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Design an Engaging Interactive Experience for People with Dementia

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Abstract

The population of the world is increasing resulting in a higher number of people dealing with dementia—whether being diagnosed with it or taking care of someone that is diagnosed with it. This master thesis aims to investigate which types of multi-media technology-based experiences can improve the quality of life for people with dementia.

To reach the goal of the thesis—investigation will be done through different iterations of a design method; divergence, transformation and convergence. These iterations will include observations, interviews and using personas as a tool to design.

The results from the methods were used to create a high fidelity prototype which was evaluated by an expert in the field of dementia.

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1

Introduction

This thesis is performed at Barcelona School of Informatics, Polytechnic University of Catalonia. The project is carried out in collaboration with the Technical Research care facility for Dependency Care and Autonomous Living. The goal with the thesis is to design an experience for people with dementia that could possibly improve their quality of life. In order to achieve this goal, composition and analyzes of different design studies including areas of how experiences can affect and engage people. Additional studies observing the actual behaviour- and living-patterns of people with dementia, will be conducted. As a complement to this, extensive literature studies will be performed in order to get increased knowledge of relevant research in the area and more specifically how technology can be used to enrich the living standards of both elderly suffering from dementia and elderly in general.

1.1 Background

The topic of Interaction Design has become wider and more used in today's society. There is not a single device or environment in technology that does not comprise the science of interaction design. This thesis will have a focus on providing a rationale for selecting and designing interactive, engaging and gamified activities while working towards improving the lives of people with dementia. Dementia is a brain disease that can cause the person diagnosed with it to, partially or fully, lose their cognitive capabilities [1].

This thesis will also aim to increase the knowledge of how technology can be used to enrich the lives of elderly by interactive experiences. The thesis student will work in the research line of a PhD project currently being carried out at the Technical Research Centre for Dependency and Autonomous Living, the project is "ENGAGE: a Model of Engagement for Dementia" (proposal of project can be seen in Appendix A) where the PhD student and her supervisors are trying to find ways in which engagement can be measured. The research centre has, throughout this project, collaborated with the care facility *Rédos de Sant Pere de Ribes* which will be the facility where the information is found and observations and interviews are conducted.

1.2 Objectives

Dementia is an impairment with many different diagnoses, one thing that is analogous to all types is that they result in behavioral changes. The population of the world is increasing in age, leading to a larger amount of people dealing with dementia, being the person that is diagnosed or a care taker [1]. Therefore, striving to improve the quality of life for people with dementia will benefit a vast number of people.

Characteristics of dementia include, but are not limited to, communication difficulties—meaning that the impaired person could possibly be aware of his or her surroundings just not able to express what they desire. This will most likely result in the people with dementia experiencing, even if only for a short time, a decreased quality of life. The questions this thesis addresses is whether multi-media technology-based experience can improve the quality of life for people with dementia and how it would be possible to design such an experience in a way that makes people with dementia keen on using it as an activity in their everyday lives. Lastly, the thesis will analyze the existing activities in the care facility as well as the technologies that are being used today with elderly in order to improve their quality of life.

1.3 Related work

Previous work has been done on both elderly and people with dementia. Some of the most relevant for this thesis are the studies that have been made with elderly or people with dementia using technology. Doing this prior research helped with understanding ways of testing, which studies have been made and how the observations can be made in order to get the most out of it. The aim of the thesis is to look beyond the traditional perspective of usability requirements imposed by age related functional limitations, towards the design opportunities that exist to create digital games that will offer engaging content combined with an interface that seniors can easily use. The grandPad [2] is a tablet for seniors to connect with their loved ones and also help them with their memory by being sent pictures of their loved ones through the tablet. This tablet has gotten good feedback from its users but the intended user of the grandPad is not elderly with dementia, only elderly. This product and other similar ones [3] are of great use for elderly but not necessarily applicable for enriching and engaging the lives of people with dementia.

1.4 Scope

Dementia is an impairment with more than 90 different types of diagnoses [1]. In order to make this thesis manageable, the scope had to be narrowed down. The care facility that is in collaboration with the PhD project made the user study easier since the focus already was set on the patients of this care facility. This thesis puts greater importance on the symptoms of dementia than on the actual diagnoses, this decision was made because the behavioral symptoms are the ones there is a need to

look at in order to understand how the user will interact with the future implementation. Additionally the diagnoses are many so designing to make sure that it suits all the symptoms would call for a bigger time frame than available for this thesis project.

The environment was also considered when defining the scope in which the software will be used. To make sure that it is realistic this prototype was designed for was an environment similar to the one in the care facility. Like mentioned initially, dementia has many different diagnoses that can cause behavioral symptoms depending on the state of the patient [1]. The work done during the course of this thesis puts focus mainly on patients that do not suffer of substantial cognitive impairments because if done otherwise the project would have to include added research and knowledge. Since the objectives of this thesis aim to address how a multi-media technology-based experience can improve the quality of life for people with dementia. During the execution of this thesis the assumption that the users will have guidance available throughout the use of the experience is made. This assumption was made because the people staying at, or coming to, the care facility are most likely there because they are in need of assistance in their everyday life. Of course, the ideal case would be for the intended users to want to interact with the future product so they are willing to initiate the activity without any assistance.

2

Methodology

When designing, it can be helpful to work through different steps because each iterations gives new knowledge and understandings. Therefore the work of the thesis was divided into three different iterations, allowing the design or experience to grow through each phase. The division was done after the structure from Jones' book *Design Methods* [4] where he has chosen to name the different iterations after what happens in each; Divergence, Transformation and Convergence.

2.1 Divergence

The divergence phase is a process of collecting information and learning about the area that is to be designed for [4]. Here is where the literature studies on the topic of dementia and also on general tools that people with memory dysfunctional impairments are handling everyday will be made. During the divergence phase, the focus will lay on getting a realistic view of the users and include composition of observational studies in the end-users natural environment. The observations will be made in order to give deeper knowledge and a better view of how people dealing with dementia spend their days at a care facility. Observations on how they engage in the daily activities at the facility will help gain inspiration and rules for creating the interactive engaging experience.

2.1.1 Literature studies

To gain knowledge about the field of dementia and understand the end-user, extensive literature studies will be made. Literature search is cost and time efficient and also important to ensure the state of the art is correctly defined.

2.1.2 Observational studies

There are different ways of conducting observations. The observations that follow through in this project will be two different defined observation types. The "fly on the wall" type, where the observant does not interfere but only collects information from what is seen [5]. These observations will be made in the care facility to have a foundation for further analyzes of the existing activities.

The other type of observation includes asking questions to the care facilitators to make sure there are no misinterpretations.

Visits at care facility will be conducted as many times as needed in order to understand the environment fully. The visits will be scheduled with a care facilitator to be there and explain the activities and other doubts that might arise.

2.1.3 Benchmarking

Benchmarking is a method used to learn about the work done by others in the same field and position yourself amongst them [6]. Benchmarking will be used to investigate already existing technologies to see which technology-based media is most suitable for the intended user to use and research if there are multi-media technology-based experiences on the market that have the same aim as the project of this thesis.

2.1.4 Interviews

Interviews can be conducted through different structures [5]; structured, semi-structured and unstructured. Through this thesis semi-structured interviews will be conducted with the care facilitators, however, the interviews were conducted not only in the divergence phase but throughout the whole project to ensure that the information collected and ideas risen will be evaluated through interviews with experts on dementia.

