statistics also show that 98% of all homes own a mobile phone, which means there is potential for a very high percentage of homes owning a smartphone in the near future as users upgrade their phones. Thanks to smartphones, we are able to access information and interact with each other and systems over distance from virtually everywhere.

Museums have seen the potential smartphones provide, and have started to have apps designed to act as guides of various sorts. Smartphones have opened a whole new area of possibilities as visitors equipped with a smartphone carry with them a device that can provide audio, pictures, videos, internet connection, location information and advanced graphics. Exactly the availability of location information from the users is evolutionary as it is proving to be an entrance point towards ubiquitous computing [7]. Ubiquitous computing is a paradigm that, as stated by Weiser, "*takes into account the human world and allows the computers themselves to vanish into the background*" [8]. This allows for a more user friendly and unobtrusive computer environment where people can focus on the tasks in their everyday and working lives without being distracted or becoming frustrated with technology. It also supports the notion that computers are everywhere in the environment helping us processing information as a ubiquitous system is context and location aware and has access to stored data about our past actions. The combination of smartphones and cloud computing, a paradigm where data is always accessible through network connection, is therefore the beginning of the ubiquitous era predicted by Weiser. Ubiquitous computing, or ubicomp in short, is also known as pervasive computing [Word9] to emphasize that it is present everywhere in contrast to the personal computer paradigm.

As ubicomp is becoming more common, the possibilities of gaming within this paradigm are also being explored with the field's own term, namely pervasive games. By definition, pervasive games are games that have "*one or more salient features that expand the contractual magic circle of play spatially, temporally, or socially*" [10]. The magic circle is a metaphor for the temporary world people enter when they engage in activities of play according to Huizinga's studies on games and play. This means that a game becomes pervasive when players can enter the temporary world of play of the game from different places, at different times and with different participants. Pervasive games do not necessarily need to use pervasive technologies although the latter can help by rendering the experience more immersive, for example with Augmented Reality as in Epidemic Menace [10]. In this pervasive game, players step into the role of agents that have to track down a lethal virus that has escaped from a research laboratory. The players are divided in two teams who compete against each other about finding all the escaped specimen of the virus first. To carry out the mission players are equipped with various gadgets that aid them and have access to a laboratory they use as command central. Team members rotate between hunting virus specimen and communicating from the command central, as exposure to the virus has to be minimized. Figure 3 shows to agents hunting a virus specimen. Epidemic Menace is not the most pervasive game created, as the expansion of the magic circle's boundaries is limited, although it is a good example of the use of ubicomp technology for gaming. It also is an example of another paradigm known as cross-media. Cross-media refers to "*integrated experiences across multiple media, including the Internet, video and film, broadcast and cable TV, mobile devices, DVD, print, and radio … typically [involving] some high level of audience interactivity*" [11]. This means that the users experience different but related experiences at different times and with different technology.

Museums, as mentioned, are starting to explore the possibilities of providing experiences by other means than at the physical location of the museum, mainly by focusing on web 2.0 technologies. This means that the museum experience is moving towards becoming a cross-media experience. In order to become more appealing for younger audiences ubicomp and pervasive games could prove to be an interesting solution to make museums more interesting for the younger generations, as the museum experience would become more fun and engaging.

Figure 3. Agents hunting virus specimen in the pervasive game Epidemic Menace [F05].

3 Problem specification

As museums have adopted web 2.0 technologies and started delivering more active experiences, the problem of appealing to the younger generation remains. Having games on the museum's web site provides awareness about the museum being children friendly but the best experience should still be physically at the museum. The right solution according to research is to have participating activities combined with the exhibitions [4]. For history and science museums it is quite easy to design immersive experiences for the younger generations as history is a virtually infinite source for story creation and the best way to understand science is by participating in experiments. With art museums, it is more difficult as art requires one to interpret the artwork and generate a personal meaning to truly appreciate it. If a visitor is not able to appreciate the details of an artwork and generate a personal meaning, this visitor will remain a browser, which is a type of visitor identified by the British firm Morris Hargreaves McIntyre [12]. This museum and heritage consultancy firm has identified four types of museum visitors:

- **Browsers**: they wander the exhibit until they find objects that catch their attention and they require and explanation of the object to make meaning. They can turn into followers by encouragement to follow the explanation onto other related objects.

- **Followers**: they want the museum to select objects, which illustrate themes or topics for them to follow and require a narrative explanation of themes to make meaning. They can turn into searchers by encouragement and scope to follow personal interests and thereby search for related objects.

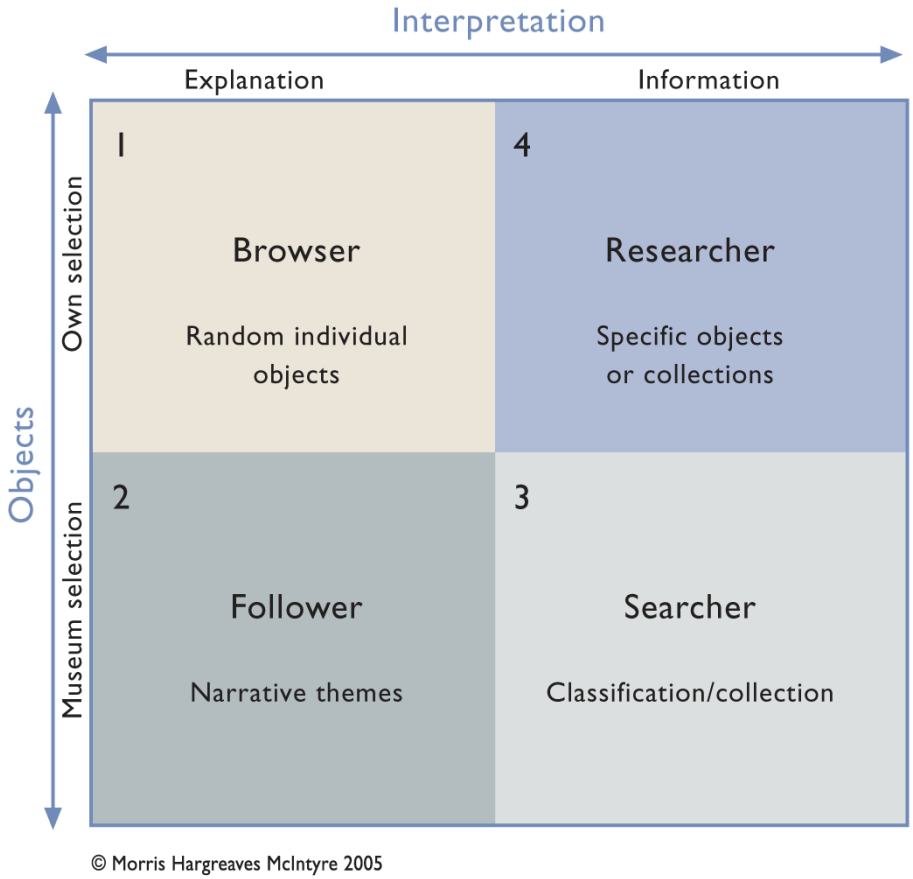

Figure 4. The four types of museum visitors. Visitors start as browsers the first time, and move their way up to become searchers and researchers when they have found topics of interest [F06].

- **Searchers**: they already have a good general understanding of the topic and want to consume all the information available in the exhibit. They can turn into researchers by direction to further sources of information.

- **Researchers**: they are focused specialist visitors who select objects themselves based on their in-depth knowledge of the subject and want access to expert information.

The further visitors advance in this meaning hierarchy the more engaged they become and the more fulfilled they feel after the visit [12]. Figure 4 illustrates the meaning hierarchy. Getting younger visitors interested in artwork can be difficult, as they require activity and engagement since they become easily bored.

Another issue is how to attract the young audiences in the first place. Children and teens usually come to museums because brought by school or family but do not necessarily feel a desire to visit museums, unless they know that there are fun activities.

Kunsten is the museum of modern art of Nordjylland in Denmark and it experiences the same issues of being appealing for younger people. It is a very active museum that has several different themed exhibits a year, a modern website and activities for all visitor groups. One group it has problems engaging is young teens as it is difficult to get them to make meaning of the exhibited art and therefore request an interactive solution that can solve this issue. As expressed in an interview [A02], Kunsten has the following goals for young visitors:

- To provide a social experience for the museum visitors.

- To give the visitors tools to find meaning in the artworks.

- To make sure the visitors experience other ways to view and express the world.

- To build up consciousness of art outside of the museum.

- To help people become self-conscious.

An optimal solution that provides more engaging experiences for young people should take these goals into account as well. Thus the problem statement for this project is:

Design an engaging pervasive experience for young people that can help them make meaning of the exhibited art according to Kunsten's goals.

3.1 Target user analysis

As mentioned previously and stated by a report from the Danish Ministry of Culture [2] the users that needs to become more attracted by museums are young people, more precisely between 14 and 29 years. This group of people is very large with many diverse personalities, which makes it a difficult task to design a concept that appeals for everyone in the group.

For this project, personas [13] were chosen as an initial user analysis tool. Using personas also enables to wait with incorporating end users until a lo-fi prototype is available. The reason for this is that end users typically can have difficulties imagining the solution to their problems [14] and therefore it is best to incorporate them once they can see a concept. Personas allow focusing on the end users without having to incorporate real persons in the design but are also a valuable tool to analyze the users, as information must me collected to create the foundation document. The foundation document contains description and all relevant data about the persona.

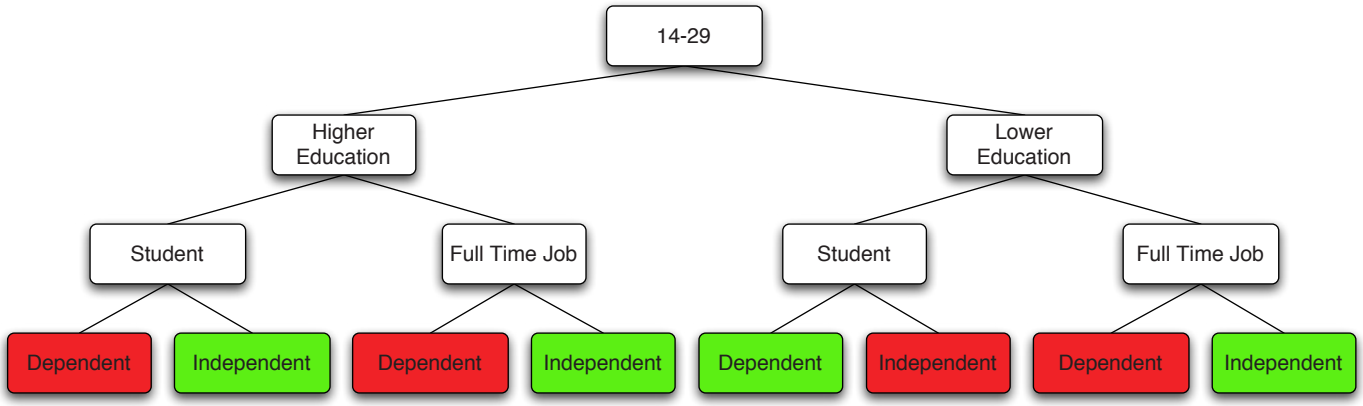

Figure 5. The user group segmentation. Red boxes are excluded segments as they represent rarer cases.

Creating good personas can require extensive work and therefore it is best to keep the number of personas to a minimum. The user group was segmented based on education level and if currently studying or not. The education level has an effect on the interest in art according to the report [2] and students usually have more spare time to visit museums, if not visiting with their school. The segmentation was performed according to the following guidelines:

1. Find the main user characteristics.
2. Find main user groups and prioritize them.
3. Create personas as typical and representative users from the group.
4. Gather information from the users and redesign the user group descriptions and personas according to the new information gathered

These guidelines are adapted to the use of personas from a set of general user segmentation guidelines for user-centered design [15]. The general guidelines required an initial brainstorming session, which was omitted in this case, as the user group is known. Figure 5 illustrates the segmentation. The appendix contains the complete details of the segmentation [A05]. From this segmentation four personas were created, with the aim to design these personas as incorporating most characteristics of the user group. In addition to the foundation documents, empathy maps [16, p. 130-133] were made for each persona in order to focus on what the personas would experience in everyday life. It was found that personas combined with empathy maps give more thorough and lively representations of the end users and following when referring to personas the empathy map is included. The foundation documents and empathy maps of the personas can be seen in the appendix [A05].

At a meeting with Kunsten more details about the target user group were gathered and it was discovered that people above 18 years usually are already interested in art if visiting the museum. For this reason, combined with the results of the first user evaluation, which is described in the [lo-fi prototype section], it was decided to focus mostly on the teenagers of the user group. This decision does not exclude older users since they often enjoy gaming concepts as well, as seen in the gaming industry [17, p. 99-102]. This decision resulted in reducing the number of personas used in design to the two youngest. The youngest persona's empathy map is shown in figure 6.

The personas and particularly the empathy maps show that the target user group does not really care about art and museums, which is why a game concept could be an interesting solution for making

museums more interesting. Games have the ability to turn subjects this user group finds boring into interesting and engaging experiences.

