Improving the quality of life through gamification:

Making going outside more fun for elderly people

Sozialdienste Götzis

Mark Wong

Andreas Künz, Mag. – FH Voralberg University of Applied Sciences
Richard de Koning, MSc. – Amsterdam University of Applied Sciences

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Name
Mark Shuö-lin Wong

Student number
500708724

Phone number
+31654344910

University
Amsterdam University of Applied Sciences

Study
HBO-ICT Game Development

Year
Semester 2, Year 4

University mentor
M.sc. Richard de Koning

Company mentor
Andreas Künz, Mag.

Company name
Sozialdienste Götzis

Company address
Schulgasse
Götzis, Austria

Company phone number
+43 5572 792 7303

Date
14/08/2018

Location
Dornbirn, Austria

Summary

When you become older it is important to maintain an active lifestyle. An active lifestyle has been proven to be the recipe towards healthy ageing. This paper presents a product to motivate elderly people to go outside and be physically active through the use of gamification. The elderly people are between the 60 and the 80 years old and live in an assisted living home. First the target group's needs, wishes, pains and gains are explored. Research has been done to map the target group's wishes, pains and gains. Data is collected through three methods: interview, observation and conducting previous done research. The data was then visualized through an empathy map, which could then be conducted during the design phase. The target group is computer illiterate and most of them have a mental restriction. This means that special care should be taken regarding the design of the product. Their current behaviour is researched; most residents already have a light motivation, but they need a little extra push from the caretakers to go outside. The proposed concept should provide this push.

Following this a theoretical frame is made of human motivation theory and gamification. Following this requirement engineering is performed through: interviews, empirical research and brainstorms have been used to create a MOSCOW. In addition, the desired behaviour is decided as well: residents go outside for approximately 30 to 60 minutes every day, regardless of the physical intensity. To prevent making something that has already been done, previous done projects have been researched.

Based on the requirements and previous done project a concept is created: Pic to go. Pic to go is a photography concept which combines walking/hiking and photography into one. The goal is to increase the resident's physical health style by motivating them to go outside and be physically active. Residents receive a theme and can go outside and take photos related to this theme. In the common room, their pictures will appear on the TV screen. At the end of the theme a slideshow can be watched of all the taken photos. To maintain the mental model of the residents, a special smartphone case was made to make the smartphone look like an old camera.

 Three tests were done, and the overall impression is that people are interested. Four out of the five people enjoyed the photos on the tv screen and four out of the five people experienced taking the camera with them for a walk as non-pleasant. They found the camera too difficult to use/too much of a hassle. The camera did not behave enough like an old camera, and because of their mental restrictions the camera had to be explained repeatedly. As a result, residents felt overwhelmed and discouraged. They lost their interest quickly, often within a couple of days. Improvements would be to redesign the camera case, simplifying the user journey and making it possible the residents can see their progression.

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1 INTRODUCTION

When you become older it is important to maintain an active lifestyle. An active lifestyle has been proven to be the recipe towards healthy ageing. Positive effects include: prevent disease (osteoporosis, coronary artery disease, and non-insulin-dependent diabetes mellitus), decrease the risk of falling, improve sleep, enhance mood and general well-being, improve blood pressure and decrease relative abdominal fat (Resnick, Orwig, Magaziner, & Wynne, 2002). But often it is difficult to maintain this lifestyle.

> But often this group require assistance and support in sustaining their intrinsic motivations to maintain a healthy and fit lifestyle. Older adults feel amotived, confused and unsure of the complex fitness offering available in the marketplace and the adaptability of these program to suit their specific needs. (Kappen D. L., 2015)

To make maintaining this lifestyle easier, gamification can be used to gamify the exercises or provide an extrinsic motivation to pursue a healthy lifestyle. This paper describes a product which motivates elderly people to go outside, through the use of gamification.