2.2 Transformation

The next phase of the process is when the knowledge that has been gathered in the divergence phase should be used to see if there are reoccurring findings that can be defined as patterns. This phase will go through all the steps that will lead to the detailed explanation of the experience that is to be designed. The experience will be created through user-centered design meaning that all decisions that are made regarding the design has a starting point in the previous phase where all the information about the end-users and their environment was gathered [7].

2.2.1 Personas

There are several benefits to working with personas; one of them includes the simplicity of collecting many future users into a few personas to use as a guide towards the design choices [8]. This working process is good for understanding and focusing on a certain type of behavior of users [9]. This method will be used in this project after gaining an understanding of the end-users. Two or three personas, depending on the user-profiles in the care facility, will be created to structure and narrow down the planning and creation of the experience.

2.2.2 Low and high fidelity prototypes

Prototypes can be created in different levels of fidelity. According to Jones [4] it is best to begin with a low fidelity, evaluate, and then create a prototype of a some-

what higher fidelity until the end result is reached. He also states that by using a low fidelity prototype in the beginning, makes it easier to focus on the idea.

When the experience has been decided a low fidelity prototype will be created in order to allow feedback from the care facility. With the feedback gained from this prototype a high fidelity prototype will be implemented if the time-frame allows. This will be created using inVision, a prototyping tool for creating screens and interactive spots [10].

2.3 Convergence

The last phase of this design process is the convergence, where the final testing and evaluations are made to make sure all design choices are feasible and right for the intended end-user.

2.3.1 Heuristics

"heuristics (used with a sing. verb)

The study and application of heuristic methods and processes." [11]

Heuristics will be created in order to define which principles and experience created for people with dementia should follow. This will be done by editing already existing heuristics to save time [12] [13].

2.3.2 Evaluation by experts

Evaluations will not only be conducted in the convergence phase but also in the earlier iterations because each step of the design should be evaluated to make sure that the transformation from research and observations to experience has been made correctly focusing on the end-user. The evaluation that will be conducted in the Convergence phase will be made by a facilitator of the care facility.

3

Theory

One of the most important things when designing is to understand the future user. To do this, extensive research about elderly and dementia was done. In this chapter some of the information that was gathered through literature studies in the divergence phase will be presented.

3.1 Ageing and cognitive impairment

To make the scope more related to the experience, the choice was made to focus on the users cognitive and functional capabilities as well as their behavioural symptoms instead of defining which type of dementia the experience will be useful. When looking at the behavioral symptoms, it is easier to understand how that type of user would act in a particular context.

Dementia is a disease that includes many different diagnoses, all are considered brain diseases and can be categorized into various types of dementia. The ones that are most spoken about are: Alzheimer's disease, vascular dementia, dementia with Lewy bodies (DLB) and Alzheimer's disease mixed with Parkinson's disease [?]. There are different types of symptoms when speaking about dementia; psychological and behavioral symptoms. The behavioral symptoms are important to this thesis since the experience that has been designed has to fit to the intended users behavior. The behavioral symptoms based on observations of the patients are, for example, physical agitation. If they are restless and the level of their agitation. The behavioral symptoms are more important to this thesis since there is a wish to improve the quality of life of the patients and the psychological symptoms are out of the thesis groups scope. The symptoms of the most common diagnoses are presented below.

3.1.1 Alzheimer's disease

Alzheimer's disease is said to account to more than 50% of cases of dementia [1]. The most common symptoms are short-term memory loss and language or word-finding difficulties. The early symptoms also include getting lost, difficulties of keeping track of things and cooking new or difficult meals.

3.1.2 Vascular dementia

The second type of dementia that is the cause of at least 20% of dementia cases is vascular dementia. This type of dementia is caused by disease or injury to blood vessels that damage the brain, and could arise after having a stroke. For this type, it is harder to specify the different symptoms since it depends on the size of the damaged vessels and where in the brain the strokes have occurred [1].

3.1.3 Dementia with Lewy bodies (DLB)

This type of dementia is the cause of 20% of dementia cases. For dementia with Lewy bodies, or DLB, hallucinations is one of the primary symptoms. It causes visual hallucinations and might also be the cause of "Parkinsonism" which is a term that is used to describe a person who has features of Parkinson's disease but is not diagnosed with Parkinson's. The features might include tremor, rigid muscles or a face without emotion [1].

3.2 Technology based activities

To get an extensive knowledge on which technology is currently being used to improve the lives of people with dementia some technologies were analysed. The technologies that were chosen were ones that previously have been used in work with elderly: Nintendos Wii Remote (or Wiimote), XBOX kinect and multi-touch screens. To make sure the information acquired from these analyzes were to be useful for the thesis, research was made to see which functionalities of the hardware should be included in order to be suitable for elderly users.

Three main points were focused on when analyzing the technology-based activities. The first to find out if the user has to have prior knowledge in order to be able to use the technology. According to the care facilitators people with dementia are more likely to be either confused or left feeling overwhelmed if they need to learn new things before using the technology-based activity. When designing for people with dementia it is important to make sure the user experience mostly includes norms they are familiar with and remember to avoid introducing a lot of new rules that they will have to remember during the activity.

The feedback during each activity was examined throughout the analyzes. For instance, will the user understand what is happening, or is there too much feedback which might leave them feeling confused.

The last thing that was analyzed was whether the activity asked the user to focus on more things at once. When working with elderly, and especially people with dementia, it is important to be aware that their attention-span does not work the same as it might for healthy people [1]. For this reason, analyzes of how big of an attention-span the user of the technology based activity needs was included in the benchmarking. The explained analyzes were done on both the hardware of the

technology and the chosen activities also.

3.2.1 Nintendo's Wiimote

Nintendo's Wii has been used in studies with elderly to find out if there is a possibility to engage them in games [14]. Since this process of the thesis was used in order to find out the technology that could be most suitable to use in the future design the analyze focused on the remote that is used when playing the Wii. The Wiimote (seen in figure 3.1) has many similarities with regular TV remote controls. The remote is equipped with one speaker, accelerometer, gyroscope (Wiimote Plus), infrared sensors, 8 digital buttons, and a D-pad.



Figure 3.1: Nintendos Wiimote with the original strap attached to it.

The remote control that is used for playing the different games is very similar to a TV remote control. This allows the user to apply previous knowledge to the usage of a new device. Even though there are similarities, the Wiimote has very different functionalities. This remote is sensitive to movement and is also equipped with buttons that are different to a normal remote control. The remote is used in different ways, depending on the game, which means the software can be the final decision in how the Wiimote is used so the software could be implemented to simplify for the user. However, even with a simplified functionality of the remote, it still might have buttons that are not used in a game, forcing the user to remember which ones to use and when. This might create confusion for the intended user.

The feedback given from the remote is vibration and lights—both can be turned off. For people with dementia the better choice might be to turn these off because if they have more than one thing to put their focus on, there is a bigger chance that they will get confused and feel overwhelmed.

There are several games that have been tested to use for elderly to improve their well-being [15] [16] [17]. These studies are all talking about how Nintendo Wii can be used for interaction with elderly. The Atlantic [17] discuss the opportunity to use Wii to help the elderly psychologically. In other words it can be said that they wanna show that their quality of life could be improved by using Wii. They do not mention people with dementia, only that this could be beneficial for elderly. The article says that studies have shown that exergames, games that encourages exercise, have been proved to help with depression, sense of self and relevancy. The study also presents positive results from testing the link between exergames and mental health of seniors. To see whether this could be applied for people with dementia, two games for Wii were looked closer at.