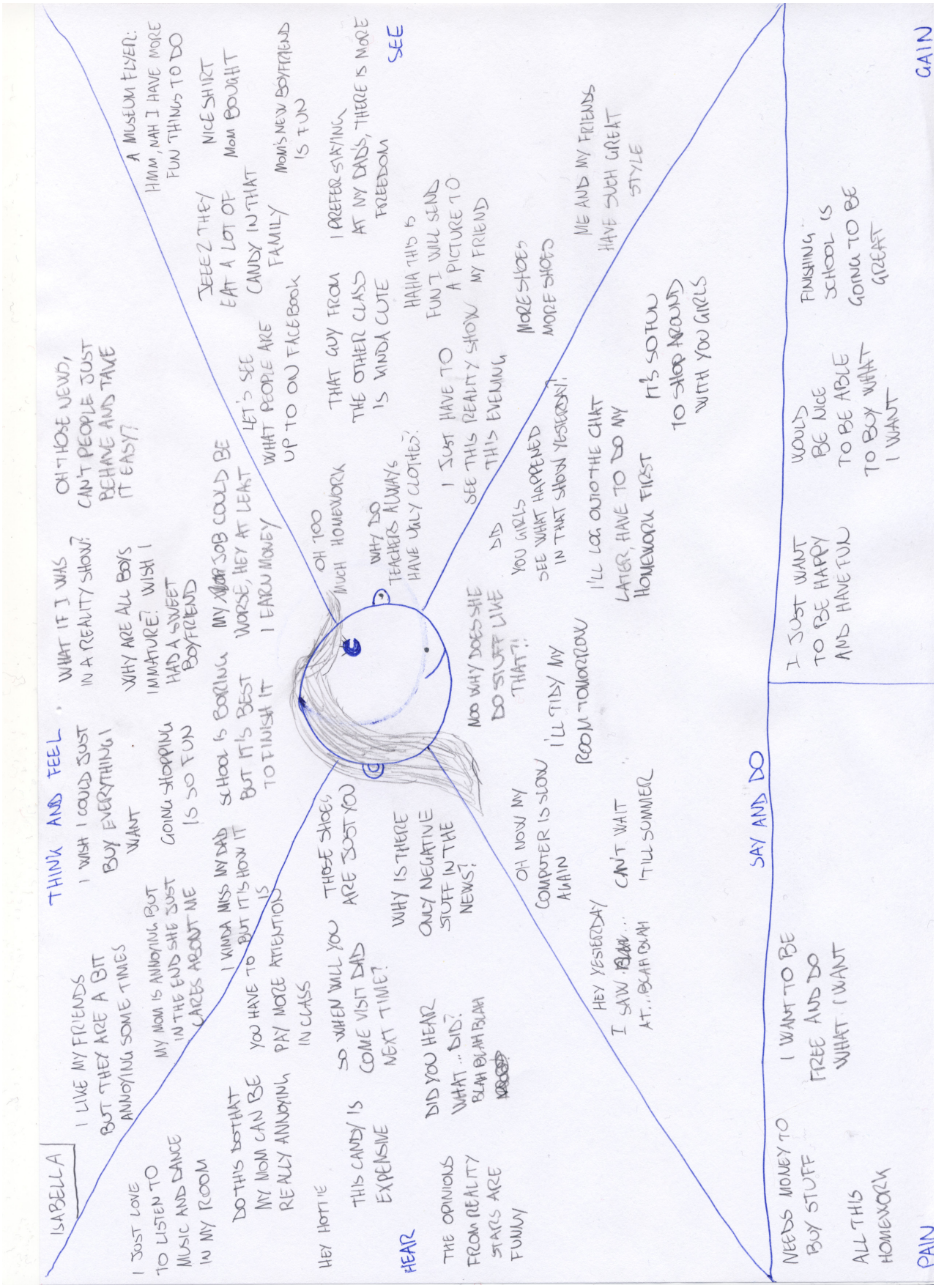

Figure 6. Empathy map for a persona representing a 16 year old girl.

4 State of the art

This section analyzes existing solutions and research related to pervasive technologies, with the possibilities for applications in a museum context.

We are currently in the beginning of the era of ubiquitous computing [8] as more and more people are adopting smartphones, and tablets are also becoming the norm, as shown by the recent boom of the Apple iPad as well as of many Android based tablets. But the availability of the technology is not necessarily enough to cause the masses to enter the ubiquitous era, as appealing content is most needed. A catalyst for ubiquitous content could prove to be the advertising industry as pervasive technology is proving to be the solution to many of the problems that advertisers face [18]. The information about the users that pervasive technologies have access to, allow for the creation of targeted and personalized advertisements, which will possibly result in a more positive effect on users. This of course is debatable as the main drive is sales and users probably would prefer to be without advertising, but the intent is to provide advertising that matches the users needs.

The combination of ubiquitous technology and advertising has resulted in the creation of location based social networks such as Foursquare [19] and SCVNGR [20]. Members of these types of networks are required to check-in at locations and by doing this at business locations such as cafés and burger bars they can receive rewards, in some cases by completing challenges. With the boom of e-commerce local retailers have feared loss of revenue because of the commodity of online shopping, but these new types of social networks and ubicomp are helping retailers innovate. By collaborating with social networks, the retailers provide visitors to their physical stores with new experiences.

Location based social networks are interesting phenomena but the experiences they provide are not very unique to the single locations and therefore would not make the museum experience stand out. In other words, they are a means for visitors to show to their friends that they are at a museum, but they do not attract visitors.

Museums are also starting to adopt ubiquitous technologies and good examples are the solutions from the MoMA, Museum of Modern Art of New York, and the Tate Modern in London. The MoMA has an app available for iOS and Android phones that features a calendar of current and upcoming exhibitions, audio tours, art index with information about the artworks, museum information, the possibility to take snapshots with the smartphone camera and to listen to music from the users personal collection while using the app during a visit. The MoMA also features an app for the iPad tablet, which is focused on a specific exhibit on abstract expressionism. The iPad app provides users with extensive information about the artworks as well as images in high resolution [21]. The MoMA apps' target users are visitors to the museum who want to explore the art further, who have become searchers and researchers, and do not provide experiences for less art enthusiastic and younger visitors. The MoMA apps represent a natural adaptation of ubicomp, where the apps deliver web 2.0 features but in the environment.

The Tate Modern also has an iOS app but it is much more entertainment focused compared to the MoMA app, and therefore more suitable for visitors that are browsers. The app consists in a game of trump where artworks represent the cards. The game can only be played at the museum, as the players need to collect artworks to battle each other in the game. Players collect artworks by typing the id numbers associated with the works into the app. Once a collection is created the players gather and play the trump game in one of three modes: battle, mood and collection. In battle mode artworks have battle scores based on how well the content of the art would fare in a fight. In mood mode battle scores are based on the moods that the art tries to convey. In collection mode, the scores relate to how famous the work of art is, its age and how easy it is to house at the museum [22]. The Tate Trumps app is embracing the possibilities of ubicomp being present in the environment as it creates interaction based on objects present in the physical world, in this

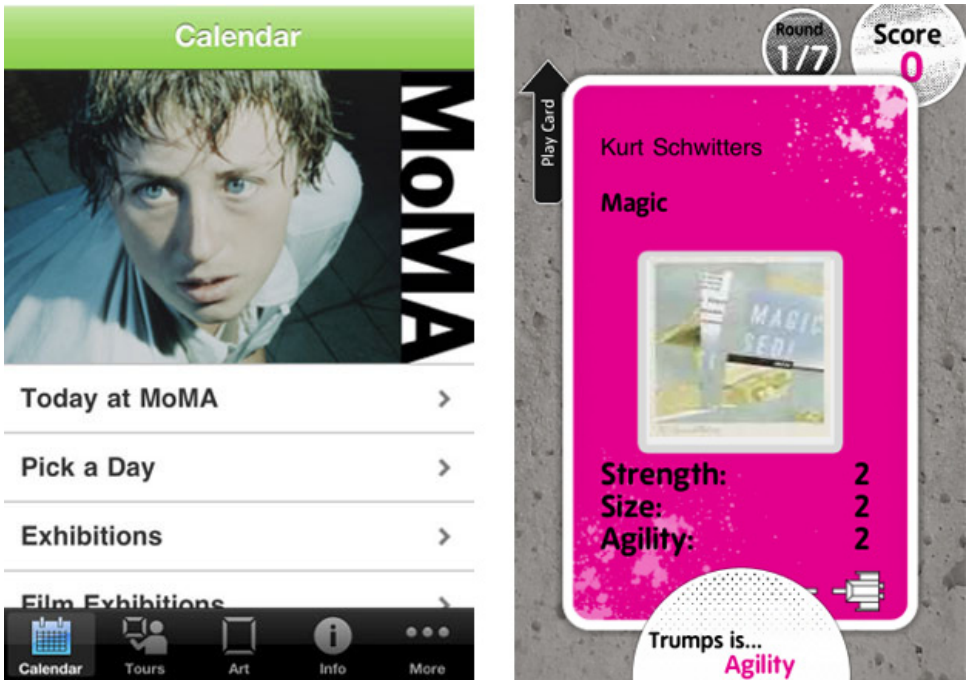

Figure 7. (a) The MoMA iPhone app [F07]; (b) The Tate Trumps app.

case the artworks. Nevertheless the game can only be played inside the Tate Modern for obvious reasons and therefore has no value elsewhere and becomes clutter on a users smartphone. The Tate Trumps app is an example of enabled space, which is "*a physical space that has the ability to interact with mobile or ubiquitous devices and to serve its visitors in completing their tasks*" [23]. This means that enabled space refers to an environment rendered interactive by pervasive computing. Figure 7 shows screenshots of the MoMA iOS app and the Tate Trumps app.

Mixed reality environments [24] are also being explored for the museum context. A Portuguese interactive design firm YDreams has created a proof of concept product that explores the possibilities of a virtual interactive tour guide [25]. In this concept an animated character named VicTour follows the visitors appearing on different screens in the exhibit as they approach and they can see themselves on some of the screens, standing next to the guide. They have also implemented games where users see themselves and VicTour on a projected screen and interact with bubbles by moving. A camera tracks their movements and the bubbles bounce off VicTour as well who also play with the bubbles. This results in the visitors being able to interact directly with the virtual guide besides simply listening. The pervasiveness lies in the fact that VicTour moves between the various screens in the exhibit environment.

Another interesting mixed reality example is the Sukiennice in Krakow, Poland. The Sukiennice had an advertisement firm create an augmented reality experience at the museum and an interesting campaign throughout Krakow city [26]. Around Krakow city there were posters with personalities from the artworks at the museum and a number to send an sms to or call. In return curious users received some details about a story related to the personality on the poster. At the museum visitors received an iPhone that would show the stories in augmented reality videos when pointing the smartphone's camera towards specific tags adjacent to the artworks. This case is a good example of the museum experience breaking the boundaries of the museum's walls, making outside people aware of the experience available.

The solutions proposed by YDreams and the Sukiennice are very interesting as they show good use of pervasive technologies and careful design of the experience. The downside of these solutions is that they are very expensive and difficult to alter after being installed in a museum. This is not feasible for an art

museum with exhibits that change regularly.

Museums are interested in having the museum experience break the boundaries of the museum walls, as it creates awareness of the exhibits, attracts new visitors and keeps a relationship with previous visitors. A solution involving sms messages on mobile phones is the Brightkite wall at the Mattress Factory museum of contemporary art in Pittsburg, Pennsylvania, USA [27]. Brightkite is a service that allows groups of people to share sms' and mms' and applied to the museum it allows past, present and future visitors to share opinions about the exhibits. These opinions are displayed on a screen at the museum. This is an example of communication between users through the museum walls in the real environment, although not much different from what social networking provides.

Solutions for the museums are definitely being explored, as the previous examples show, but the out coming products are typically focused on a single topic and not much on the overall museum experience. The reason could be that pervasive technologies are still relatively new and therefore the focus in on designing the systems and not much the experiences the systems will provide. If the solution only concerns a specific exhibit, it is not an issue, but if it is a permanent installation, its design should fit in with the rest of the museum experiences. Especially when designing pervasive systems this should be considered to avoid the product appearing out of context for the user. This becomes more important as museums move into the direction of becoming educational theme parks as for example the Newseum [28], one of the most interactive museums in the world. The Newseum is a museum about the value of a free press in a free society and tells stories of the world's event in interactive and engaging ways. This museum has a theme that is experiences both at the museum and on its web 2.0 presences and gives visitors the possibility to immerse themselves into the world of reportage from home even before they have been at the museum. Nevertheless providing such an experience can be complicated if a thorough theme is not present at the museum. This project aims to explore the possibility of designing an experience for Kunsten that extends beyond the museum's walls and still is compatible with the ever-changing themes of the exhibits.

5 Concept

The concept presented in this section proposes a solution to the issues outlined in the [problem specification section], and is the outcome from a creativity session where various ideas [A06] were generated. The creativity session was based on the Creative Platform creativity framework [29], which enables to find innovative solutions to specific problems. The idea behind the following concept was selected based on how well it fitted the design principles specified in the [design section]. Also the ideas where evaluated based on the personas to see if they are suitable for the target user group.

The solution had to be gaming related in order to appeal to the target user group and turn the museum into an enabled space in order to incorporate the exhibit into the concept. In addition, the concept had to be applicable to all the areas the museum has a presence and outside the museums walls as well. It is possible to design an experience that is composed of various experiences, as experiences are scalable. The scalability of an experience is defined as "*the infinite amount of smaller user-product interactions and emotional responses (relating to contexts, people, goals and actions at a particular moment) that build up to yield larger and larger experiences over time*" [30]. This means that if experiences are designed in correlation between all the museum's presences they can add up to a larger experience for users willing to engage themselves in all these areas.