1.1 BACKGROUND

The research presented in this paper is part of an Erasmus+ project between five universities: Amsterdam University of Applied Sciences(Amsterdam, Netherlands), Voralberg University of Applied Sciences(Dornbirn, Austria), Norges teknisk- Naturvitenskapelige Universitet(Trondheim, Norway) and Hochschule Bonn-Rhein-Sieg (Bonn, Germany). This collaboration spans across several disciplines: Game Design, Game Technology, Software Engineering, Mechanical Engineering and Human Science Movement. Every university delivered one student per team. Making each team consist of one team member per discipline. Each team collaborates on their own project with their own theme. However, all the themes are related to the overarching theme "Game and welfare technology". In total there are four multicultural and multidisciplinary teams. The projects are done together with a non-academic partner. These partners are situated in all the above-mentioned countries, except for Germany. This paper discusses the project with the non-academic partner in Austria: the Sozialdienste Götzis.

In 2002 the town of Götzis, a town in Vorarlberg, outsourced its social service to a private company: The Sozialdienste Götzis. The Sozialdienste is a private company fully owned by the local municipality. The company is not a non-profit organisation; however, their goal is not profit oriented. The company provides a wide range of social services and supports the work of the community's social department. The Sozialdienste has two social centres, also known as "Häuser der Generationen". One in Götzis, opened in 2005. And another one in Koblach, opened in 2016. This project focusses on the Koblach location 'Haus Koblach'. Haus Koblach is a complex which exists of three buildings. In the Wegeler 8 building the entire third floor is occupied by the Sozialdienste. On the lower two floors are four apartments which have care organised by the Socialdienste. The remaining Is private rented. On the third floor are twelve apartments, a common space and kitchen. Each apartment has their bed- and bathroom. For lunch the residents go to Haus Koblach, which is next the Wegeler 8 building. Finally attached to this building is the Wegeler 12 building where people with higher care live. The scope of this project is only on the Wegeler 8 building, third floor. Currently there are 11 residents living here (nine female and two male). The residents (the target group)

consists of men and woman between 50 and 80 years old. During the day there is a caretaker available to help the residents with their daily routines: e.g. changing clothes, going to the toilet and showering. There is always a caretaker between 7:00 and 21:00. In addition to the caretaker there is a nurse, with a nursing degree, available 70% of the time.

The project had a welcome week in Amsterdam in October 2017, and a mid-project week in Bonn (Germany) in January 2018. In the Amsterdam week the problem definition and scope had been defined. The problem definition and scope were used for the brainstorm session to come up with several concepts. One of these concepts was chosen and developed as a low fidelity prototype. This prototype was presented in Bonn to Marika Widmann from the Sozialdienste Götzis. Marika was there both during the Amsterdam and Bonn week to give feedback on the prototype.

1.2   RESEARCH QUESTIONS

The main goal of this paper is to provide the residents of Haus Koblach with a product, which extrinsically motivates them to go outside. The secondary goal includes: ease of use and fun to use. Whereby the latter is achieved through gamification. The product has a soft- and hardware component and is specifically created for the eleven residents of Haus Koblach. This makes it easier to adjust and personalize the concept to align with the target group's needs. That makes the following problem statement:

How can we motivate elderly people between 60 and 80 years old living in an assisted living home, to go outside on their own incentive by designing a soft- and hardware tool which uses gamification elements and is integrated into their daily life's as less technologically intrusive as possible?

First the target group should be identified and defined; their needs, wishes, pains and gains. A theoretical frame is created around human motivation and gamification. Following this their current behaviour is identified, and together with the stakeholders the desired behaviour (what is the behaviour change that should happen?). Then, there has been looked at previous done projects, sharing this goal. Finally, an implementation is developed and tested.

- What is our target group's needs, wishes, pains and gains?
- What is the target group's current behaviour, and what is the desired behaviour?
- What is human motivation and how can you motivate the target group to go outside by themselves and maintain this?
- What has already been researched and tested regarding motivating elderly people to go outside?
- What is gamification and how can you integrate this as less technological intrusive as possible into elderly people's life?