Wii sports This game includes the sports golf, tennis, boxing, bowling and baseball. The focus was on these games because the modality of the interaction to play could not be implemented in the same manner without the Wiimote. All of the games included in this software are easy to understand since they follow the mental model of how one plays the real-life sports. However, even if the players would understand the gameplay and can benefit from the health aspects proven when using Wii, using the remote in order to be able to play could cause distraction for the user if it is a person with dementia. Heuristics presented in section 4.9 were looked at when evaluating the games included in Wii sport. The Wii sport can check of most of the principles defined in the Heuristics (section 4.9) but there are some in the second category–Game Usability–that do not apply well. The first principle says that "Players do not need to take in a lot of new information to play the game." and when evaluated it seems like this principle does not apply to Wii sport since there are several different aspects to focus on from the beginning. The buttons on the remote, the screen, the award-system and playing the games.

3.2.2 XBOX' Kinect

XBOX has developed a console which detects the users movements and sounds. One version of the console can be seen in figure 3.2. Analyzing a technology like this is difficult since the user experience depends mostly on how the interface of the software has been implemented. From looking at the way the console is used, it becomes clear that the users have to be aware that the games are controlled by their movements and sounds. This is a rule that most elderly users will not be used to and is not natural for the intended user. The Kinect has been used in a lot of rehabilitation studies with both elderly and people that are trying to get functionality back in impaired limbs. It has been proved as a positive tool in a study [18]. This study was done in order to research how the subjects move and if their limbs could use some help in the everyday life.



Figure 3.2: Kinect Console for XBOX 360

The games that are designed for kinect are many physical ones, alike the game presented for the Wii. The difference is that with the kinect, the players are the control, allowing the players to focus mostly on the screen. What should be considered here though is that some diagnoses of dementia the symptoms can include less functioning limbs [1] not ensuring that the players can use the game fully.

3.2.3 Multi-touch screens

The multi-touch screens have become very popular in the past years. They are being used on the streets, in grocery stores, at hospitals, etc. They can have different shape and form but their functionality does not differ much. The functionality is simple—an interface with which the user interacts by touching the screen. Because of its simple functionality, it was a bit difficult to analyze the hardware since there is not much more to it than a screen, however the analyzes showed that all the categories looked at depended on the interface of the software being used with the hardware. Different multi-touch screens can have different technologies, some might be more sensitive than others, have better resolution and have a simpler hardware design. But if generalizing, it can be said that out of the three technology-based activities, this is the one that depends almost only on the interface and does not force the user to divide his or her attention. There can of course be sounds and vibrations but it is up to the designer if he or she wishes to use these functionalities.

The figure shown below (3.3) is a grandPad [2]. The grandPad is created for elderly to live more independently by allowing them to keep up with the lives of their families through pictures, call their contacts straight through the tablet and play games. The design is clean and simple and uses big fonts and is adapted to its intended user-group. However the interface has many functions, too many for a person with dementia to understand on a first try. This multi-touch screen software is the closest that was found to the experience that the objective aimed to created, however this software still lacks in the user-focus and the engagement for the user—if the user has dementia.



Figure 3.3: Example of a grandPad being used.

3.3 Serious games for elderly

After analyzing the hardware and games of the three technologies a choice was made to look at serious games also. This was done to get a better understanding of the games that are appropriate for elderly and to find inspiration for the interactive experience this thesis aimed to create. The goal with analysing the hardware of different technologies (section 3.2) was to reach a decision on which of these technologies would be most suitable for a prototype of an interactive engaging experience for people with dementia.

The serious games already on the market are mostly focused on achieving beneficial goals for the users cognitive or physical being. Through investigation it has been shown that there is a lack of serious games that puts focus solely on improving the users quality of life by an interactive experience [19] [20].

3.3.1 The AIR touch

The AIR touch is a set of serious games developed by Annett et. al [21]. This study was chosen to look closer at because the authors used tabletop when designing their games. By taking a closer look at these games and the authors conclusion it was possible for the thesis group to find inspiration and gain knowledge from their success or failures. The authors present several games that were implemented on a tabletop in order to help patients rehabilitate. So the focus of this development was different then what the thesis group wished to achieve, since the AIR touch was intended to be a physical help for both patients and therapists rather than being an interactive experience used to improve their quality of life. However, a lot of information could be gathered from the work of Annett et. al because it was made with a user group similar to the one wished to design for. The project was developed as a series of games on a table touch with multi-touch functions. There were five games developed to help the elderly but also their therapists. The games that were developed by the authors were the following:

Pop Those Balloons! A game where the user is intended to touch balloons that fly over the screen before they disappear.

Drumhab This game is inspired by Rock Band and Guitar Hero and the patient must use their hands as drumsticks and hit the drums in the right point in time.

Paint By Number The patient is encouraged to fill in a piece of the table with their finger following a numbered guide and lines.

Picture Tracing This game lets the patient follow a drawing, or picture, with their finger and trace the lines of the image. This way the motorics of the patients fingers are exercised.

Therapist Do-It-Yourself This activity is one lead by a therapist. The therapist defines a target on the tabletop which the patients are presented to the patients who then should reach for these targets.

All of the games developed by the team of the AIR touch are intended to help the patients to rehabilitate. The AIR touch was the one that the thesis group had the most use of since the previous analyzes (3.2) had shown that a multi-touch screen is the best suitable for the intended users. These games are all developed to help patients and their therapists with motor skills while having fun. What is different from these games to the experience this thesis wished to create is that these games all contain either pressure or stress, which as mentioned earlier are not good bases for an experience for people with dementia.

4

Execution

The approach of implementing the prototype was based on the observations of the activities and technologies used with elderly today. After the observations of the activities, evaluations of the technologies and interviews with the care facilitators, there was enough information to start with the implementation phase. The design of the experience consist in a full scale implementation of the design of the interface was produced iteratively going through the divergence, transformation and convergence phase. This chapter will cover the explanation of all these phases leading up to the final prototype.

4.1 Interventions

In addition to the technologies, the activities that are conducted at the care facility were reviewed in order to get a better understanding of their methods. Also taken into consideration is who can or cannot join in the activities—this is to see if changes could be made in a digital version in order to include everyone. Below follows an explanation of the different activities, some were observed and others were discussed with the health care takers in charge of the activities. This was done to understand what can be used in a technical design. This way a better understanding of the strategy of the activities they manage at the care facility every day was gained.

To understand the users, observations of the future users everyday lives while taking notes of how their days look and how they act in different situations were conducted. These observations were carried out with particular aspects in mind; how the subjects act when there are no activities involved, the different levels of engagement in different activities in the care facility and how the subjects interact amongst each other. These three things were what was mostly looked on because it had been agreed that the experience that were to be designed would most likely be brought into the subjects' everyday lives meaning that it makes it more feasible if the users behaviour is observed and learnt before starting to look at other internal and external factors. The personas that are presented in chapter 3 were built on the knowledge gained through the observations. The analyzes of the users brought information on not only how the users act individually in groups but also showed how the different activities they have in the care facility affect them.

To get a realistic view of who the future user is it is important to not only understand the user but also the environment in which the design is planned to be

used. The context of this thesis is based on the observations in the care facility. The context was analyzed by staying in the users environment and complemented by interviewing the health care takers in the care facility. The environment that was designed for is the health care facility and is based on the activities that have been observed. The observations of the activities showed that the users sometimes need help to understand what is happening, meaning that guidance is crucial for some of the future users. Since the observations were held in the users natural environment it was easy to see the interaction between not only the users but also the users and the environment. The care facility has two different types of patients, the ones that only come to the facility for a short stay, and the ones that have a room and live there. In order to understand both types of patients and their environment, it was made sure to see if the health care takers made any difference for the patients depending on their type of stay. When speaking to Dr. Barea, the psychologist at the facility, it was clear that the main difference is that the patients that actually stay at the care facility are usually in need of more care and therefore might not be able to participate in as many activities, but other than this she says that the do not make particular differences.