Figure 8 shows the museum experience divided into areas. A box represents each area and the main areas are the museum's building, the web, the user's home and the external environment. Each area can have smaller boxes that represent experiences such as an interactive installation or the museums Facebook page. Currently the typical museum experiences happen on the museum's physical box and on the web box, and they are not always linked. If the museum experience has to become pervasive, it must

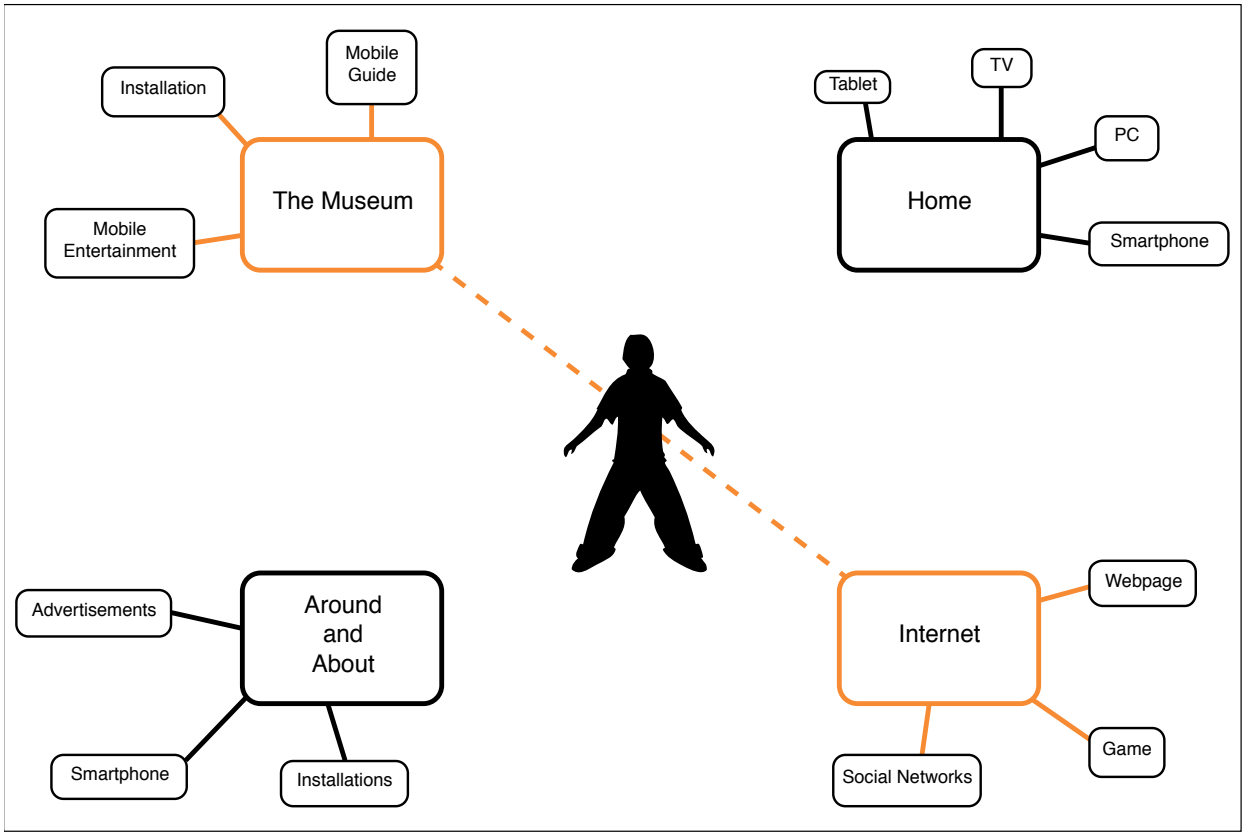

Figure 8. User experience areas and the museums presence.

be extended to the two other boxes. As a pervasive system means a system that can be used everywhere in the environment and is aware of the location, a pervasive experience is an experience that can be accessed everywhere and each location affects the experience. This means that each box can be designed to produce an experience and experiencing all the boxes therefore becomes part of one pervasive experience related to Kunsten. From this point, the notions box and area will be used interchangeably in the context of pervasive systems.

The idea found being the best solution proposition builds on the notions of enabled space, pervasive games and scalable experiences. It is a pervasive virtual pet game called Monsters at the Museum. The difference from normal virtual pet games is that this pet has interchangeable body parts that player have to collect to customize their monster pet.

This concept is composed of following parts:

- The museum as enabled space.
- A pervasive game.
- A touchscreen located at the museum.
- An online game
- Social events

The museum is turned into an enabled space by providing artworks with tags that enable the users to register the artworks. Registering the artworks with their smartphones or iPod touches they get to complete challenges where they can win monster parts. Visitors can decide if they want to use a device with a monster each or they want to share a monster as a group, similarly to a family pet. Body parts for these monsters are also available around and about, outside of the museum where there are art related objects. The game consists in caring for the monster and collecting parts that can be traded with friends.

The body parts' designs are related to the artworks the parts are collected from in order to create a link with the art.

The touchscreen at the museum represents the monsters' home and visitors are able to interact and play with monsters previous visitors have created and own, like a sort of monster zoo. This serves as gallery and as enticement for visitors to take part in the experience. This monster zoo is also viewable from the museum's website. This means that previous, present and future visitors are always able to access their monsters from their smartphones and on the museum's website from home for example. In addition, all events concerning the experience can be shared on social networks, which provide the users with social experiences and can result in making more people aware of the experience at the museum. Figure 9 visualizes this concept.

The focus of this project will be to design the pervasive game at the museum concentrating on the interactions required to turn the museum into an enabled space. This will result in a platform upon which it is possible to design for a pervasive experience. For this reason, there will not be paid much attention to the design of virtual pet game mechanics during the first iterations. The areas of interest are interaction design of the challenges, the relation to the artwork and the museum's goals and the customization of the monster, in order to design for an experience suited for Kunsten. This part of the concept should provide the users with a fun experience that helps them make meaning of the artworks.

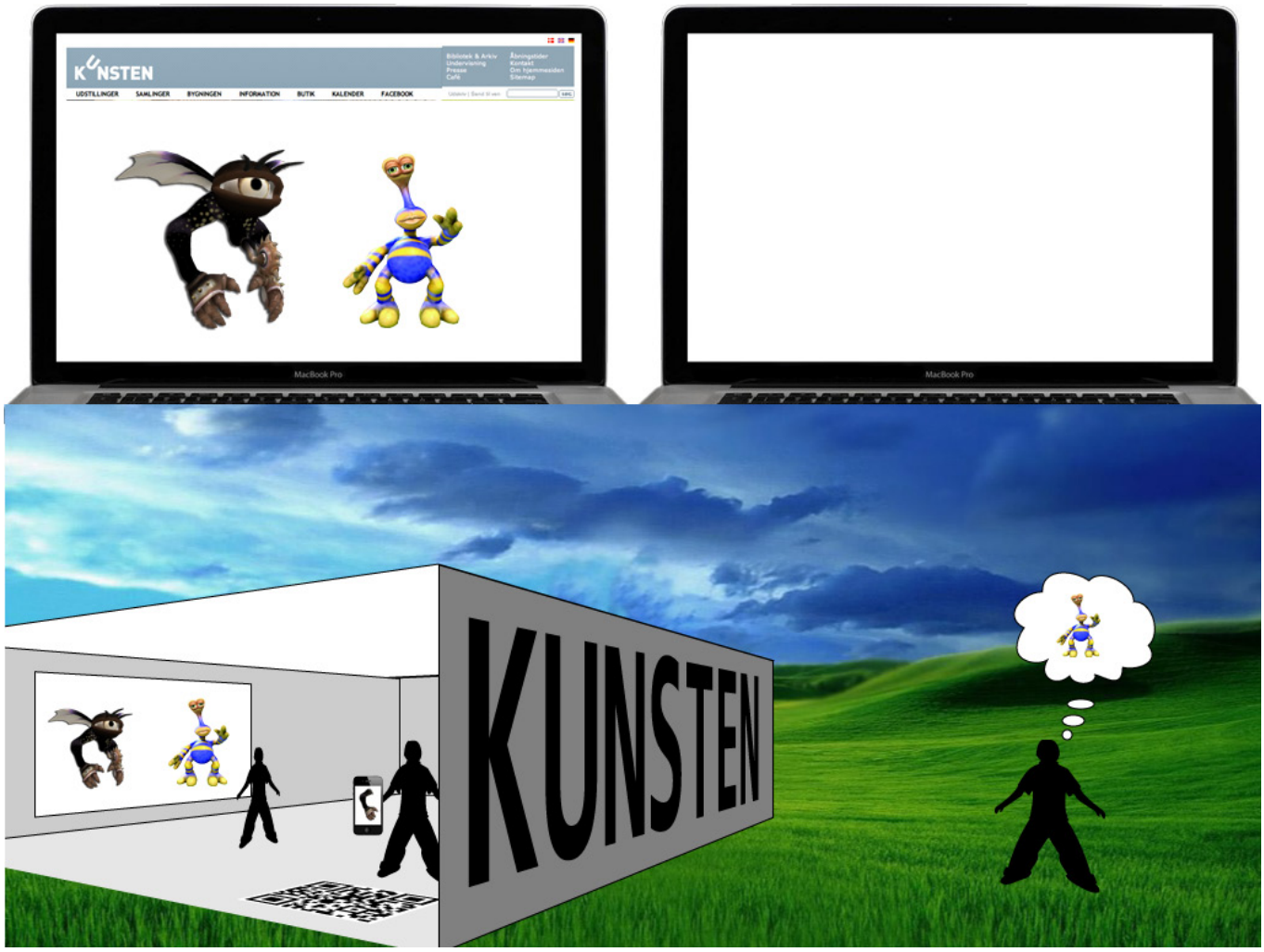

Figure 9. The Monsters at the Museum concept.

6 Design

In this section, the design of the prototype is explained, focusing on the methods used to ensure that the outcome will be the best possible experience for the users and best possible product for the stakeholder, namely Kunsten. The application of these methods in an iterative process will lead to the design of the hi-fi prototype of the concept. As mentioned in the [concept section], this report will only concern the design of the enabled environment at the museum and in part the online presence of the concept, as it is the main interest of Kunsten. Once this platform is designed and developed, it will be possible to design for a truly pervasive experience.

6.1 Experience design principles

Designing a pervasive experience requires design skills from various fields such as experience design, interaction design, interface design, information architecture and user centered design. Years of research in these fields have established several design principles that are good practice to follow since they have proved to produce better designs. These principles were also used to select the concept idea amongst a series of ideas as mentioned in the [concept section].

The principles selected to focus on in this project are based on interaction design principles, experience theory and the museum's goals, and are the following:

6.1.1 Interactions

The most important element in an interactive experience is of course the design of the interactions involved. Interactions with a product can be categorized into three types [30]:

- **Fluent**: these are interactions that are performed almost automatically and are well learned, such as riding a bicycle.

- **Cognitive**: these are interactions that require focus on the product at hand and cause a change in the user. This change can be in the form of gained knowledge or confusion or error. An example is solving a new type of puzzle.

- **Expressive**: these are interactions that help the user form a relationship to a product and require them to change, modify or personalize the product. An example is setting the background image on a smartphone.

Designing interactions as fluent as possible lets the user concentrate on the desired outcomes and thus the interface becomes a transparent tool and not an attention and skill requiring element [31]. The interactions that must be designed as such are the ones concerning the usage of the app and the website. The challenges that users must complete to win monster parts represent cognitive challenges and these must be designed such that they do not cause confusion for the user. Virtual pet game mechanics fall in this category as well. Customizing the monster is an expressive interaction and the users must be able to customize it as much as possible, within reason, so that they have expressive freedom. The customization constraints should be that all monsters share a format that defines the possible placements of body parts and the changes available to the user. This will also allow the comparison of monsters.

6.1.2 Emotions

Emotions are tied to experiences, as positive emotions are en element of good experiences and therefore designs should provoke these emotions in the users [32]. It is still being researched how we produce emotions, but a general framework proposes a categorization of positive emotions into four

dimensions [33]. Negative emotions are not of concern in this context as the aim is to create positive experiences. The four dimensions and the emotions they concern are:

- **Absorption**: these range from private to social absorbing experiences.
- **Potency**: these concern whether the subject feels active and capable.
- **Altruism**: these concern the giving or receiving of something.
- **Spiritual**: these concern matters that are important for the self.

Since emotions are tied to experiences, designing for experiences that aim to produce emotions belonging to these four categories could result in good experiences for the users. In terms of interaction design, these four categories remind of some interaction design concepts. When users are in a state of flow, being the optimal experience where they are completely immersed in the context, they are experiencing absorbing emotions [34]. Flow is achievable when the users' skills continuously match the challenges presented, as figure 10 shows. Keeping users in good balance between their skills and the challenges they are presented to ensure that they do not fall into boredom or anxiety.

Potency refers to emotions experienced when completing challenges and therefore can be a catalyst for achieving the state of flow and thereby absorbing emotions. Games exploit potency in their aim to bring users into a state of flow, as games can be seen as a series of challenges for the users to complete in playful manner [17, p. 37]. Presenting the users with challenges that aim to provoke emotions in this dimension can make the museum visitors feel they have achieved something with the visit.

Emotions in the altruism dimension concern interactions with others and therefore call for social elements in the experience. The design must therefore promote social interactions in all the boxes of the pervasive experience, aiming for co-experiences. Co-experiences arise when the user's experiences and the interpretations made are related to others [30].

The spiritual dimension is related to all emotions having to do with one self. The design should aim for a positive personal experience with the concept. This is related to Donald Norman's view on emotions in

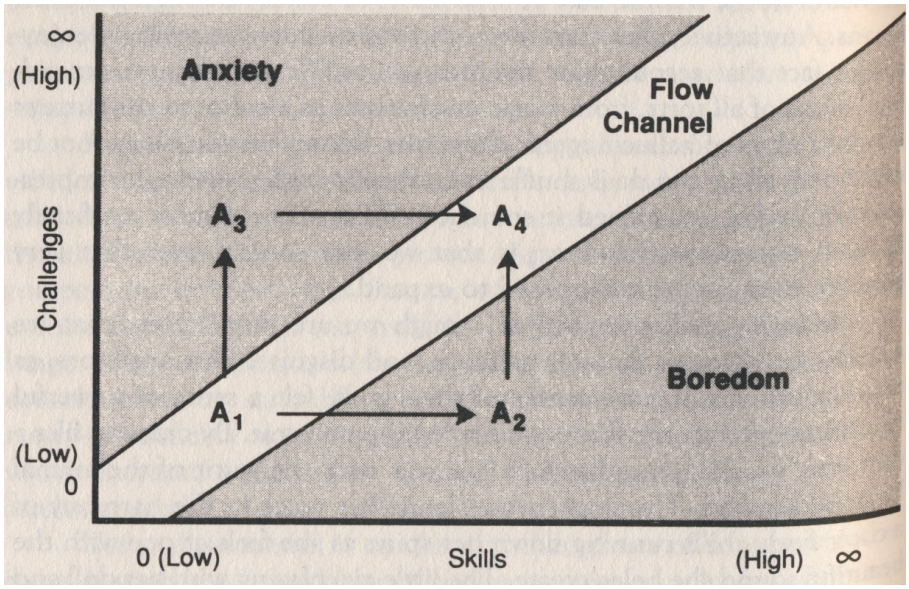

Figure 10. The flow diagram. A1, A2, A3, A4 are user states and A1 and A4 represent states of optimal experience.

design, where he identifies three levels [32] in a design that help produce positive emotions:

- **Visceral design**: concerns the appearance.
- **Behavioral design**: concerns the pleasure and effectiveness of use.
- **Reflective design**: concerns the self-image, personal satisfaction and memories the users connects to the design.

Incorporating these three levels in all parts of the concept can produce spiritual emotions in the users.

6.1.3 Storytelling

Stories have the ability to engage the users, evoke emotions and enrich the context. "*When a story is successfully employed, an audience will experience and recall the events in a personal way*" [35]. This means that stories can provoke emotions of the spiritual dimension in the users. In addition, stories can put the concept into context and help answering questions such as why there are monsters missing body parts at the museum.