1.3   RESEARCH PHASES

The research roughly comes down to the following four phases:

1. Research phase
   Explore the problem context and get to know the target group through interviews, observations, conversations and previous done user research by the Fachhochschule Voralberg (FHV). The residents only know German; thus, translations were done together with a staff member or colleague from the university. The collected data is put together in an empathy map (Appendix B), which gives an overview of the targets group sensory

experience. After that a theoretical framework is setup of main concepts: gamification, serious games and motivational theory.

2. Design & Implementation

   A set of requirements is setup by requirement engineering. This set of requirements contain the desired behaviour among others. Based on these requirements, a concept is brainstormed. This concept is prototyped in paper and digital form. It is then implemented, and a first interactive prototype is created.

3. Evaluation

   Testing of the interactive prototype on location in assisted flats in Koblach. Both short and long tests are done. Focusing on emotional response, engagement rate and ease of use. Taking the scope of this project the long-term effects cannot be measured within this project. Test results are noted, and improvements are suggested.

4. Conclusion & Future work

   Based on the research and test results, a conclusion is drawn of the interactive prototype. The paper closes with suggestions for future work.

2 TARGET GROUP'S BEHAVIOUR

In human centred design the target group is always the vocal point of the design. Their wishes and needs are what drives the design, therefore this chapter explores the target group's: goals, gains, pains and sensory experiences. Next to these the current behaviour is mapped as well. To achieve this the following methods have been used: interviews (with both the residents and caretakers), observations and conducting previous done research. The findings will be used to create an empathy map, which can then be used as a reference for the design process.

2.1 USER GROUPS AND RESEARCH

User research has been conducted with the two user groups: residents & caretakers. Three methods have been used: Interview, observations and the empathy map. The findings from the interview, observations as well as previous done research by the Fachhochschule Voralberg (FHV) have been used for the empathy map.

Below, both user groups will be introduced and what their needs and goals are for this project. Both of the groups are the so called 'end users'. An end user is a person who ultimately uses or is intended to ultimately use a product (Legal Information Institute, 1989).

Residents

The residents are the people who live in Haus Koblach. This group consist of elderly people between the 60 and 80 years old and is the group for whom the concept is designed. They live in an assisted living home, which means that they need support and are not completely independent. Most of the residents also have some sort of mental restriction. Right now, this group tends to stay inside if they have no reason to go outside. It is considered healthy for them to go outside at least once a day, even if it is for a short time span. The goal is to provide this group with an incentive/motivation to go outside daily.

Caretaker

The caretakers are the staff members who work at Haus Koblach. Their jobs include cleaning, helping the residents, socializing with them and encouraging them to go outside. They do this by telling them: "The weather outside is good", "Sun is good for you" or "Can you go for shopping?". The goal of this product is to take this activity (giving the residents a "push") away from the caretaker and reduce their workload. However, they do have to maintain the concept and validate the taken pictures. The end result should at least not create more work. Although, it is expected this will occur in the beginning.

Interview

Two interviews have been done by student groups from the FHV in the past. These interviews focused on the resident's life, technical affinity, daily routine and game experiences. Below are some of the most interesting results regarding the research question.

Q: Do you like to play? If so, which games do you like? Do you enjoy playing multi-player games? Do you like the competition in the game?

A: We like to play games and frequently there are groups playing "Mensch ärgere Dich nicht" or "Triomino" (a kind of Domino) together. Some people also prefer to play indicidual games (puzzles, patience, etc.). According to Marika Widmann, it often takes a push to get everyone playing, but

when they do they play gladly. Also, some people do crafts depending on skills. (Koblach, FHV interview team A, 2017)

Q: What modern techniques do you use? Mobile phone, smartphone, tablet, PC. Why do not you use your mobile phone, smartphone, tablet, PC? Are you interested in modern technologies?