4.1.1 Schedule at the care facility

The figure shown below (4.1) shows a week of activities at the care facility. There are several activities throughout the weekdays. The activities include gymnastics, garden work, bingo and many more. Some are focused on the physical well-being of the patients and others on engaging them during their time at the facility.

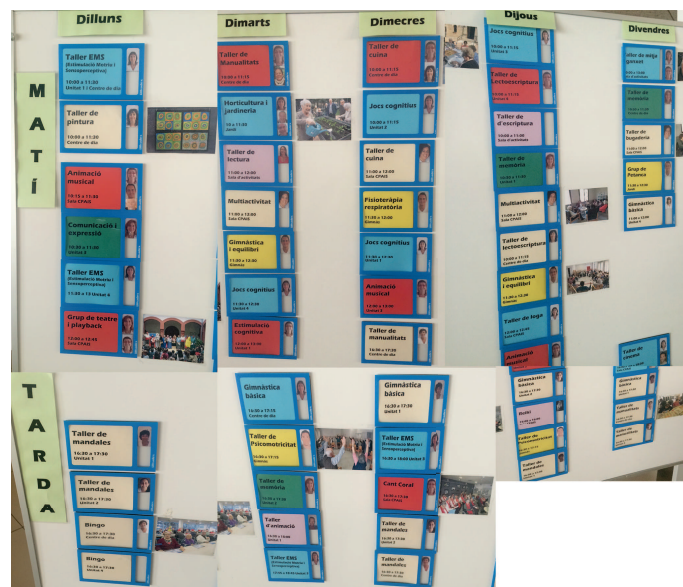


Figure 4.1: How a schedule of the week looks at the research centre. The most interesting to look at were some of the workshops that are held and there are presented below the figure.

4.1.2 Memory therapy workshop

This workshop is held to exercise the patients' memory and is repeated at least two times a week. Through this workshop the facilitators wish to practice the patient in trying to remember and hopefully improve their short term memory by trying to remember things from the previous sessions. The workshop is conducted by a psychologist in the care facility, for the purpose of this thesis we will call her Dr. Barea, who holds group sessions with the patients where she goes through different steps to therapeutically make them engage and discuss different topics. The group in this activity is big, about 30-40 people. During the observation the different stages of the therapy were noticed and are being presented below.

Presentation From the start of the activity Dr. Barea has a casual approach towards the group. She is making jokes and it does not feel like this is a workshop but rather a conversation. The session starts with Dr. Barea asking open questions like "Which year is it?". While observing, it was clear that some of the participants already were on the edge of their seats waiting to answer and others seemed to not be as interested.

General topics During this part of the session, Dr. Barea was asking general questions about the weather for example. When it came to these open questions some of the patients were quick to answer while others were waiting for the question to be directed towards them. The participants were excited, even though some of them started speaking about the weather in the year of 19xx. The conversation proceeds with open questions asked by Dr. Barea, one example is "Has any one of you ever lived in a country where it snowed a lot?". By observation these questions seem to bring out engagement in parts of the group. However it is hard for some of the participants to really join in because they are either slower than someone else or simply not focused enough to come up with an answer.

Riddles Dr. Barea goes through riddles and waits for the participants to give an answer. After one of the participants answers Dr. Barea follows up with more open questions. The questions do not have a specific answer but are for example formulated as: "What else can we find there?". Speaking to Dr. Barea it was learnt that this is done to not imply that there is only one correct answer because that might scare the patients and hinder them from answering. Observed during this part of the therapy was that there definitely are patients that would like to speak more but are not loud or quick enough.

Expressions During the next step of the therapy, Dr. Barea says an expression and together in the group they try to figure out how it is used. While this exercise is ongoing, the participants are mentioning very old memories like remembering how their grandparents used to pay for the doctor. When Dr. Barea directs the question to one certain participant, who seems very uninterested during the exercise, he has answers to almost everything. This shows that even though a person does not seem engaged, they can still join the activity if it is directed towards them. Dr. Barea

asks the group to tell her about things that happened a few weeks ago or in the last session, but clearly explains that if they do not remember, she will help them find the answer. In the course of the whole process Dr. Barea jokes with the group and most of the participants seem to loosen up a bit, some even seem to be more engaged in the presence of humor.

Opposites This part of the session includes Dr. Barea saying a word and asks the group to say the opposite. Some of the participants say the words but some moments after, the answer has already been heard from someone else. According to Dr. Barea, this does not have to be because they could not think about it themselves but rather because their cognitive level cannot handle to express the answer that quickly. Since this activity comes with some stress it was also evaluated to be one of the factors that make the participants a bit tired and not as engaged as they could be. While observing, it seems more like the stress factors make some of the participants back away and disengage them to try harder. This part of the activity acknowledged their disinterest. In the beginning of the exercise everyone seemed excited but that excitement decreased after each of Dr. Barea's words.

Dancing The last exercise in the session was dancing. The group is still sitting down but Dr. Barea puts on some music and is standing in the middle of the circle of chairs and doing movements related to the lyrics of the song. It is clear that the movements are the same for each of these workshops and that the participants have seen them before, however not everyone is able to focus and follow for a long time. When she changes moves too quickly some of the participants just stop trying instead of continuing with the previous movement. Some are singing along, there are participants that sing although a little bit after the actual song. The participants that seem really unengaged are following some but at times, Dr. Barea has to get their attention in order to make them to the moves again. For the majority of participants, it seems difficult to follow just by looking at Dr. Barea's moves but find it easier when she verbally tells them what to do.

General observations During the activities there are people coming in and sitting down so there does not seem to be any time or size-limit to this workshop. The majority of the participants seem to listen and focus during the session. Even the ones that are quiet are nodding to show that they are there and aware of what is happening. However some do not seem to be present in the interaction or activity.

4.1.3 Painting workshop

Through this workshop, the care facility wishes to provide fun for the patients but also practice their finger dexterity. This activity was discussed with the health care takers to achieve a better understanding of how they conduct it and also which type of patients are recommended to join. The interesting and useful facts learned from this workshop was that the participants are able to choose the level of difficulty. According to Dr. Barea they have either plain papers on which the participants can draw with a free hand (pictures that they can color, or connect the dots type of

drawing). The tools they provide are also different and more or less complicated to use. This activity is definitely adjustable to the participants cognitive levels.

4.1.4 Boole group

One of the goals with this activity is to engage the patients to play and compete. There is also interest in seeing how the patients can handle the rules and physical phases of a group activity similar to this one. Since the care facility is located in Spain the patients are most often fortunate enough to be able to have activities outside. One of these activities is playing Boole in the garden of the care facility. The thesis student have observed one of these games and noticed the majority of the participants enjoyed the game. However, some of them had a very difficult time knowing when it was their turn to throw so guidance from the physiotherapist was needed. One interesting thing that was observed during the game was how the participants that won showed happiness, implying that the winning element of games can have an engaging factor for the intended user.

4.1.5 General information from care facilitators

According to the psychologist working at the care facility it is always better to perform the activities in smaller groups. In her professional opinion, having groups of 6-8 people would be the best. She expresses that this is not possible because there is not enough resources at the moment. Most of the activities, that are held at the care facility, are with bigger groups and this does not allow everyone to participate as much as they could if the care facility had the possibility of having several small groups instead.

4.2 The Users

The users are elderly people with dementia that are spending time in a care facility—either living there or just spending some hours there each day. The observations, presented above, gave enough information about the users to create two personas.