Designing a story is not a main priority for early prototypes, as getting the right interaction design is more important, although it provides a context from which to design.

6.1.4 Social

To provide a social experience is one of the goals of the museum and this fits well with provoking emotions as previously mentioned. Designing for co-experiences, will allow groups of users to participate and build upon social relations they create, and in the case of pervasive experiences once they have left the museum as well.

The main social part of the concept is the possibility for the users to trade the monster parts and be able to share their experiences on social networks. Additionally, designing the app so that multiple users can share a single device and complete challenges together can strengthen the social experience at the museum.

6.1.5 Meaning making

One of the main goals of Kunsten is to help the visitors make meaning of the exhibited art. This relates to the previously mentioned expressive interactions and a concern is that if interactions created with the artworks do not make meaning to the users, there cannot be a good experience as outcome. In contrary, if the concept succeeds in helping the visitors making meaning of art, it helps creating a better experience at Kunsten.

Besides the visitors' meanings of the artworks, the interactions with the handheld device and the web presence must make meaning, otherwise the interactions risk creating frustration or removing the incentive for engaging in the interactions. As mentioned, including storytelling in the design can help the users make meaning as it can put the events into context.

While making meaning users relate the object in question to themselves and their identity and thereby get to see the world from other perspectives. The object in question can be an artwork, the handheld device or an interface to the web. Therefore, the design must support these possibilities and not hinder them.

6.1.6 Art focus

There must be focus on the artworks exhibited at the museum as well as art outside of the museum, in order to comply with Kunsten's goals. This means that the design must not take away focus from the art, as

the goal of the concept is to help users make meaning of the art while having fun.

6.1.7 Openness

Kunsten has as goals to be open towards all types of audiences, relate the exhibitions to society and to provide different viewpoints on our existence [A02]. This calls for the design to be accessible by as many users as possible, also users not in the target user group, as they can have a desire to try Monsters at the Museum as well. Since it is a pervasive experience that is being designed towards, the design must also be open for being used in various places not related with the museum, and be able to collaborate with areas of the web not related to Kunsten's website, such as social networks.

The goal of these principles is to ensure that the resulting design has the potential to provide the best experience possible for the users, inside the museum and once they have left.

6.2 Scenario

"*Scenarios are informal stories about user tasks and activities… that enable to express proposed and imagined situations*" [36, p. 554]. The scenario was created as a visual sketch to provide fast reference during the design process. Also keeping it in sketch form allows applying the personas to the scenario more

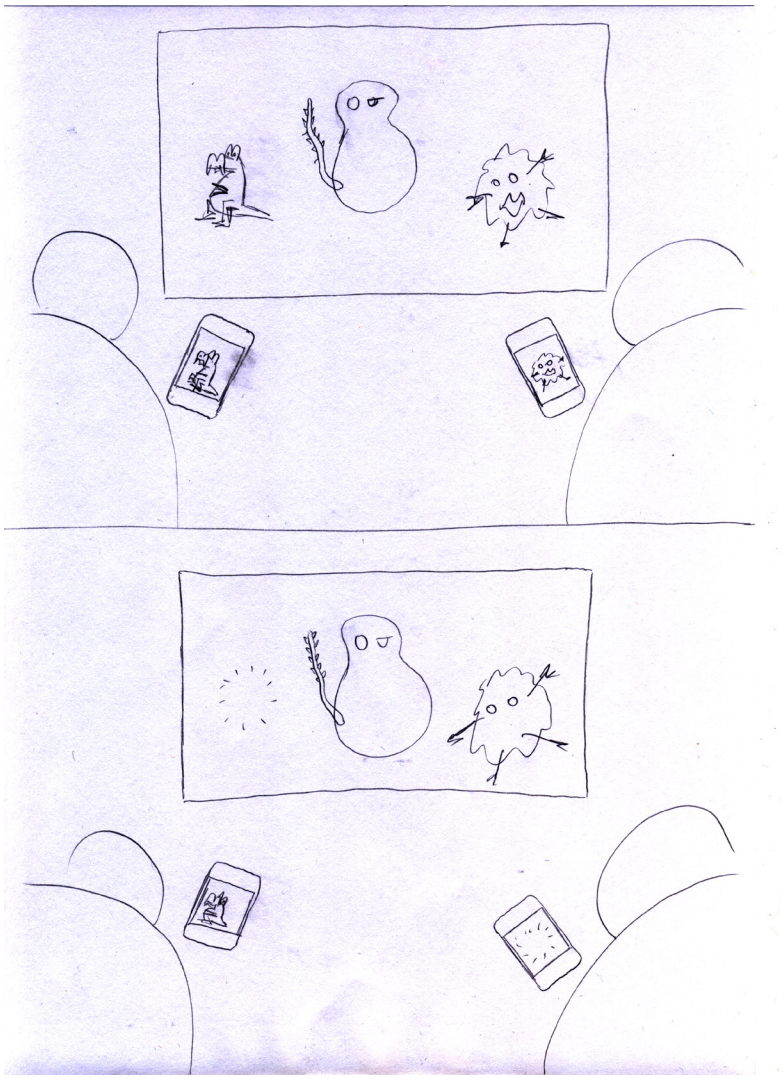

Figure 11. The monster presence issue. (a) The monsters live in all areas of the experience; (b) the monsters can only be in one area at the time.

freely, without the need to create a new scenario sketch for each persona. Thus, the scenario was used as a story platform more than a definite storyboard, which is a common type of scenario [37]. The story platform allowed role-playing with the personas and exploring various outcomes of user actions and system performance, positive outcomes as well as negative outcomes. Role-playing is a method that consists in acting out a scenario pretending to be a user from the target user group [37]. Besides acting as story platform the scenario functioned as a basis reference point for the entire design process. The scenario used is available in the appendix [A07].

The roleplaying revealed a couple of issues about the concept that required attention. It became clear that a decision had to be made about the presence of the monster since it is a ubiquitous environment. The question was whether each monster could appear in more boxes at the same time or if they could move from box to box, called by the users. Figure 11 illustrates the two cases. Both are interesting as in the first one when a user interacts with a monster, friends and other visitors would be able to see the actions in near real time. This would add a cross-reality like element to the concept. Cross-reality is a pervasive computing paradigm where actions in the real environment are mapped to effects in a virtual environment, and vice versa [38]. In the second case the monster becomes more like a real pet as it follows the user onto the box where the users decide to interact. This could be interesting in terms of the virtual pet game experience. The first case was chosen as solution as in terms of interaction it allows the design of co-experiences, and then each box can be seen as a portal window into a parallel monster dimension where the monsters live.

The scenario also allowed focusing on details such as login into the game and the creation of a new monster. The problem arises as it is possible for museum visitors to loan an iPod Touch from Kunsten on which the Monsters at the Museum app will be installed. Each user needs a unique user account in order to be recognized on each box of the pervasive system. Smartphones and the like are usually very personal devices and therefore it is good practice to let the device remember login information. This practice would be unsafe for the museum's iPod Touches as they have multiple users and users should not be able to log into each other's accounts without permission or by accident. Also it is annoying for the users to type in login information on a handheld device each time they logout, which can happen regularly as there are other apps related to Kunsten installed on the device and available to the users. A solution for this issue needs to be found through testing. The prototypes had the museum box experience as focus and therefore a login screen was present each time the app was started.

6.3 App interface design

The interface that renders the experience pervasive and enables the museum environment is the handheld multi-touch device and therefore it will be the focus of the first iterations. In addition, without the box represented by the handheld device the only experience from the concept available at the museum would be the interactive monster screen, which is less interesting as it is static. This section covers design principles and information required to design the app for the museum.

6.3.1 The device

Since Kunsten has iPod Touch devices available for the visitors to loan, this project concentrated on development for iOS. The devices are more specifically iPod Touch 2nd generation that have wireless network support, a built-in speaker and no camera. Figure 12 shows a model of this version of iPod Touch.

Having a multi-touch screen, iOS as operating system and wireless network access these iPod Touches approximate a smartphone and can therefore be used as means to create a pervasive experience. Designing for the iPod Touch means designing for the iOS platform and therefore the design is also perfectly suitable for the iPhone smartphone, and in part for the iPad tablet as well. Once a first version of the pervasive system is implemented other mobile platforms can be explored.

Figure 12. The iPod Touch 2nd Generation [F08].

6.3.2 Touch interface design principles

Apple has formulated a series of Human-Computer Interface design principles that have become good practice to follow when developing apps for the iOS platform [A01]. These have been combined with common interaction design and user experience principles [36] and resulted in the following:

- **Visibility**: the possibilities and the state of the system must always be clear to the user. Providing immediate feedback acknowledges the user's actions. This concept is also known as perceived affordances.

- **User control**: allowing the users to initiate and control actions ensures that they do not perceive the system as unpredictable and thereby become frustrated or confused. Providing freedom to explore and clearly marked emergency exits shows the users how to leave unwanted states.

- **Consistency and standards**: taking advantage of the standards and paradigms of iOS users have become comfortable with, allows them to learn the interface faster and more easily. Preserving this consistency internally in the app as well avoids confusion.

- **Aesthetic integrity and minimalist design**: the appearance of the app must integrate with its function. Displaying only the relevant information helps the users complete their tasks more efficiently.

- **Metaphors**: Using appropriate metaphors to suggest the interaction affordances helps the users understand the app.

- **Direct manipulation**: Exploiting the touch interface by providing direct manipulation of screen objects by gestural interaction for example, presents the user with a more interactive and engaging experi-

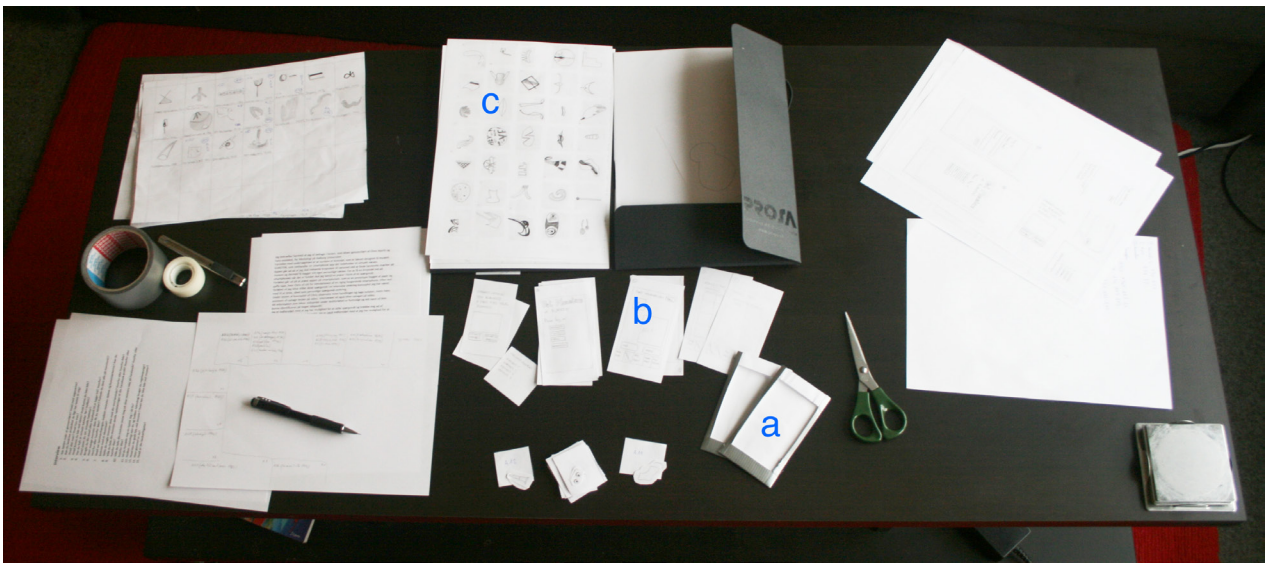

Figure 13. The lo-fi prototype. (a) Gaffa phone; (b) screens; (c) monster parts.

ence. This principle has been criticized [39] as causing a step backwards in usability design, but the main issue is that developers have a tendency to ignore some of the other principles.

- **Recognition rather than recall**: Providing visible references to available objects, actions and options lessen the memory strain on the user and thereby the difficulty of using the app.

- **Flexibility and ease of use**: new users as well as experienced ones should find the usage of the app pleasing. Providing accelerator functions makes repetitive tasks more efficient for experienced users.

These principles were added as a subset to the ones previously specified and was considered when designing the handheld device part of the concept.

6.4 Lo-fi iteration

Based on the design principles and the scenario a lo-fi prototype was built for testing at Kunsten. A lo-fi prototype is a simple, cheap and quick to modify prototype of the concept being designed, that allows for exploration and quick testing of solutions [36]. Figure 13 shows the prototype. The goal of this iteration was to evaluate a first solution in terms of the pervasive experience at the museum, the interface design and the users' reactions towards the concept of pervasive experiences. Content is an important part of the experience and therefore a prototype version of the monster was designed, as well as challenges and monster parts. Once the content had been designed a prototype smartphone was created and then a user test and a cognitive walkthrough were performed.

6.4.1 The monster

To design the monster an initial version of the monster's mechanics had to be designed, answering questions about how body parts could be attached and moved around. The most appropriate form of interaction is letting the users drag the items into place, taking advantage of the touch interface on the handheld device and following the direct manipulation principle. This also gives a more engaging experience compared to assigning positions through a form or button like interface for example.