A: Everyone has a cell phone, but no one a smartphone, tablet or PC. They are not interested into learning new technology, even the simplest applications. Almost everyone has an own TV (there is also a shared TV in the common room). TV channels are available via cable, which is available to everyone. E. has no TV. W. likes to look crime and would like to see more animal films. When it comes to documentaries, there is one other resident reported and said that she also likes to look. A also said that he cares about quiz shows. A. has a landline phone in addition to the mobile phone, with big buttons, as well as the mobile phone, and shortcuts to the family. (Koblach, FHV interview team A, 2017)

Q: Describe your favourite games (board card games etc)

A: No games - drink coffee, watch news
Man does not annoy you, Jassen
11er out!
City-Country-River
Social (Koblach, FHV interview team B, 2017)

Q: What is your daily routine?

A: Everyone has breakfast between 7 and 9. After that activities vary: Shopping, walking, choir, flower watching ... Mostly alone, but they do not mind that. In the evening is usually very quiet, until 8 o'clock some resident still pursues activities, after 8 they go back to their room. (Koblach, FHV interview team B, 2017)

Since the last done interviews, a couple of people have switched in Haus Koblach. Thus, a new interview will be done with the residents. In addition to the residents a small interview with a caretaker has been done as well. A semi structured interview was done with four of the eleven residents. Two females and two males. Beforehand, a list of questions had been prepared covering numerous topics such as: their daily life/routine, favourite activities, technical affinity and social interaction (Appendix A). The interview started with one resident in the living room. During the interview other residents would join the conversation and leave. Their lack of concentration and other plans changed the planned formal interview into an informal one which came closer to a conversation. The interview was not solely led by the questions, rather on what topics the residents wanted to talk about. When the resident steered too much away from the topic, a follow up question would be asked to steer them back. Since all the residents do not speak English, the interview had been done together with a colleague student from the FHV. The complete results of the interview are in Appendix A, but some interesting results are below.

- There is only one person owning a smartphone, however she doesn't make use of the smartphone 'capabilities'. She only uses it for sending a text message or making a phone call.
- One person had experiences with a film camera, but not with a digital camera. However, she would be interested into trying one. In fact, multiple people be interested into trying a digital camera if it was available for their use.
- One resident was already thinking about motives to take pictures, or specific objects that he wanted to photograph.

- The described daily routine from one resident: wake up; eat breakfast; read some comics or the newspaper; eat lunch; socialize with people and sometimes take a nap, if the weather allows it he goes to a pond nearby; eat dinner; play card games or watch tv in the evening. It's a very passive routine where he stays inside/non-active most of the time.

In addition to the residents a small interview with a caretaker has been conducted as well. The most interesting points were:

- 8 residents go outside by themselves without being pushed by the nurses, 2 residents don't go outside or only with a strong push and lastly there is 1 person who sometimes goes out by him- or herself and needs an extrinsic motivation occasionally.
- The goal is that everybody is going outside for at least 30 minutes per day.
- Reduce the workload from the caretaker, by not having to motivate the residents to go outside.
- It would be nice to stimulate social contact between the residents.
- The complete application must be in German, because both the residents and caretakers don't know English.
- The caretaker mentions that the residents are aware of the fact that going outside is healthy to them.
- You need a "reason" to get the residents to go outside. Such as: Buy something, do choirs or a popular one, "The sun is good for your skin, vitamin D".

Survey

To get an overview of the resident's habits in terms of their daily physical activities, a survey (Appendix B) has been conducted with 9 of the 11 residents. The survey asked the following three questions:

1. How many times per week do you go outside for a walk or other physical activities?
2. How long does these sessions usually last?
3. What kind of physical activities do you perform?

Table 1 shows all the survey results.

Resident number	Times per week going outside (days)	Time of these sessions (minutes)	Kind of activities
1	7 (if the weather allows it and if in a healthy state)	60 – 90	Exercises for therapy, gymnastic with instructor, walking with a rollator, walking with walking sticks
2	1	60	Walking, gymnastic
3	7 (if the weather allows it)	60	Fast walking with a rollator (prefers going alone, because others are too slow)
4	7	60	Walking with a rollator, gymnastic
5	7 (multiple times per day)	120 – 180	Walking fast, gymnastic
6	7	60 – 90	Walking, gymnastic
7	3	45 – 60	Walking, hikes, biking (likes to do things alone)

| 8 | 7 (multiple times per day) | 45 – 120 | Walking (sometimes with a dog), hiking (with a group), gymnastic |
| 9 | 3 – 4 | 45 – 60 | Walking, biking, gymnastic (by herself) |

Table 1. Survey Results on Weekly Physical Activity Behaviour

As noted two residents did not participate in the survey. According to the caretaker there is one other resident next to resident number 2 which does not go outside on their own, unless strongly pushed by the caretaker. All nine residents share walking as an activity among them. Next is gymnastic which seven residents do.