4.2.1 Personas

Personas are a design tool that can be used to guide design choices [8]. There are several benefits to working with personas. This working process is good for understanding and focusing on a certain type of behavior of users [9], however it is important that the personas reflect more than one type of user—a good persona includes patterns that have been observed in the research. Therefore the personas used in this project were created after the first observations at the care facility were made. Two personas were created with help from the PhD student and the psychologist at the care facility who have more knowledge about the patients at the care facility. The personas were created with Coopers definitions of how a good persona should look. Some of the points that were particularly considered were that the personas should reflect the patterns that have been observed in the research.

They should also focus on the current state of the environment and not on the future. Cooper also says that it is important to be realistic when creating your personas and not try to create one that is the ideal version of the intended user. With these factors in mind, two personas were created and are presented below.

Marie

Marie is a persona that is created in order to reflect the future user that has a critical cognitive state and cannot really join even all the activities that she would like. This persona is created because the observation at the care facility showed that during the activities there were a lot of participants that would have liked to join in and their engagement truly showed but they were not qualified enough to be able to carry the activity through. Marie is a persona who has a lot of interest and engagement but not the cognitive capability of focusing on an activity long enough to finalize it. If Marie would be able to, she would like to be included in every single activity they have at the care facility but she is not cognitively able to. **About**

- female, 69 years old
- critical cognitive state
- 4 children, one of them very involved, the others not as much

Behavior

- understands everything
- not capable of communication/joining in on all she would want
- able to focus on particular things for a while
- very talkative when she knows what she wants to express
- would want to perform more activities than she is capable of

Javier

The second persona that was created reflects the users who can participate in all activities but do not have the willingness to. Javiers cognitive state allows for him to join in on every activity. This persona was created to include the potential users that might have the cognitive possibility to engage but are not really willing to. **About**

- male, 78 years old
- vascular dementia (not severely)
- seems apatic
- 2 children, both live outside of Spain but visit when they can

Behavior

- indifferent about the activities
- quiet
- laughs when jokes are directed towards him but not otherwise
- has the medical capability of joining every activity but is not willing

The two personas are very different and this was one of the reasons why they were chosen. It is easier to imagine the personas that can be in between these two, instead of creating one to reflect each type of dementia the choice to focus on the behavioral symptoms was made here also.

4.2.2 Interviews

The following step was to make sure the activities that were to be included in the experience were of the type that engages the user. To see whether or not this was true semi-structured interviews were conducted with the care facilitators, making sure to ask how the patients act and seem during different parts of the activities. What was taught here was that there is no general way of looking at it, the patients act differently depending on their mood and day. However, Dr. Barea says that they try to have something in each activity to include as many patients as possible, but the patients do not always enjoy what is on the schedule of the day. Unfortunately, the care facility does not have enough resources to perform multiple activities at the same time and place. Looking at the activities and observing the patients it was clear that there are a lot of different cognitive levels in one group. Learning that—the experience that were to be designed should allow the user to choose a level of difficulty. This is how they perform the activities in the facility as well—explained in chapter 4.1. This part of the analyzes helped understand what sort of real-life activities can be captured in the engaging interactive experience for people with dementia. It showed that the user is more engaged if he or she can share the experience with other people, this was clear when observing the memory therapy (chapter 4.1.2) because the participants all wanted to share their stories with others. During this interview, a decision to create the experience for groups not bigger than 8 people was made. This was the group-size Dr. Barea thought was the best to allow each person to feel comfortable and give them the time they need to not feel stressed when engaging in activity.

4.3 Technologies

The benchmarking (chapter 3) showed that the multi-touch screen was most suitable for working with people with dementia or elderly in general. This was why it was chosen to focus the work around multi-touch screens. The next step in the implementation was to make sure the interactive experience had an engaging factor to for intended user. This step was created after looking at the emotions of the participants in the different activities in the care facility. The analyzes of the technologies was important in order to understand the previous technologies that have been used with elderly. After seeing and understanding how this has been done the thesis group could continue the work with more information on how elderly—and people with dementia—interact with different hardware. It was decided to use multi-touch screens in the design because this hardware had shown the best potential in the benchmarking.

4.4 Using pictures to start conversation

When the analyzes of the activities were conducted the thesis group found it interesting to test out some of the information that had been gathered. One thing was whether it was possible to start and retain a conversation just from using a

picture. This idea presented itself during the observation of the memory workshop (section 4.1.2). The thesis student brought different pictures in A5-size (one is shown in figure ??) to see how the end-users would react and engage when being presented a picture. This was done because there had been a realization that the end-users seem to be more engaged when there is something general to converse about, and engaging in conversation brought out a lot of activity in many of the participants (section 4.1.2). This showed that the experience that was to be designed could bring out engagement just by allowing the users to be part of a conversation. In order to include as many users as possible it was important that the pictures were as general as they could be, one example of a picture that was shown can be seen below in figure 4.2. It was made sure to not ask too many questions to see how much the pictures themselves could bring out from the users.



Figure 4.2: One of the picture that was shown to the future end-user.

4.5 Engaging interactive experience - limitations

During the design phase of this experience it was important to make sure the previous research was followed. This because there is a great importance to make the experience as feasible as possible, and also something the user would appreciate and initiate activity with. The limitations discovered during the research phase of the thesis decided how the work should proceed, the limitations are mostly related to the cognitive level of the people that were observed during the research phase. The experience should not be stressful or include too much competition because that could lead to the participants losing motivation and engagement. Heard from Dr. Barea, it is important to not include too many rules when designing for people with dementia because they have difficulties to remember details—therefore the design was created to have guidance from care facilitators.

4.6 Mental models of elderly

To make sure that the experience matches the way people with dementia and elderly think, in generalization, the mental model of elderly was considered throughout the design of the experience. Dr. Barea said that the users are not used to using touch screens, meaning that the experience has to be designed so the movements and touches are as natural as possible for them. It is beneficial for them that the movements are similar to the movements they use everyday, to not introduce many new concepts. As mentioned in earlier chapter (3) it is important to make sure that the users do not need to focus on more things in the same moment. For this reason sounds during the experience were considered carefully.

4.7 Concept of experience

First decision made about the engaging interactive experience was that it should include pictures and be a conversational game presented as an application on an iPad. This decision was made since it was clear from the start of the observations that photos trigger both emotion and conversation. During the divergence phase a test was made to see how much guiding the future users need in order to start a conversation only looking at a photo and even though the test was only made with few participants it showed positive results. After this test the decision to create a tablet game that focuses on pictures was made. The design should include photos but have a gamified feel to allow the users to feel like they want to accomplish their goals throughout the play. To be able to create even the first sketch of the experience it was necessary to have most of the functionalities thought out.

4.7.1 The pictures

The purpose of the thesis is to create an experience that engages people with dementia. The pictures were decided to be the core of a game because the research phase proved that using pictures and open questions was a good way to include everyone without personalizing the experience. During the memory workshops most of the participants seemed to have something to say about the general questions (chapter 3) proving that a conversational game most likely will bring out engagement in the intended users.

4.8 Low fidelity prototype

The low fidelity prototype, shown in figure 4.3 was created for the purpose of presenting the idea and showing how the game was intended to be used by the elderly. It was created on an iPad because the final prototype was planned to also be created for an iPad 2. This way the designer had an idea and feel of the true sizes from the start of the design process. The sketch was used to explain the concept and game and get to feedback and create a prototype of higher fidelity.



Figure 4.3: Low fidelity prototype to present and explain the game to experts.