The monster's body shape was chosen to loosely resemble a snowman type of shape. This idea came from the interactions happening when building a snowman where accessory items are stuck into and

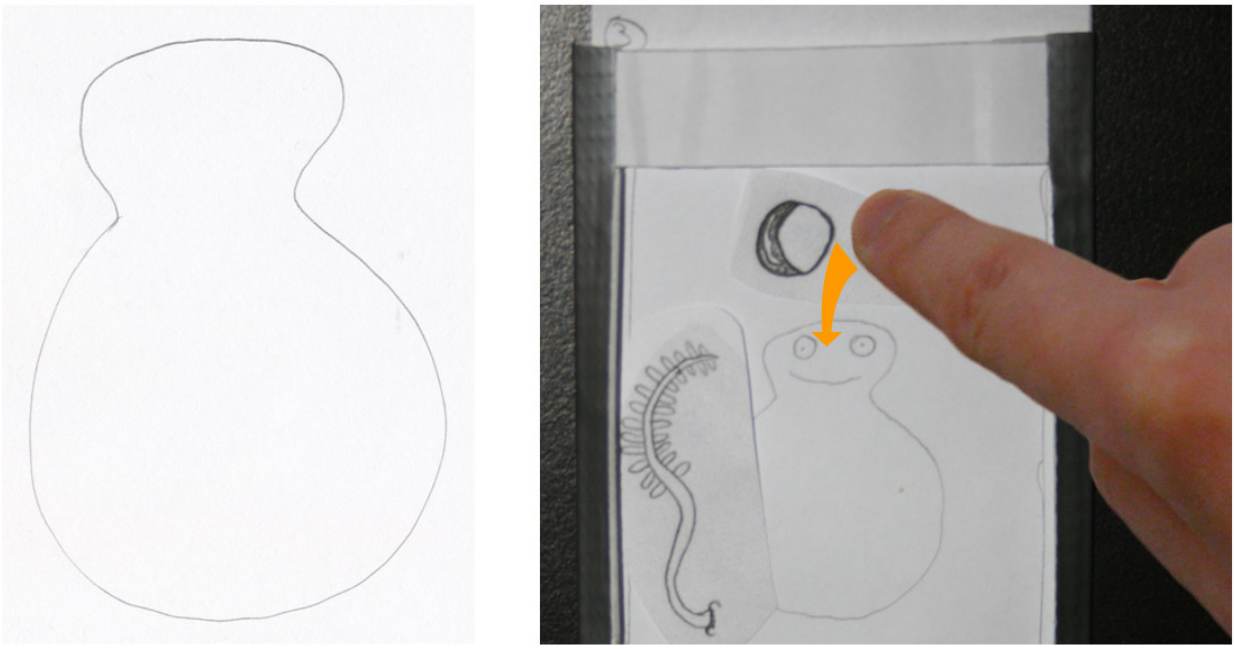

Figure 14. (a) The monster body; (b) the part placement interaction.

attached to the snowman. In addition, this shape is processed by the human mind as resembling a body, when in the right context, as the top is recognizable as a head. These same mental processes allow us to identify extremely simplified cartoons as resembling persons and the ones that allow seeing human features in a snowman. This is because our brains are extremely efficient in processing patterns based on mental models [17, p. 115-117]. This body design was intended for the lo-fi prototype only since it is easy to implement with paper. Figure 14 illustrates the monster body design and the part placement interaction.

6.4.2 The body parts

The body parts are one of the most interesting features of the concept as they are directly related to the artworks. For the prototype a series of artworks exhibited at Kunsten were chosen and for each a body part for the monster was drawn, depending on what the artwork was figuring. The focus was on finding an element in the artwork that could be used as a body part or accessory for the monster. The reason for this is to create a link between the body part and the artwork. The example in figure 15 shows a monster arm inspired by the dragon's claws.

Another benefit of this link to the artworks is that circumvents copyright. The cost of the permission to use photographs of the artworks in an app or other media devices is very expensive, and currently not feasible for museums in Denmark, besides a select range of artworks for their website. By having body parts designed so that they remind of an artwork, it is possible to help the users recall the artworks when reading information about the body part and the artwork it comes from.

6.4.3 The challenges

A part of the concept is that users have to complete challenges in order to acquire parts for their monster. Each artwork included in the concept had a challenge attached. For the lo-fi prototype, the challenges were in the form of questions related to the challenge's artwork. For each question, the users had four answers to choose between, with only one being right. This challenge format was chosen as it requires to focus on details of the artworks, allows guessing and trial and error, and information about the artworks that could be used to create the challenges was available on Kunsten's website. For example the question related to the

Figure 15. (a) St. George and the Dragon by Olaf Rude [F09]; (b) a monster arm inspired from the dragon's claw in the artwork.

artwork *St. George and the Dragon* illustrated in figure 14 was:

Which animal is St. George fighting in the artwork?

For this challenge the possible answers were:

- *A penguin*
- *A horse*
- *A dragon*
- *A crocodile*

The answer is obvious for the reader because the name of the artwork is known, but visitors in the user group rarely pay attention to the artworks' names. This was an observation made in a previous project in collaboration with the museum. Although the challenge is very basic and easy, it requires paying some attention to what the artwork exactly represents or to read the sign accompanying the artwork. Even if simply reading the sign immediately, a natural reaction is to search for the dragon in the artwork and, because of the question, to decide if it resembles a dragon, resulting in the users paying attention to the artwork in a different way. This particular challenge caused some discussion amongst the test persons as discussed in the [lo-fi user evaluation section].

Of course, not all challenges had the answer written so obviously and some required trial and error, a feature chosen in order to evaluate the users' reactions to this situation.

The questions and answers were created based on information available about artworks present on Kunsten's website, which has an online artwork gallery [40]. This means that only art present on Kunsten's website could be used, but this was not an issue as the online gallery contains around 100 artworks.

Figure 16. An artwork tag, with lo-fi monster parts.

6.4.4 Artwork interaction

What makes the Monsters at the Museum app different from common smartphone apps is that it is possible to interact with items from the real environment. As mentioned, to acquire a body part a user must first find an artwork that is included in the concept. Once an artwork has been found, the issue becomes how to let the app recognize which artworks the user is standing in front of. The optimal choice for smartphones is to use QR codes as identifiers for the art since this would only require the user to scan the code with the smartphones camera. QR are codes are basically 2D barcodes. QR codes are also a good choice for pervasive games because they require the user to be at the location, limiting cheating possibilities. RFID tags, which are used with near field communication technologies, provide the same benefits as the QR codes and can be used to create more aesthetically pleasing solutions, but are expensive in terms of hardware.

Unfortunately, the iPod Touch 2nd generation does not have a camera so QR codes are not a possible solution. Numbered tags will approximate the QR code functionality and the users will be required to type in the numbers on the app. In the lo-fi prototype, this translated into the users typing on a paper keyboard popping up on the phone prototype. Entering numbers on a touchscreen device is not optimal as it requires typing and thus there are possibilities for human error. This will be evaluated with working prototypes. Also using text codes enables user to cheat by guessing or sharing codes. Figure 16 shows a lo-fi artwork tag used at Kunsten.

6.4.5 The gaffa-phone

As shown previously in figure 13 smartphone was constructed from gaffa tape, resembling the design of the iPhone so that users will recognize it as a smartphone. Wireframes were used to apply the touch interface design principles and test a first interface design before implementing it in the gaffa-phone. The final wireframes used in the lo-fi prototype can be seen in the appendix [A08].

This first version of the gaffa-phone consisted of eight screens representing the different functionalities of the app: login choice, login input, main monster screen, add part screen, monster part collection, part information, monster customization and share part. Besides the two login screens all the others have a common tab bar, which provides access to the different screens. This was inspired from the default apps

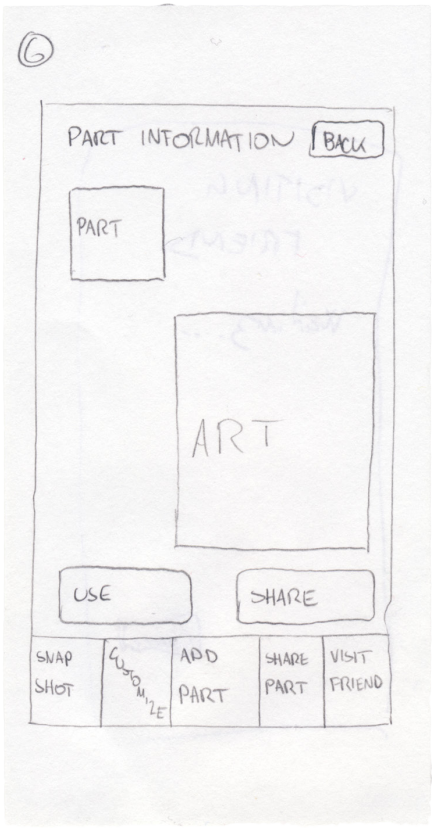

Figure 17. Wireframe of the interface for the lo-fi user evalutation.

that come with iOS. When needed, screen titles and back buttons are placed at the top of the screen, which is also standard on the iOS platform. This placement of the back button can cause confusion for Android users as they are used to a hardware back button placed on the bottom of the smartphones. Figure 17 shows a screen with the tab bar and back button.

The tab bar also features a snapshot button, which takes a snapshot of the monster and uploads it to the server. This was included to indicate to the users that there is also an online part included in the concept.

6.4.6 User evaluation

The goal of this iteration is to test the concept and evaluate the possibilities of it. The evaluation aims to understand if the user group would use such a concept in a museum and if they would use the app on their smartphones in their everyday lives. Their response to the service linking to their social network must also be explored as well as the likeliness of the users visiting the museums website.

The focus is the value for the users of the concept in the museum. Only when the museum part is designed it is possible to proceed to design for the pervasive experience.

The test was designed such that the participants were given a gaffa phone and asked to explore the museum while searching for monster parts for their monster. Since the goals of this test are the reactions to the idea and the possibilities in designing for good experiences, a laboratory test would not make sense as it would require the participants to imagine being at a museum, which might bias the results with the participants personal opinions and expectations for the museum.

The type of data needed is of qualitative nature, which is the reason for the use of qualitative methods. The test facilitator served as operator for the prototype, making the prototype react to the user's actions. For this reason the participants were asked to think-aloud, which is a technique were the participant speaks aloud the intended actions and what is being thought [36]. The facilitator annotated relevant observations

Figure 18. User testing the lo-fi with the test facilitator.

while a cameraman filmed the whole evaluation. After the participants' test of the prototype was completed, they were posed a semi-structured interview. The semi-structured format poses the same agenda for all participant interviews, but also allows exploring specific topics that can arise in the interview [36]. The video recording, observation notes and interview data are available in the appendix [A09] along with a more detailed description of this user evaluation. Figure 18 shows a test participant evaluating the product.

Of the ten recruited test persons only two in the target user group showed up, one of those with his older brother who was asked to test as well as he was below 29 years. The two brothers were asked to evaluate the prototype sharing a gaffa phone. This allowed observing social interactions as well. The data gathered from evaluating on these three participants was deemed enough to continue the design process as some interesting issues became known.

There seemed to be an issue with the information architecture of the app design as the monster parts screen, and therefore the monster information screen, where never accessed by the test participants. This is an important issue as if the users do not see the possibility to view information about the monster part they will not read about the art information as well, since it is displayed on the same screen.

Besides this the participants expressed that they felt the concept was targeted a younger user group. This lead to the decision mentioned in the [target user group section], based on a meeting with Kunsten as well, to focus mostly on the younger part of the target user group. Aiming for teenagers would still allow all other users to enjoy the experience if it is designed as fun, as can be seen in examples such as the Spore [41] computer game and Angry Birds [42] smartphone game. These examples are very cartoonish but all age groups can enjoy them because of the fun game mechanics present. Incorporating fun and engaging game mechanics into the concept is not the focus of this report though and will be left for the design of a final product.

The two brothers' social interaction with the gaffa phone and the challenges was quite interesting as they argued and mocked each other during different challenges, obviously competing to be the cleverest. This shows potential for groups of people having a good experience with a single device.

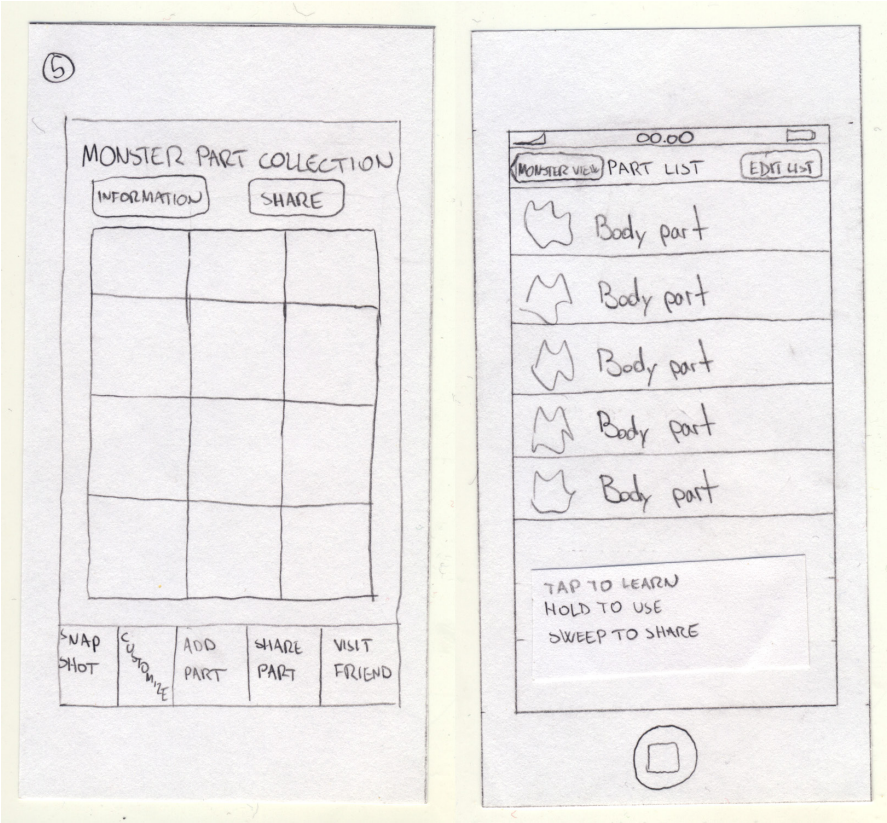

Figure 19. Comparison of the two GUI designs. (a) user evaluation design; (b) Cognitive walkthrough design, with popup.

6.4.7 Redesign

Based on the findings in the user evaluation the app GUI was redesigned focusing on the information architecture. The tab bar was removed from each screen so that it was only present on the main monster screen and with only three tabs: *action*, *add new part* and *body parts*. The reason was that this would divide the information in the app into three navigation paths, organizing the information structure better. A bar was added at the top of each screen informing the user about which screen is being displayed and providing the back button, and snapshot button in the case of the main screen. In addition, information features were introduced to help the user learn the interface. This was in the form of a small popup shown at the bottom of the screen, which then disappears after a couple of seconds. The popup is illustrated in figure 19.

This aesthetic design was changed slightly to be much more alike standard iOS apps compared to the previous version. Figure 19 shows a comparison. The wireframes for this design are available in the appendix [A08].