Empathy Map

An empathy map is designed to gain a better understanding of the target groups behaviour. Gamestorming describes the empathy map as a tool that "helps teams develop deep, shared understanding and empathy for other people." (Gray, Brown, & Macanufo, Gamestorming: A Playbook for Innovators, Rulebreakers, and Changemakers, 2010). The empathy map's purpose is similar to that of a persona. However, while a persona describes a lifestyle, it does not necessarily describe their (sensory) experiences (MediaLAB Amsterdam, 2016). In this case the empathy map is an addition on top of the persona to create a deeper understanding and more expanded view of the user's behaviour. See figure 1 for the empathy map template (Gray, Updated Empathy Map Canvas, 2017).
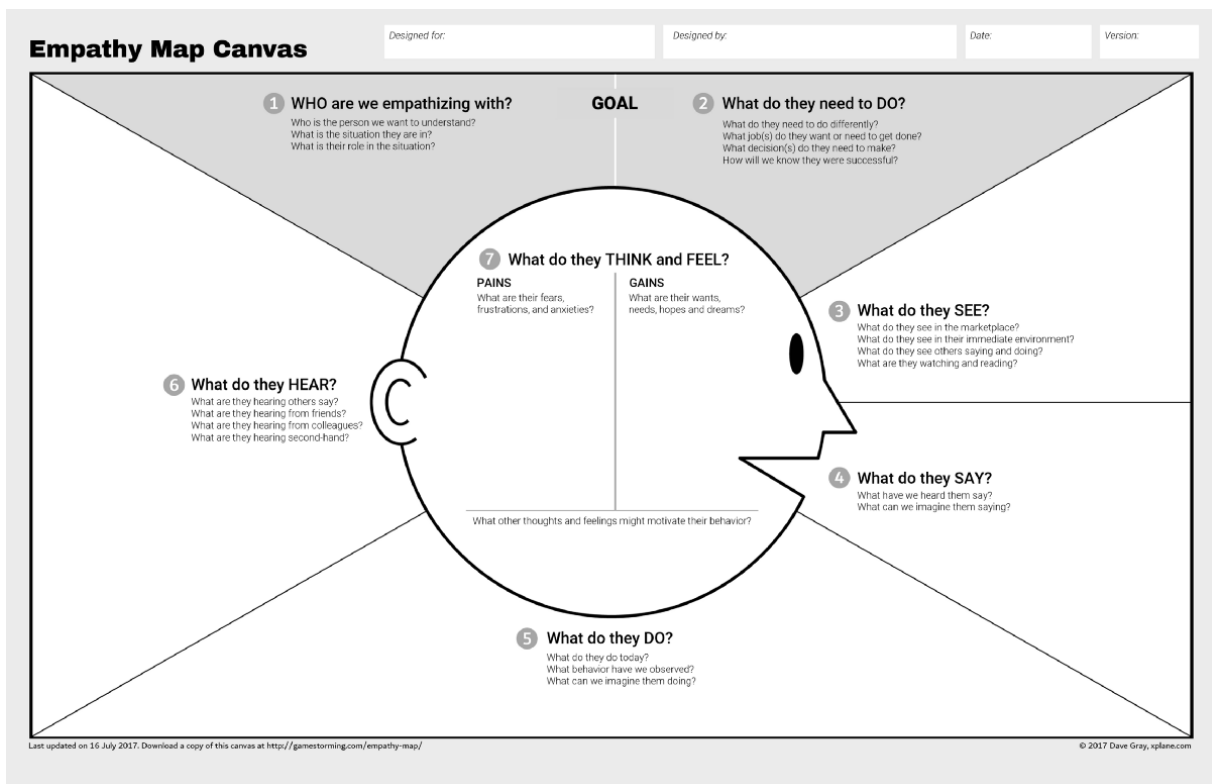

Figure 1. An Empathy Map (Gray, Updated Empathy Map Canvas, 2017)

Dave Gray describes the usage of this template the following way:

1. Start with writing the goal sections by defining **who** will be the subject of the empathy map and what you want them to **do**.