4.9 Heuristics

The model of heuristic evaluation was used because it allowed for evaluation that has been tested by others and also because it is a proven way to evaluate games. The heuristic evaluation was chosen to be made here to allow the thesis student a model to use and think through the details of the game concept. In order to save time and resources a heuristic model was not developed from scratch but rather one created by gathering principles from Desurvire and Wiberg [12] and Desurvire et. al [13]. Since their rules are developed without the consideration that the players might be people with dementia or elderly, some heuristics were completely changed and several removed. The most important reason for using already created heuristics was saving time. With the inspiration from earlier mentioned authors in addition with the research and observation that had been done in the early phases of the thesis project.

The first category of the heuristics, Game Play, covers the players endorsement during the game. These heuristics are important to follow since the thesis project aims for the intended user to take initiative to play or interact through the experience. The heuristics for Game Usability covers all the principles that should be used in order for the game to be a positive and uplifting experience for the users and not cause any frustration. The last category of heuristics is Game Mechanics. Here there are rules about how the game should react towards the player. The heuristics, ordered by category, that were produced to suit this project are shown below:

I. Game Play

1. The players find the game easy to understand, with tasks that follow their mental model.
2. The players are not significantly penalized for failure.
3. The players should not lose possessions.
4. Game play is short and does not force the player to divide his or hers attention.
5. Challenge and level of the game are in balance.
6. The difficulty of the game can be varied to fit the players cognitive state.
7. Challenges should contribute to a positive experience.
8. The interface is created so it is clear what the challenge is, with hints that can be activated by the player if needed to achieve the goals.
9. The game goals are clear. There are short term goals as well as long term.
10. The skills needed to attain goals should need to be taught but rather be skills that the players possess beforehand.
11. The game gives rewards that immerse the players more deeply by increasing their capabilities.
12. The game supports a variety of game categories.
13. The first seconds of play are obvious and create a sense of control for the player.
14. The game has a clear focus on positive feedback.

II. Game Usability

1. Players do not need to take in a lot of new information to play the game.
2. The setup of the game can be done by an outsider and still allow the player to understand where and how the game begins.
3. It is okay for the players to be guided through the game with a physically present support (e.g. care facilitator).
4. Game controls are consistent within the game and follow standard conventions.
5. Status score indicators are seamless, obvious, available but do not interfere with game play.
6. Controls are intuitive, and mapped in a natural way; they are customizable and default to industry standard settings.
7. Game provides positive feedback and reacts to the players actions.
8. The game uses audio feedback where appropriate.
9. The game puts no burden on the player.

10. Players are given basic enough controls to understand quickly.
11. Screen layout is efficient, integrated, and visually pleasing.
12. Players should be given context sensitive help while playing so that they are not stuck and need to rely on a manual for help.
13. The players experience the user interface as part of the game.

III. Game Mechanics

1. Error caused by the player is avoided.
2. Player interruption is supported, so that players can easily turn the game on and off and be able to save the games.
3. Upon turning on the game, the player or physically present support (e.g. care facilitator) has enough information to begin to play.
4. All levels of players are able to play and get involved quickly and easily with guidance from physically present support (e.g. care facilitator), and/or progressive or adjustable difficulty levels.

4.10 Evaluation with personas

The personas were created in the first phases of the thesis and worked as a guideline throughout the project. Since the prototype cannot be evaluated with real-life subjects an evaluation of the personas was made lastly to make sure that the experience designed would suit the personas.

Guide game For **Marie** to join the game and want to interact through the game needs to be simple so she understands it before losing interest. Therefore Marie would need to play through a guided version of the game, either letting one of her team mates or a care facilitator lead.

Javier would also need help with the first interaction steps, but mostly to allow him to understand that an activity about guessing the image on the picture is about to start. Since his cognitive abilities are better than Marie's he would not have as big of a problem to understand the few rules there are in the game.

Interaction between the two personas The two personas are different and have very different behavior. So if they would be placed in the same team, would the interaction and conversation between them still function? This is a difficult evaluation to make since interaction is human and therefore rarely follows a pattern. However, keeping a conversation alive is easier when there is one main focus. If they lose track of the conversation there is always the opportunity to have a care facilitator guiding them.

Difficulties for both personas For a user alike **Marie** the biggest difficulty would probably be to keep focus for long. This persona also has a difficult time remembering the topic of the conversation which is why one could guess that the pictures that will be used in the interface should be of help for a focus-point.

Javier is a persona that would most likely understand the whole process of the game

seeing as this persona has a good cognitive state. With this persona the difficulty would be to make him engage throughout the play. By having the teams be smaller it will be easier to make sure that each player has their time to discuss the correct result.

5

Results

The results of this thesis is an interactive engaging experience and concept for people with dementia, the experience is visualized through a high fidelity prototype of the game. Both are presented below.

5.1 The Interactive Engaging Experience

The result of this thesis is a game for people with dementia created as a prototype on a multi-touch screen. The game is meant to be played in teams of 6-8 players and can be guided by a care facilitator or played independently, only constraint being the players cognitive state.

5.1.1 Conversation

During the observational studies of the project there were indications that showed the end-users felt engagement through conversation. Therefore the game was designed to include conversation and fun amongst the players.

5.1.2 The pictures

The game is meant to use pictures to bring out the conversation from the users. The pictures are the conversation starter for the team of players. The choice of category is presented to allow the users to have an idea which theme the pictures will be of and this way also have an opp

5.2 High Fidelity Prototype

The prototype that was implemented was created using inVision [10], a prototyping tool that is used to create screens for different technology based media such as iPads. Below are presented a selection of the screens which is the result of all the phases throughout the project.