6.4.8 Cognitive Walkthrough

To evaluate the usability of the app GUI it was chosen to let experts perform a cognitive walkthrough. "*Cognitive walkthroughs involve simulating a user's problem-solving process at each step in the human-computer dialog, checking to see if the user's goals and memory for actions can be assumed to lead to the next correct action*" [36, p. 702]. They are based on the observation that users learn by exploration and therefore can give good insight into how users would use the interface and thereby discover interface problems. Cognitive walkthroughs are good for evaluating the information paths and the steps required by the users to complete specific tasks. The cognitive walkthrough was chosen as method to find solutions for eventual interface issues similar to those found in the user evaluation.

The experts were asked to put themselves in the role of a thirteen-year-old teenager and perform a

Figure 20. Cognitive walkthrough.

series of predefined tasks. For each task, they had to answer the following questions [36, p. 703]:

- Will the correct action be sufficiently evident to the user? (Will the user know what to do to achieve the task?)
- Will the user notice that the correct action is available? (Can users see the button or menu item that they should use for the next action? Is it apparent when it is needed?)
- Will the user associate and interpret the response from the action correctly? (Will users know from the feedback that they have made a correct or incorrect choice of action?)

The tasks they were asked to perform were:

- Send a snapshot
- Add a monster part from a tag
- Add a body part to the monster
- Move an equipped body part to another position
- View an items information

After the walkthrough, a discussion session with each expert was performed, to analyze the issues with the questions that were answered with a no. A picture of the walkthrough being performed can be seen in figure 20 and all gathered data is available in the appendix [A10].

Four experts performed the walkthrough and were 10th semester students from the Master in Medialogy course at Aalborg University, who have five years experience with user interface design and usability methods. Research has found that in expert evaluations a number of experts between three and five will

Issues	Reasons	Solutions
Naming problems: - Action - Add new part - Photo	Confusing names	- Monster - New Challenge - Snapshot
Missing interaction hints	Gestural interactions are difficult to guess	Info popup always accessible
Tag design	Does not show the affordance	Visualize the metaphor
Hold feedback	Could be better	Use vibration
App exploration	Long navigation paths	Include tab bar on each screen

Figure 21. The issues and solutions found with the cognitive walkthrough.

identify around 75% of the total usability problems in an interface [36, p. 689]. This data, combined with the results of the cognitive walkthrough that were showing congruency, resulted in the decision that four experts were enough.

Figure 21 visualizes the issues identified along with solutions found during the discussions.

6.5 Hi-fi design

A hi-fi prototype uses materials that are expected to be found in a final product and results in a prototype that looks and feels like the final thing [36, p. 535-536]. Such a prototype will allow evaluating the experience of Monsters at the Museum and let the users carry out a test without the need for a facilitator. It also allows testing out technical issues before starting the development of a final product. These benefits come with some risks though, the main risk being evaluators tending to focus on superficial features, having too high expectations and that a single bug can halt the entire evaluation.

The aim of the hi-fi prototype is to evaluate the enabled space at Kunsten, since as previously mentioned it is important to get this part designed right before proceeding to the design of the other areas of the pervasive experience. For this reason this hi-fi prototype will be limited to the museum part of the concept and a website that functions as monster gallery. This section explains the application of the design principles to the design of a hi-fi prototype while focusing on minimizing the mentioned risks.

6.5.1 App interface design

A new user interface was designed based on the findings from the user evaluation and the cognitive walkthrough, performed on the lo-fi prototype. Wireframes were created, serving as a reference during the implementation, and these can be seen in the appendix [A11] and in figure 22.

For the hi-fi prototype, the GUI design is mainly the same as for the cognitive walkthrough lo-fi prototype, with the main difference being the tab bar added to each screen, so that users always can access the main areas of the app, a feature found by the experts in the cognitive walkthrough. Some name changes were made including turning "*add new part*" into "*new challenge*" which is a better hint for inserting a number

Figure 22. Wireframes of the hi-fi GUI design. (a) monster screen; (b) new challenge screen; (c) challenge screen; (d) completed challenge screen; (e) monster part list; (f) part info screen.

found on a tag around the museum, as users search for challenges and not for monster parts. Figure 22 illustrates these changes.

This section examines the design principles, according to how they apply to the design of the hi-fi prototype.

Visibility

The screen name is displayed in the top bar for each screen to inform the user. All areas that react to touch such as buttons will lighten up or darken when touched to provide visual feedback. A small icon with *i* as logo will be visible on needed screens to provide users with help information.

User control

The app takes no decisions for the user and the user is free to explore all areas of the user interface. Also all screens are reachable from all screens in the app through the tab bar and presence of back buttons.

Figure 23. The Hybrid Photo-Graphic Composition methos applied to the hi-fi prototype.

Consistency and standards

The tab bar and upper bar are consistent with standard iOS apps and provide consistency within the app. The monster item list and text inputs were designed as the standard iOS apps and particularly the list design will afford scrolling because of this consistency.

Aesthetic integrity and minimalist design

The purpose of the app is to provide interaction with the monster and to allow customization of it. The app also contains a list of all the user's gathered monster items with accompanying information about the artwork the part comes from. For this reason the app's look is a hybrid between a game app and a utility app. The monster screen represents the game part where it is possible to interact with the monster and the other screens are information containers. The content that needs to be delivered to the user is separated into relevant screens to avoid confusion and clutter.

To avoid the risk of the prototype being evaluated on the aesthetics, the monster and monster parts are scanned images taken from the monster and monster parts used for the lo-fi prototype. This technique is inspired from the Hybrid Photo-Graphic Composition method [37, p. 279-281] where sketches are superimposed on photographs. The result is a clear message that the monster is hand drawn, as it is part of a prototype. Therefore, the users will just accept the sketch look and not expect advanced graphics and animations. This technique also provides benefits for the implementation of the prototype, which well be explained in the [implementation section]. Figure 23 shows the result.

Metaphors

Besides standard smartphone metaphors, such as touching a GUI button to "press" it, the only metaphor used in the hi-fi prototype is for attaching and detaching body parts to the monster. Selecting the part and dragging it into position, which is also the natural interaction with a paper monster on a table, performs this interaction. Touching a part attached to the monster for a short period of time releases the part, and dragging it away from the monster and releasing the touch makes the part disappear from the monster

screen. Attaching and removing accessories to and from a snowman is a comparable interaction.

When designing the interactions with the monster more metaphors can be of good use, but this is not the focus of this prototype as they concern the virtual pet game design.

Direct manipulation

The users are required to drag monster parts and the part list as well, and buttons are touched directly. This means that the user manipulates all elements directly.

Recognition rather than recall

The only elements that require recalling are how to position a monster part on the monster and the shortcuts for experienced users, which the next principle describes. The users can be reminded by the shortcuts by selecting the info button, but they are intuitive so should be recalled once tried the first time.

Flexibility and ease of use

A shortcut or accelerator function is present so that experienced users can select monster parts from the list, shown in figure 22.e, without having to go through the part info screen. Holding the touch on the part in the list for a short amount of time does this.

6.5.2 Experience design principles

The following section analyzes how the experience design principles have been applied to the hi-fi prototype.

Interactivity

All the interactions concerning the user interface on the smartphone are fluent as they are native to the platform. The GUI has been designed to follow the platform conventions, which keeps the fluidity. The placement of monster part interactions aims to become fluid because of their intuitive design, so that users can focus on the customization of their monster.

Entering a new challenge also aims to become fluid, as the focus is the content of the challenges. Users enter a new challenge by typing the found challenge code into the app and then the challenge appears. Completing the challenge is a cognitive interaction, as the user has to think about the question posed.

Once the user has acquired a monster part by completing the challenge, customizing the monster is possible. This is an expressive interaction as the user chooses the looks of the monster according to personal taste.

Incorporating these three types of interactions into the prototype should provide a good interactive experience for the end user.

Emotions

The hi-fi prototype aims to trigger emotions in the users as well. The hunt for monster parts and completion of challenges intends provoking absorbing and potency emotions, hopefully bringing the user into a state of flow while at the museum. Altruistic emotions have not been in focus for this iteration, as the trading of monster parts will not be implemented. As seen in the user evaluation of the lo-fi prototype though, visitors can help each other to solve the challenges, which can trigger altruistic emotions.

For the spiritual dimension, the visual design of the prototype has been examined in the [app interface design section]. Since it is a prototype mainly for interaction evaluation, provoking emotions by visceral design is not a focus. The behavioral design focused on providing a pleasing interactive experience, as explained in the [interactivity section]. All interactions are designed to be fluid so that the user can focus on

the task and not be frustrated about the process.

Customizing the monster and having the monster appear on the website so that other users can see it is meant to provoke reflective emotions, as the user explores personal tastes and expose them to others.

Storytelling

A background story has been designed based on the writer's journey [43] and can be read in the appendix [A12]. The background story serves to put the monsters in context at the museum. The story was not implemented in the prototype but serves as context from which to design.

Social

As mentioned, the social elements are not the focus for the hi-fi prototype as the part trading features are not included. The design allows multiple users to participate at the challenges at the museum sharing an iPod Touch or going on a monster part hunt together, with each their device. When at home users who know each other can see the each others monsters on the website.

Meaning Making

The story provided the context in which the monsters had a meaning and therefore the interaction with the artworks had meaning. This was not apparent to the users who tested the prototype, as the story was not implemented, but they received a proper introduction before the test. The challenges entice the users to think about the artworks and look for details, helping them to make their own meaning of the artworks. This was observed during the user evaluation of the lo-fi prototype. The Monsters at the Museum app presents the users with more information about the artworks so that they can find out why a certain answer to a challenge was the right one or just get additional information. The information about the artworks used in the app is the same available at the online art gallery on Kunsten's website [40].

Art Focus

The entire experience design evolved around the idea of interacting with artworks. The monster parts are tightly related to the artworks they come from, so there is extensive focus on the art. Art present outside of the museum was not incorporated in this prototype for the reason that the priority is to first create a good experience inside Kunsten and online.

Openness

The Monsters at the Museum app can also be used to access information about artworks that is normally not readily available at the exhibition by collecting parts and viewing the information. This could be appealing for older users who could also use the app to collect artworks they find interesting.

The prototype is in Danish as the test participants will be Danish speaking. This excludes tourists but this is not important as long as it is only a prototype and the tourists are not test participants.

7 Prototype implementation

Figure 24 shows the components of the hi-fi prototype system. These are: the iPod Touch App, the middleware server, the database, the administration site and the Unity 3D web application.

7.1 The middleware

Middleware is software that handles communication between other software. This is an important part of a pervasive system, as various devices need to communicate. In this context, the iPod Touch app and the web app need to communicate with each other and users need to be able to login on different devices while still being able to access their data.

The most important task of the middleware is to update the database and enable other components to synchronize with the database.

The middleware system was implemented in PHP running on a test server. It sent and received information from the other boxes in the system as XML strings.

7.2 The database

On the same server where the middleware was running a database was present. It stored information about the users, the created monsters, the available monster parts, the available challenges and the owned items. The UML diagram for this database is in the appendix [A11].

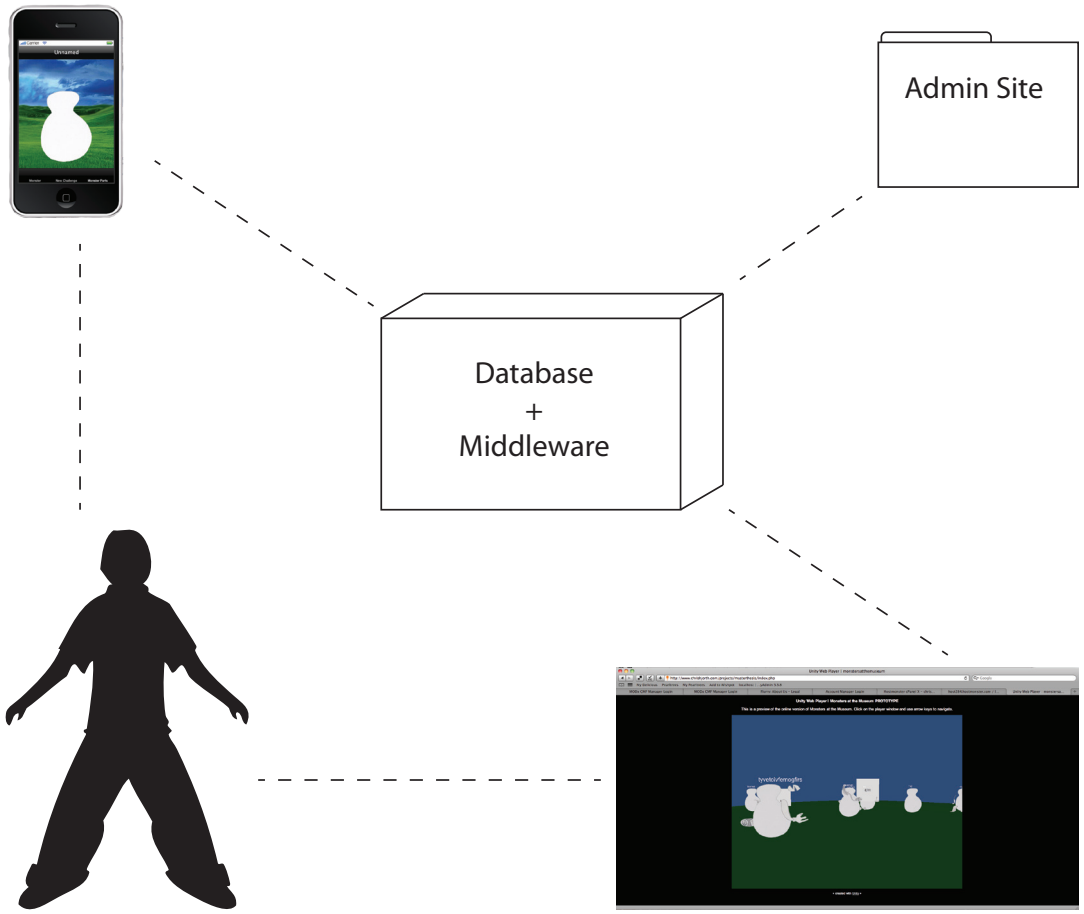

Figure 24. The components of the hi-fi prototype.