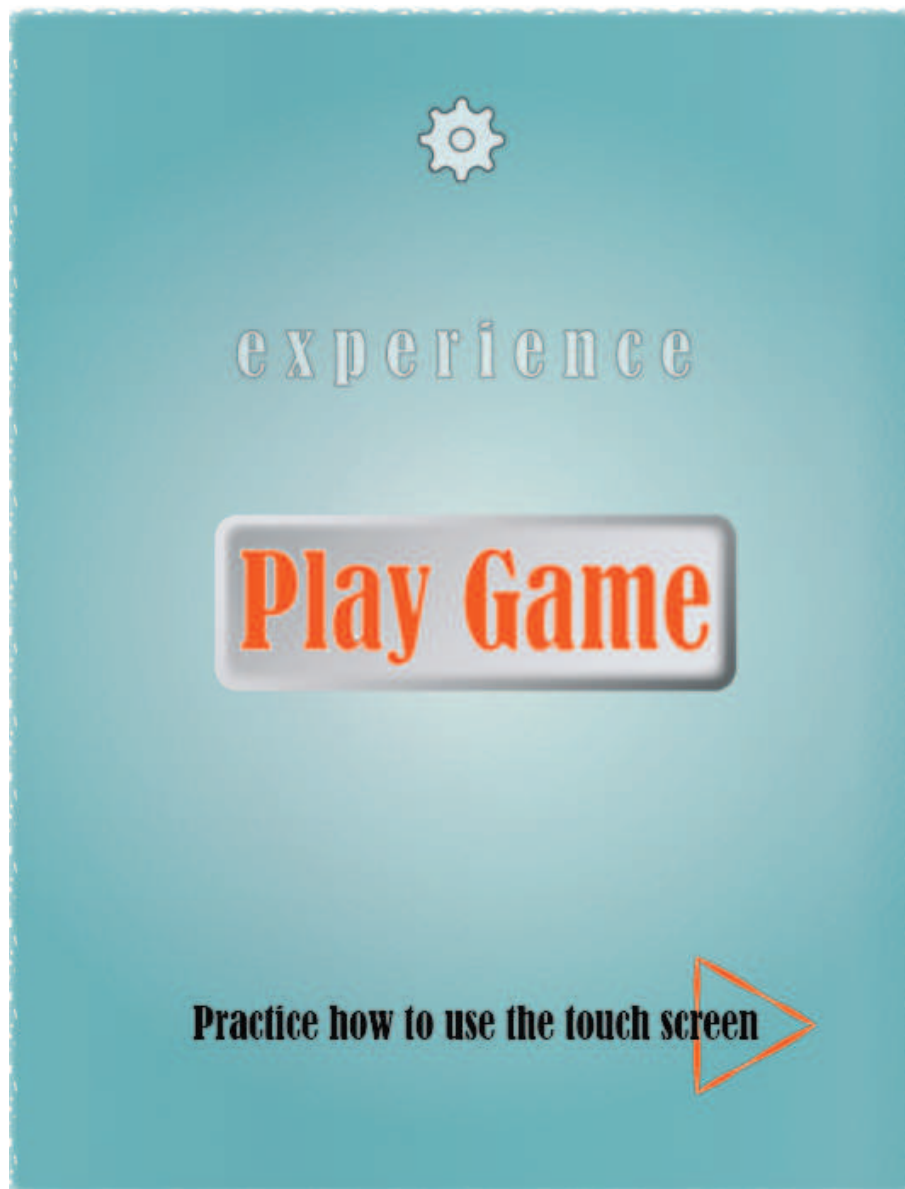


Figure 5.1: Start screen of the prototype. This is what the future user will be presented with when starting the application. There is a settings option where the intended user or a care facilitator can choose the settings of the game such as number of players in the team and language. The part that reads "experience" is where the name of the application would go and below is an option for the player to get to know the medium they will play on.



Figure 5.2: Choice of category in the prototype. Here one of the players of the team or a health care taker can choose the preferred category for the game that is about to be started.



Figure 5.3: When the game has been started the player is presented a picture that is in the chosen category. The progress bar that is on the top of the screen shows how much zoomed in the picture is, this screen shows how it looks after the players have zoomed out one. The idea here is for the team to discuss what is shown on the picture and this way start a conversation amongst them. If the players find it difficult to guess what is on the photo they can tap on the screen to have the photo zoom out. After a zoom out is done the players will not get as many points for guessing correctly. The award symbol in the top right corner shows the number of points the team has collected at this moment.

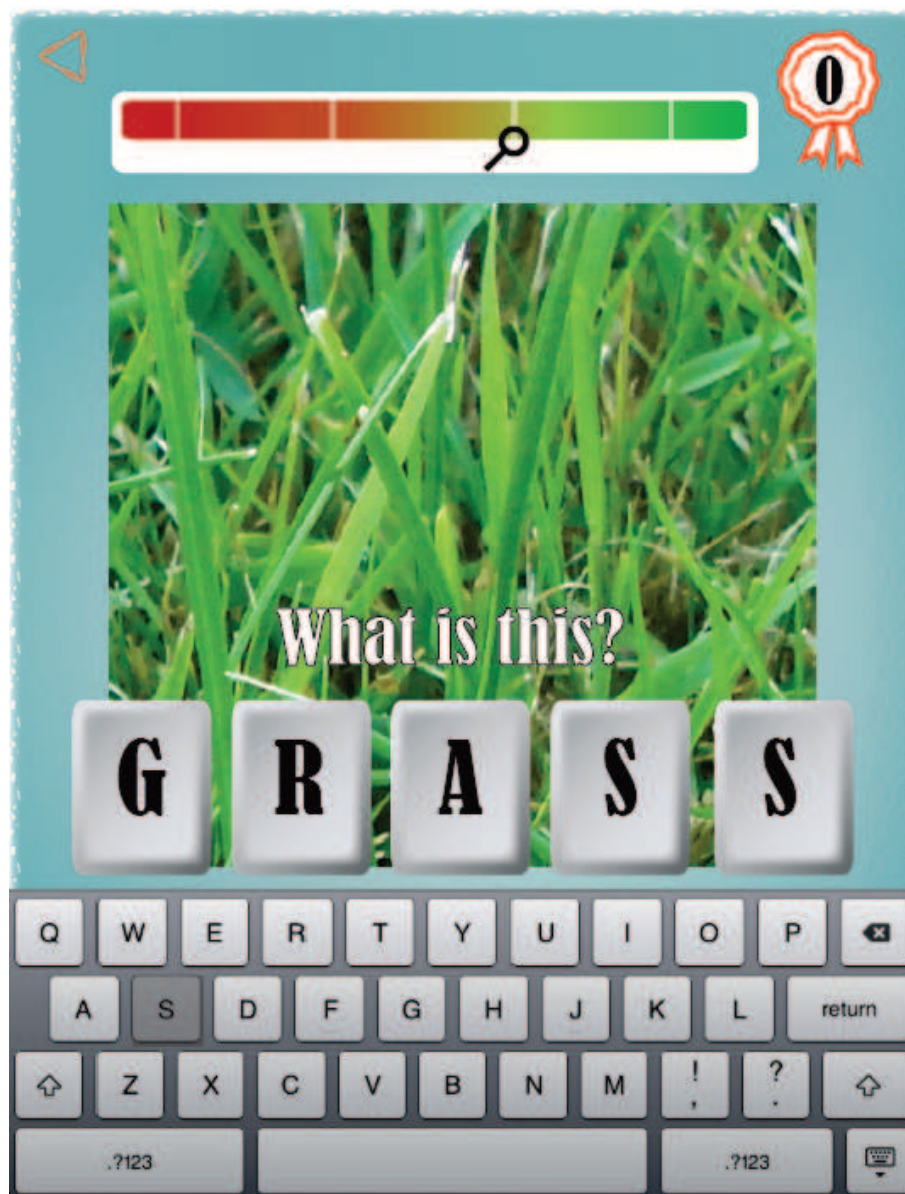


Figure 5.4: How the answer is typed. When the players have finished discussing the photo and together come to a conclusion of what they see on the photo they can press the indicators of where the answer goes and either one of the players or a health care taker can input the guess.

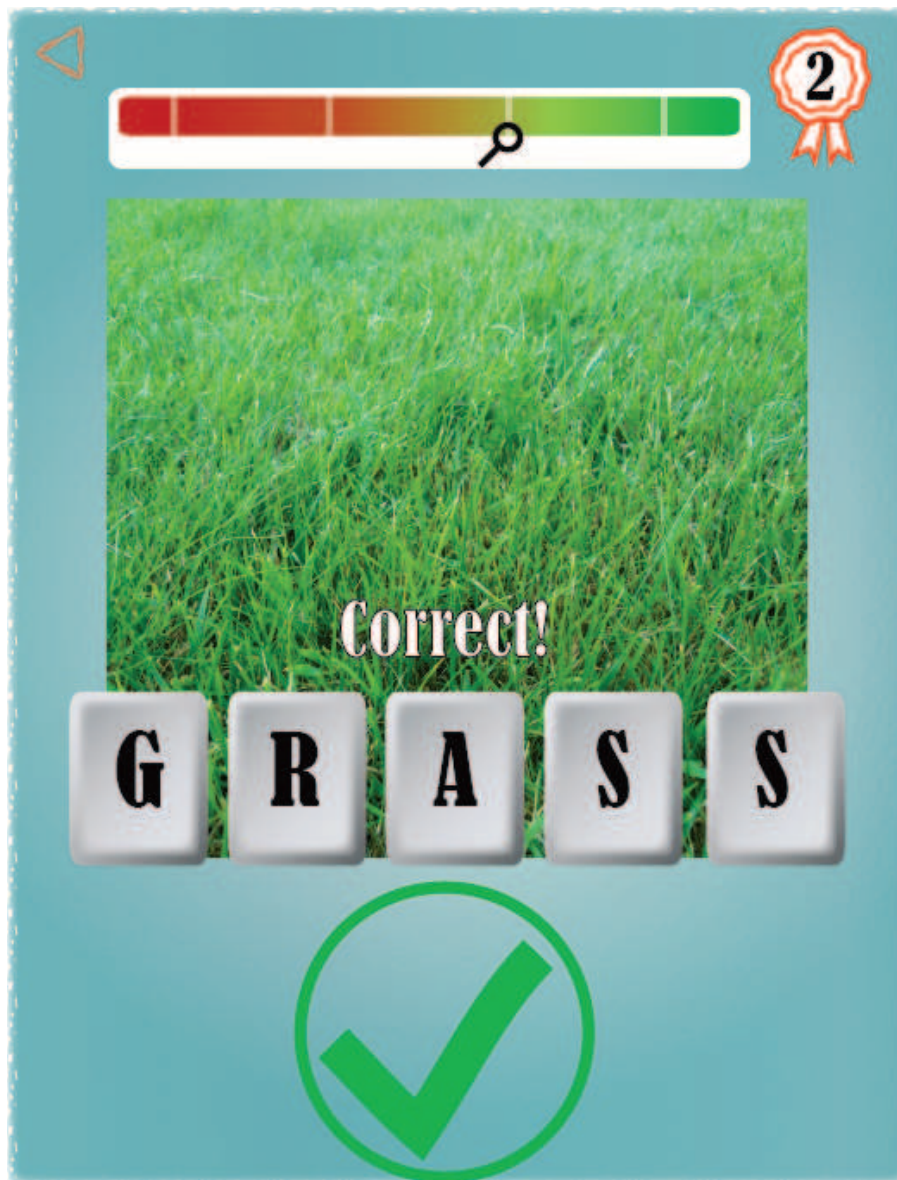


Figure 5.5: How the screen looks when the players have guessed correctly.

6

Discussion

As stated in the introduction the aim of this thesis was to create an interactive engaging experience for people with dementia. This chapter covers the discussion around the choices made to reach the final result of the thesis.

6.1 Ethical Aspects

When implementing something for people with an impairment it is especially important to handle everything with care to make sure the research or work is not affecting the way that they feel while conducting interviews or exercises. There is a big risk for ethical issues to arise when working with people that have a disease, mostly because there can be a greater challenge to address them correctly and frustration might appear because there is a possibility that the intended users act or think differently from healthy participants. Of course, this is an issue with all designs because people are of a nature different, but to act with extra caution is particularly important in the beginning of the project because it might take a while for the designer to get to know the intended user and their way of living.

6.2 Challenges

For every project there are challenges, in this project one of the greatest challenges was the testing phase. When working on a project that results in a prototype a test with the future users would be the perfect way to make a final evaluation and conclusion of the result. To accumulate surveys and ask the participants how they felt during an exercise would help a lot in the implementation of the design. The problem when working with and for people with dementia is that they might not be able to express how they felt during a test, some might not even remember it. For the same reasons it will be difficult to conduct tests with the subjects if the prototype is not fully working. If the subject would be a healthy elderly person it would be easier to explain that the prototype is not in its fully finished state. However, in this project it has been considered that the intended users have dementia and will most likely have a difficult time taking in too much information at once. Knowing that dementia is a broad disease it would also have been difficult to determine how much information is too much, since the users can be and seem aware at one moment but after some time they might have forgotten everything that has been explained.

The challenge of not being able to conduct tests with the real end-user affects the

end result and conclusion. Observations of the end-user maneuvering the prototype could of course be done but it would not result in a true picture of how it affects them since the prototype would not be fully implemented and working. If something would go wrong during the test there is a greater possibility that they could maybe not even understand enough to explain it. Here there is a need to make sure the subjects understand the task, meaning that it has to be thoroughly explained to the people with dementia beforehand. Which is why it should be noted that the evaluation has not only relied on replies from the intended users directly but rather from their facilitators.

6.3 Methodology

To use a methodology which focuses on the analyzes of conducted observations and interviews was key in this thesis. Having reached the end of the time frame—the choice of method can be evaluated and it can be stated that it was a good idea to use a design process that puts big focus on the analyzes and pre-face of the design. However the partition of the different iterations could have been thought over further. The first phase took longer than anticipated, leaving the other iterations with less time than planned for. However, if less time would have been spent on the divergence phase the risk of not having enough knowledge about the area before moving on to ideation would be bigger.

6.4 Results

The main objective with this thesis was to design an experience that will help improve the quality of life for elderly. By using pictures in the game the players will be able to carry on a conversation even if they do not understand the play of the game. The game was mainly designed with use of the observations of the activities, following the research of the hardware of different technologies that can be used when designing for people with dementia. By choosing multi-touch screens for the design of the game there was a possibility to make a prototype that actually could have been tested in the true environment if more time had been at hand.

The final prototype, presented in chapter [?], was shown to the psychologist that the thesis student have been in contact with throughout the project. Questions were formulated to see whether or not she believes that the interactive engaging experience can be beneficial to improve the quality of life for people with dementia. The questions were asked and answered in Spanish but for the purpose of this thesis they have been translated and are shown below:

1. What are your thoughts on people with dementia using iPad's, or similar tools, in their everyday lives?

I think if used with care and not with people that have critical cognitive impairments there should not be a problem. Of course some might not be able to maneuver it but since there most of

the time will be a care facilitator with them when doing activities anyway.

2. Do you believe that the aim to reach different cognitive levels through this game has been reached?

It is difficult to say before I have tested using it.

3. Would you, as an expert in the field, consider using a tool like this when working with your patients?

Yes.

4. Can you imagine your patients response to this game?

Since the focus group of this thesis are not people that suffer from severe cognitive impairments I think that there is a good chance that the responses would be positive, especially if we were given the opportunity to actually play it with the group size that you designed for.

5. Do you see the patients taking initiative to use this game to interact?

That is a difficult question to answer seeing as we have not used the game in the facility. But I believe that focusing the game on conversation could strengthen the patients desire to play.

Additional to the interview Dr. Barea also made some suggestions about the interface of the design, informing that she is not sure that the patients of the care facility will be able to understand that they can zoom a picture.

6.5 Future work

The time frame of the project conducted through this thesis was unfortunately not big enough to carry out all iterations that the thesis student would have wanted, therefore the work will continue outside of the thesis scope. The work that follows after is to create a prototype that is fully functioning and use this to make an observation of how the intended end-users interact with it. Even though it will be difficult to know for sure how they experience the game there would be an easier possibility to observe.

7

Conclusion

One of the objectives of this thesis was to find out whether and under which conditions multi-media technology-based experiences can improve the quality of life for people with dementia and moreover express how it could be possible to design such an experience in a way that makes people with dementia keen on using it as an activity in their everyday lives. Through the results of the evaluation of the thesis from the experts it can be said that a multi-media technology-based experience can be implemented to be used in the environment of people that are living with dementia. Seeing that there is a difficulty to test the experience because the prototype is not fully functioning there is lack of testing done to surely say that an experience like the one this thesis project resulted in can improve the quality of life for people with dementia.

Moreover it was shown through analyzing the existing activities in the care facility and the technology-based activities that already existing media on the market lacks experiences that have a strict focus on the quality of life for people with dementia. The activities that are on the market have primarily other focus', such as physical or cognitive health.

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Appendix 1