7.2.1 The administration site

Museums such as Kunsten change their exhibits quite often and this poses a problem for pervasive systems that rely on exhibited artwork. For this reason a simple administration website was created that communicated with the database and allowed to easily upload new monster part images and to create challenges. The source code of the administration site is available in the appendix [A11].

The use of the sketch graphics for the prototype allows uploading scanned PNG images of monster parts that the various components of the pervasive system can download when needed. This should be a feature for the final product as well, as it allows people from Kunsten to add new items without the need of technical knowledge of the system.

7.3 The web app

The web app was implemented with Unity 3D and displayed a 3D floating island with all the created monsters on it. Figure 25 shows a screenshot of the web app. Users were able to login and view the island with the monsters and navigate using keyboard arrows. The function of the web app for the prototype was to act as monster gallery.

7.4 The iPod Touch app

The app was designed following the principles and incorporating the features described in the [hi-fi prototype design section]. Corona SDK [44] was used for the development of the app as it allows fast development since it is based on the Lua scripting language. This allows creating hi-fi prototypes without having to program in native iOS code. Native code is not desirable for a hi-fi prototype because it is time consuming. Corona SDK includes a constantly growing framework suited for mobile apps and compiles the Lua scripts into native apps so that good performance is achieved.

Other solutions were iProcessing [45], Adobe Flash, Unity 3D and creating a web app for iOS. IProcessing and Adobe Flash provide similar benefits as Corona SDK, although they do not have the amount of features and active community as Corona SDK. Unity 3D would have been an interesting solution as it allows virtually the same code to be used both for the iOS app and the web app. The

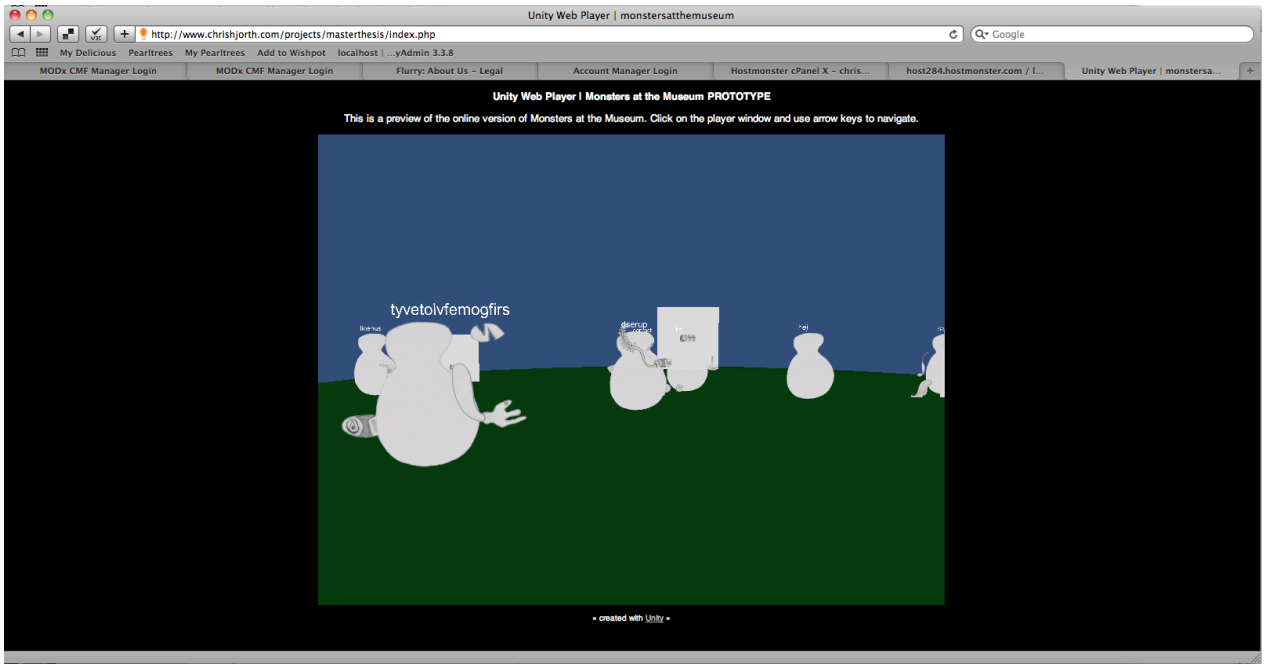

Figure 25. The web app that acts as monster gallery.

downside of Unity 3D is that it is expensive and in this context, it does not provide more of the needed features than Corona SDK. An iOS web app would have provided a fast hi-fi mockup but in terms of performance, it is not feasible. Problems could have arisen with implementing the placement of monster parts in a web app and therefore Corona SDK remained the best option. An UML diagram of the app source code is available in the appendix [A11] along with the source code.

7.4.1 App database

The iPod Touch app has a local database that synchronizes with the online main database. The main reason for this is that the wireless network signal strength is not optimal in all areas inside Kunsten, which can cause an app that needs to synchronize to constantly break. Another issue with having to synchronize constantly is that it is very power consuming in terms of battery life on the handheld devices, which is not desirable for devices that more museum visitors or test participants need to use consecutively. Having a local copy of the relevant records of the main database allows sending and receiving fewer amounts of data to and from the server. The UML diagram for the app database is available in the appendix [A11].

Each record in the tables in the database had a field that was a flag signaling if the record had been changed or not been synchronized. Each time the user logged in, received a new item or changed the monster's appearance the databases synchronized if the network was available, otherwise it synchronized the next time one of these actions were performed. This regular synchronization also allowed near-live updates in the web application. Only near-live updates because the synchronization is triggered by the user's actions and are therefore not real time.

7.4.2 Part placement

The implementation of the part placement interaction was a simplified version of the one described in the [hi-fi prototype design section]. Instead of allowing the users to place the parts anywhere on the monster body, they were restricted to eleven areas on the body, as figure 26 illustrates. The reason was to simplify

Figure 26. Hi-fi prototype part placement.

the implementation of both the iOS app and the web app and the synchronization between the two. In addition, with this solution there was not the need to choose attachment points for each body part in the prototype, as the center point of each part was used.

7.4.3 Interaction logging

A logging system was implemented to log the users' actions, a feature needed for the evaluation. The system used was Flurry [46], which consists in a library to add to the app and an online site where the logs are sent to for analysis. Each time a user interacts with the prototype an event is sent to the Flurry server. For privacy reasons the user names sent to Flurry were cropped.

7.5 Limitations and missing features

Some features included in the design of the hi-fi prototype were down prioritized in the development phase and did not make it to the evaluation. The main feature missing was the hints to the user about how to use the gestural interactions. To compensate for this, these were explained during the introductory phases of the evaluations. Other than this, the story was not implemented as mentioned and it was not possible to scroll to view all information on the part information screen, resulting in some of the text being cropped. All in all these limitations and missing features were not so grave that they would hinder evaluation of the prototype.

8 Evaluation

The evaluation of the hi-fi prototype had three focus areas: the users reaction to the concept, the stakeholder's opinion of the concept and the evaluation of the design principles used. The users reactions and opinions about the concept are important, as they are the end users of the product. Although, their reactions and opinions must not be the main driver behind future design decisions as the evaluation is being done on an early prototype and users might not be able to imagine the final product [14]. Evaluating a hi-fi prototype on end users ensures that the design decisions are going in the right direction. Also contact with the end users allows for evaluating the personas.

The stakeholder's opinion is very important and useful for this project as Kunsten has a thorough knowledge about the end users and what products and services are suitable. This combined with the fact that the stakeholder is looking at a potential future investment will ensure a critical opinion about the prototype they are presented with.

The last focus area is the most important for the design process and consisted in a heuristic evaluation so that the design principles adopted for the design could be evaluated. Also the experts used in heuristic tests are able to imagine the end product and can therefore provide valuable feedback.

8.1 User evaluation

The aim of the user evaluation of the hi-fi prototype was to test the users' reaction to the concept and to observe them experiencing the game. Observing the game gives an idea of the flow [34] of the experience and is useful to detect annoyances. The flow is not possible to evaluate in a lo-fi test, as there are usually too many interruptions from the test facilitator and the test participants are not able to explore the product on their own. The users were not asked to try the online part of the prototype as it was not ready at the time of the test and the focus of the user evaluation was centered on the experience at the museum.

8.1.1 Test design

For the user evaluation of the hi-fi prototype actual visitors to the museum were the most desired therefore no participant recruiting was performed. Instead three different days were selected, based on recommendations from Kunsten about when there would be visitors from the target user group, where visitors would be asked to use the prototype and play the Monsters at the Museum game. It was chosen not to recruit participants for the test because if recruited, their focus would be completely on the prototype, as they might not have had any intention to visit Kunsten otherwise. This can cause a bias in the evaluation of the experience, as the participants are not in the same mental state as a real visitor and therefore might not pay attention to parts of the museum that are not incorporated in the concept. A visitor to the museum might be interested in other elements of the exhibition than those incorporated in the concept and therefore might stop using the prototype to focus on other objects or commit other spontaneous acts that a recruited participant would not. This behavior was observed during the test of a hi-fi prototype of another project at Kunsten and during the user evaluation of the lo-fi prototype described in this report as well. Additionally a real visitor might find the use of the prototype annoying and incompatible with the visitor's expectations of the museum. Such an issue cannot be observed with a recruited participant. If the aim were only to test the interaction, this would not be an issue, but since the goal is to evaluate the experience real visitors are required. The risk of not recruiting participants is that visitors might not want to participate or that visitors in the target user group might not show up at the museum, but it was chosen to take this risk because of the difference in the value of the results the evaluation produces.

It must be emphasized that the user evaluation was about the experience at Kunsten for a user group who normally does not find the museum interesting, and not to evaluate the possibility of the Monsters at

the Museum experience to attract more visitors in the target user group. This is a desired result but is has not been a part of the design process and is left for future iterations.

The test was designed as including three main steps: an introduction, the test of the prototype and the answering of a questionnaire.

For the introductory part the participants received a brief introduction about what they were testing and why, emphasizing that it was not them being tested but the product. Since introductive and learning features of the product had not been implemented in the prototype the test facilitator gave an introduction to the interface and a quick demonstration of what was possible. The evaluation was on the general flow of the game and the users reception of the product and therefore it was best if they knew how to use the prototype.

During the main part of the test the participants were asked to find some body parts for the monster while they were visiting the museum. They were allowed to use the prototype as long as they felt like and were told that they decided when to stop. During the test direct observation and indirect observation were combined [36, p. 342-345]. The test facilitator observed the participants and took notes of noticeable events. The test was designed so that up to five prototypes could be evaluated by participants or groups of participants at the same time. This posed difficulties for the observer since it was impossible to observe five different singles or groups of people moving about the museum at the same time. Therefore the observant was allowed to ask questions to the participants. This setup was also the reason for the indirect observation accomplished with interaction logging implemented in the prototype as described in the [implementation section]. If a user would experience problems or have a negative experience then the interaction log could be searched to verify that interaction issues where not the cause.

After the test, the users had to answer an AttrakDiff [47] questionnaire in order to collect data about their experience in terms of attractiveness of the product. AttrakDiff is a product evaluation questionnaire developed specifically to focus on both the usability and the pleasantness of the experience. It is based on a model that separates the product experience into four elements:

- The product quality intended by the designer.
- The subjective perception and evaluation of the quality.
- The independent pragmatic and hedonic qualities.
- The behavioral and emotional consequences.

This allows measuring the pragmatic quality, the hedonic quality in terms of stimulation, the hedonic quality in terms of identification and the attractiveness of a product. The questionnaire consists of seven step items whose poles are opposite adjectives related to these four measuring elements.

Since the AttrakDiff questionnaire was available only in German and English language, the questionnaire was translated into a Danish version by a translator [A13] and reproduced on Google Docs [48]. Once the participants had answered the questionnaire on Google Docs, the answers where carefully transferred to the AttrakDiff questionnaire.

8.1.2 Results

In the three days planned for the user evaluation only two persons in the target user group visited the museum which was just the minimum required for the AttrakDiff questionnaire to produce a result. This only confirms the reports about the target user group not being interested in museums. One of the two participants was visiting with the person's family who participated actively. The participant's family was composed of a younger sister and a younger brother, both below the minimum age for the target user

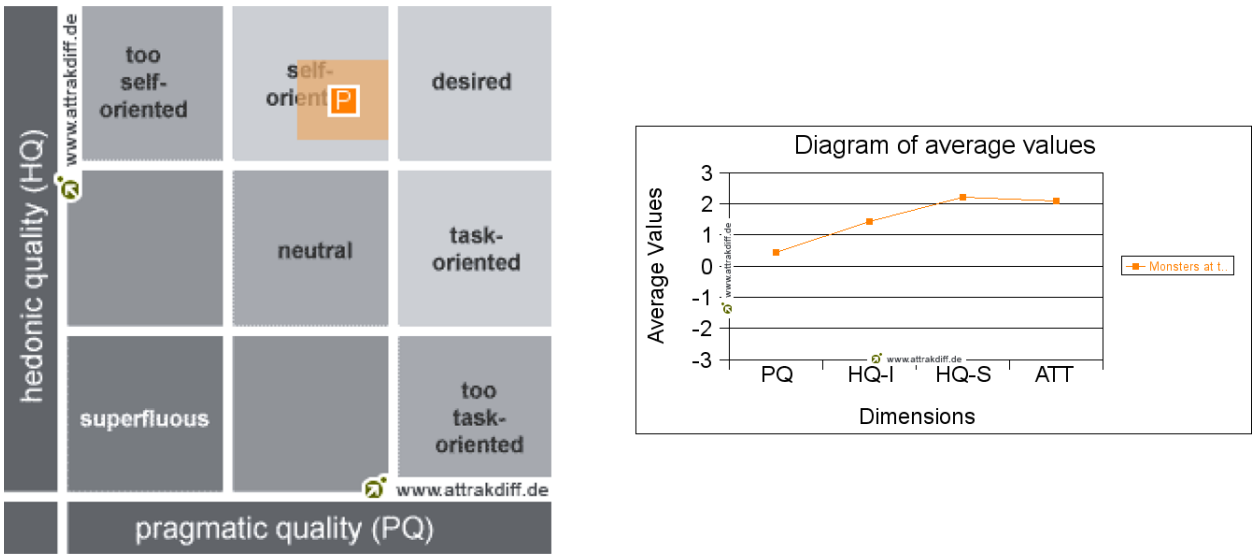

Figure 27. The AttrakDiff results.

group, and a mother and a father. Even if the entire family was actively participating in the test only the person in the target user group for this project was asked to answer the questionnaire. The reason is that the design is being evaluated for the target user group in this iteration, although important observations were made on the family members experience as well. The participant visiting with family will be referred to as P1 and the other participant as P2.

The results from the AttrakDiff questionnaire consist in a portfolio diagram and a graph that can be seen in figure 27. The diagram plots the pragmatic quality against the hedonic quality and shows if the product is a desired solution for the users. The graph shows averaged answers in the four categories.

8.1.3 Observations

Unfortunately, the number of test participants was too low for the results to be of significance, even though AttrakDiff produced a result. Even if AttrakDiff shows a confidence rectangle to compensate, the opinion of only two people is by no means enough to estimate the value of the product for the target user group.

Although it is not possible to say, based on the user evaluation, if the concept is a good solution for the target user group, important observations were made during the test. The main observation is that the test participants spent longer times looking at the paintings involved in challenges compared to other paintings that caught their interest at the museum. This resulted in them discovering details in the artworks that they would not have seen otherwise. This shows that the concept has possibilities to become a tool that helps the museum with its goal to help visitors find meaning in the art exhibited. In figure 28, a participant can be seen focusing on the details of an artwork.

The participant P2 laughed at the body parts received from the completed challenges and P1 laughed at some of the challenge questions and answers. This shows potential for a joyful experience at the museum, which is positive because users will immerse themselves more if they are having fun [49].

The case of P1 was particularly interesting as the whole experience of Monsters at the Museum became social. When the family was introduced to the concept the younger brother started jumping enthusiastically and saying that he had seen the number tags around the museum and that he new where to go. All the children got very eager to find all the monster body parts hidden in the museum and after 45 minutes when the father was reminded that they were free to stop when they felt like it, as the museum closing time was nearing, he replied "*I think this has turned into a sport*". The children where in a clear state of flow and the

Figure 28. User focusing on the details in an artwork.

parents were enjoying to be able to help the children to figure out the answers for the challenges. At some times the parents felt challenged as well and appeared to find the challenges fun. The involvement of the whole family shows potential for the Monsters at the Museum concept to provide social experiences as well, which is also one of the museum's goals for its visitors.

These were the most important observations. The observation notes from the user evaluation can be found in the appendix [A14] where there are other minor details about the experience and mostly minor interface and interaction design issues.

8.2 Stakeholder evaluation

A meeting was set up with Lars Ulrich Hansen who was the contact person from Kunsten during this project, and is the communications officer for the museum. The goal of the meeting was to present the concept through a demo of the hi-fi prototype and afterwards talk about the possibilities of the design. Additionally Lars has thorough knowledge of the behavior and needs of target user group when at the museum. Therefore Lars is able to evaluate the concept in terms of it is a fitting solution for providing a good experience for the target user group at the museum.

Lars explored the Monsters at the Museum app and was presented with the observations from the user test. He understood that the demo was of an early state prototype and that a final product would have very different looks and that the discussion would be about the interaction and experience possibilities for the end users. Following citations extracted from the meeting summarize his opinion about the product.

"*I think that it is a good idea and that kids will find it quite fun to play with while visiting the museum.*"

He compared the app to the image hunt game that the museum is currently offering. In the image hunt, the players are presented with small images that represent a part of an artwork displayed at the museum.

The goal of the hunt is then to find the matching artworks.

"*It is really good that there is a link to the artwork even if it is a virtual pet type of game.*"

The museum is interested in new interactive experiences for the younger audiences and do not necessarily require a strong connection to art as long as the experience fits into the museum's context. The fact that the monster parts are related to artwork and that there is information about the artwork in the app is a positive bonus.

"*I think that children younger than your target user group could enjoy this app as well. If not the parents could play the game with their kids.*"

This scenario had not been thought into the design process and is quite interesting. As stated by Lars parents take their children to art museums to show them the world of art and usually want to tell them about the art on display. The Monsters at the Museum app could prove to be a fun tool for the parents to get their children interested in the artworks.

"*The possibility to easily create and upload new monster parts and create challenges is very important if this is to become a real product, as the displayed art at the museum changes often.*"

This problem of the displayed art changing often, on which there has been only little focus during the two iterations of this project, was felt during the tests of the lo-fi and hi-fi prototypes as some artworks included in the tests had been removed the day of the test. In the case of a final product non-developers must be able to easily create items and add challenges. In future iterations when the aesthetics of the game will be designed this issue will have high priority such that it will be possible for people employed at the museum to add items without breaking the visual design.

In conclusion, there was very positive response from Lars and some valuable information to take into account in future iterations. The Monsters at the Museum app also seem to fit well with the needs of Kunsten and is expected to provide a good experience for the visitors in the target user group. This compensates a bit the lack of data in the user evaluation. Lars also mentioned that he is very interested in seeing this project become a final product available for visitors at Kunsten.

8.3 Heuristic evaluation

The goal of the heuristic evaluation is to verify that the design principles followed are respected and are producing the desired outcome. Four experts in Interaction Design and Human-Computer Interfaces were recruited and asked to evaluate the hi-fi prototype at Kunsten. The experts were 10th semester Medialogy students and different from the ones that performed the cognitive walkthrough on the lo-fi prototype.

8.3.1 Test design

The heuristic evaluation started with introducing the experts to the prototype including a demonstrative completion of a challenge and placement of a new body item. The reason for this is that they need to be familiar with the prototype to be able to evaluate it [36, p. 700-701]. Following the introduction they were given a sheet of paper [A15] with the heuristics explained so that they would know what to focus on and also have the possibility to take notes during the test. The heuristics where based on the design principles used in the design of the concept and the focus of the hi-fi prototype:

- **Visibility of system status**
  The system should always provide appropriate feedback and make the user aware of the system's

state.

- **User control and freedom**
  The user should always be in control and free to explore the app. Exit options should be clearly marked so that users can easily leave unwanted states.

- **Consistency and standards**
  The app's design should be consistent with other iOS multi-touch devices and other apps. The app should be consistent internally as well.

- **Aesthetic integrity and minimalist design**
  The aesthetic design should fit the purpose of the app. There should be no lack of needed information or presence of irrelevant information.

- **Metaphors, match between system and real world**
  The metaphors used for the interactions and the visual design should be familiar to the users and help them understand the affordances.

- **Recognition rather than recall**
  The users should not have to remember available objects, actions and options.

- **Flexibility and ease of use**
  Accelerator functions should be present for more experienced users.

- **Scalable experience**
  The experience should be scalable, which means that it should be possible to connect future experiences to the experience of using Monsters at the Museum.

- **Geometrical experience**
  It should be clear to the users which affordances are available in the environment the experience takes place.

- **Challenges and achievements**
  The challenges and their rewards should match the users' expectations.

- **Social context**
  It should be possible to share the experience with others such as a family or a group of friends.

The first seven heuristics are concerned with the interface and interaction design, while the latter four heuristics are concerned with the possibility of a good experience as outcome. The experience design heuristics would require imagination from the part of the experts and they were made aware of this.

The experts where asked to use the prototype at the museum until they felt they had explored it thoroughly. When done testing the app, they were introduced to the online part of the prototype.

8.3.2 Expert findings

An overview of the findings is shown in figure 29. The complete expert observations can be read in the appendix [A15]. This section will discuss the most relevant findings. Feature suggestions have been left out in this section and will be discussed in the future iterations section if relevant.

Heuristic	Element	Issue
Visibility of system status	Part list	Not possible to see if part is in use
	Hold interaction	Takes too long to respond
	The monster	Should have some initial items attached
	The monster	Missing feedback when part snaps
User control and freedom	Use part button	Can be pressed accidentally and thereby remove an equipped part
Consistency and standards	Back button	Not visible enough
Aesthetic integrity and minimalist design	Overall look	Should resemble a game app more
Metaphors		
Recognition rather than recall		
Flexibility and ease of use	Keyboard	Should appear in number mode
	Tab bar	No possible to select new challenge from the completed screen
Scalable experience	Part info screen	Display information about how the part was acquired
Geometrical experience		
Challenges and achievements	Challenge screen	Missing hints
	Challenge system	Give more special items for challenges completed first try
Social context	Challenge system	Achievements for completing challenges together

Figure 29. The main findings of the heuristic evaluation.

Visibility of system status

The experts all pointed out that a missing feature is the ability to see in the body part list which parts are currently being used on the monster. This would help in part as information but also to avoid accidentally removing an already used part.

The time the prototype is set to listen for a hold touch action from the user proved to be too long, as the experts often mistook the prototype for malfunctioning. As a curiosity, this was not an issue for the users during the user evaluation but the reason could be that users tend to accept interfaces once they are understood.

It was suggested to use colors to hint to the users when a body part is snapped in place. This could be adding a colored halo to the body part for example.

The experts found that the monster should start out with a couple of items attached in order for users to be able to explore the app and have an idea of what they can achieve.

Aesthetic integrity and minimalistic design

Two of the experts pointed out that the visual design could be more seamless and resemble more a game app than a standard iOS app. This would also allow to focus more on the monster on the monster screen, making the upper bar and the tab bar disappear and therefore having more space to visualize the monster and interact with it.

One of the experts insisted that the app could be designed with less screens and more gestural interaction and generally focusing on a more lively interaction design. This is definitely a point to consider for the next iteration.

The experts felt that the type of the body parts collected was missing, for example if a part is an arm or a mouth. The design intended to let users be free and creative with the placement of body parts on the monster, but it could be that some users need cues.

Flexibility and ease of use

All experts found that the keyboard should appear already set in number mode upon entering a new challenge number. This issue was overlooked during the implementation of the prototype, although it is not known at this moment if Corona SDK supports this or if a solution must wait for a native code implementation.

It became annoying for the experts that is was not possible to start a new challenge directly from the

completed challenge screen, as users currently have to exit the completed challenge screen first. This was particularly annoying when artworks with challenges attached were near each other at the museum. In addition, it would be annoying when users decide to collect many parts first and then focus on placing the parts at a later moment.

Scalable experience

One of the experts found that it could be nice to have information about how a body part was acquired in the part info screen. This could help recall the artwork the part comes from and thereby also help remember the experience in a future occasion.

Geometrical experience

No findings for this heuristic suggests that it is clear that the tags show that the accompanying artwork has a challenge attached.

Challenges and achievements

All experts found it frustrating that there were no hints to the challenge answers, besides in the part info screen once the challenge had been answered by trial and error in this case. Presenting hints in the form of information about the artwork to help the user could prove to be a solution and maybe help users to make meaning of the artwork in question. Currently there is a risk that users do not read the part info screen. An interesting observation is though that the participants in the user evaluation did not notice the lack of hints as an issue at all. The experts have an important observation, but their frustration could also be caused by the fact that it is annoying to get answers wrong in the role of an expert. This is definitely something to consider in the next iteration.

They also suggested giving more special or rare body parts to users getting the answer right at first attempt or having a point system. This could also prevent users from adopting trial and error methods, as well as introduce some competition.

Social context

Introducing more competition as stated for the previous heuristic could be interesting. It was also suggested that users could get special body parts or achievements for completing challenges together, each on their device for example.

8.4 Future iterations

A user evaluation with a satisfying number of participants is desired as it will prove that the design principles work and that the target user group can have a good experience at the museum with this concept. The stakeholders opinion is was matters most in order to turn this project into a real product, but to be sure that the users will have an enjoyable experience a user evaluation is needed. This is achievable with a more stable prototype that can run for a longer period at Kunsten and a computer where visitors can answer the AttrakDiff questionnaire. As a part of the next iteration, test participants will be recruited to have a user evaluation that confirms the opinions of the stakeholder and the experts that the design is going in the right direction.

The focus of the next iteration is to start developing a final product for Kunsten based on the current prototype. The stakeholder and the experts have found that the concept is mature enough. Solutions will be found for the issues revealed by the heuristic test and implemented directly since no major changes to the interface are required. An interesting addition found in the heuristic evaluation is to use vibration of the device to provide feedback. This is interesting feedback design that unfortunately has not been

experimented with much on the iOS platform. Contemporarily, prototypes will be made to evaluate the features that were not included in the evaluated prototype such as the trading of monster parts and the sharing of events on social networks.

9 Further research

This project has shown that it is possible to design for good experiences at museums while incorporating the exhibits. It has not been possible to evaluate the actual experiences of the users as experiences are very subjective and extensive evaluation is needed. Once a stable prototype that can run on its own is achieved, evaluating the experience will be in focus in order to be able to compare the solution with others. Although, the opinion of the stakeholder and the experts point that the design is going in the right direction.

The focus has been majorly on enabling the museum space at Kunsten, as this will function as basis for designing a pervasive experience. To create the pervasive experience the web app must be completed and rendered more interactive, linking to social networks must be implemented and art outside of the museum must be incorporated. Additionally, designing the game mechanics of the virtual monster pet can create an experience that is still linked to the museum experience, but that the users no not actually need to be in an area with art to enjoy.

There is good potential for experimenting with game mechanics and especially in the context of social gaming. The trading of monster parts and linking to social networks has been mentioned. An interesting possibility to explore is the notion of the monsters being able to “jump” between handheld devices. This means that when to users are sharing a location they can see each other’s monsters together with their own on the devices, playing with each other.

Another interesting possibility is to model the monster’s personality based on the equipped parts. For example, having a part that originated from a surrealistic painting will result in the monster having a more unpredictable and borderline like personality.

If an enjoyable virtual pet game is created then there is the possibility that users will start using the app for the fun of the virtual monster without the intention to visit the museum. This could result in the game attracting more visitors to the museum, as the users will want more monster parts. This would be an interesting development to evaluate.

On sight, this concept can be implemented to other museums and other businesses that have trouble with attracting this target user group as well. With motives that are more commercial, it can also be adapted to function with retail, so that monster parts are available at certain shops. For this development though, it must be ensured that the monster parts available at museums are more worth than the ones in retail stores, otherwise young people will continue not going to museums.

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11 Figure credits

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[F02] http://www.xbox.com:80/en-US/kinect

[F03] From Kunsten's online artwork gallery http://www.kunsten.dk/Default.aspx?ID=64

[F04] From the Newseums photostream on Flickr http://www.flickr.com/photos/newseum/

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