2. Continue working clockwise covering Seeing, Saying, Doing and Hearing. This way of working provides a sense of what it "feels to be like them"
3. After you have completed the outside circle you finish by filling in what the target group **thinks** and **feels**.

(Gray, Updated Empathy Map Canvas, 2017)

The empathy map has been created with another student from the FHV, who has prior experience with the target group. She has done interviews (Koblach, FHV interview team A, 2017) and observations with them in the past, thus possess a more grounded impression. After making the empathy map, a caretaker has verified it in case they wanted to add something. The goal has been identified as *motivating the residents to go outside*. The emphasis is on pushing the residents to go outside, regardless of the activity's intensity. Summed up are some of the results, figure 2 shows the full made empathy map. It is noted that residents cannot do two things at the same time. When they walk and want to talk as well, they stop what they have been doing previously. They are also very social and like to talk (about themselves, their health or past). Note that all the results in the empathy map are a mix of both empirical and anecdotal experiences and observations.

Figure 2. Empathy map of the target group

2.2   EXPLORING HUMAN MOTIVATION

When people have their own reasons for doing something, they believe those reasons more deeply and adhere to that behaviour more strongly. This phenomenon is also known as "motivation". It can be defined as those forces within an individual that push or propel him to satisfy basic needs or wants (Yorks, 1976). It drives all aspects of human's behaviour, somebodies: goals, aspirations and motivations. Abraham Maslow wanted to understand what drives the motivation behind people's behaviour. He believed that individual people are good at will and possess a motivation unrelated to a reward or unconscious desire. To better understand them he studied a monkey's behaviour. He observed that there was a pattern which the monkey's used to prioritize their actions. If there was food and play, they would always prioritize food

Figure 3. Maslow's Hierarchy of Needs

over the other. The same happened when the monkey had to choose between water and food. They would choose water, because that one is more important than food. He later transferred this theory over to the human behaviour and created the Hierarchy of needs. The hierarchy of needs is divided into five different layers: Physiological needs, Safety needs, Belonging needs, Esteem needs and Self-actualization. The lower four levels exist of "deficit needs". This is when an individual does not have enough of something. For example, when individuals eat and drink, their need for food has been temporarily satisfied, and they can move up in the pyramid. Food & Drink are a deficit need. It is important to consider that a deficit need does not have to be 100% fulfilled. 'More or less' is sufficient enough to move up to the next level. (Poston, 2009) (Boeree, 2006). The highest level in the pyramid 'Self-Actualization' is a 'being need'. Being, in this context means your spiritually self being. This layer involves the desire to "be the best of yourself" and the fullest version of "you". To do this, all your deficit needs must be satisfied. Otherwise, you can't fully devote yourself to your protential. (Poston, 2009) (Boeree, 2006). These needs form the basis of The Self Determination Theory (SDT). SDT is a human motivation theory concerning human's inherent growth to develop themselves and their psychological needs. This motivation is inherent to every person. SDT defines two types of motivation: intrinsic (autonomous) and extrinsic (controlled). With intrinsic motivation somebody is motivated to do actions for fun or challenger, rather than because of external pressure or rewards. This form of motivation is the most powerful one, because it comes from out the person himself (Ryan & Deci, 2000). Similarly, Maslow believed that people have an intrinsic motivation to develop themselves, this motivation is inherent to that person. Extrinsic motivation, on the other hand, comes from external factors such as rewards & punishment and leads to a separable outcome. Their action is only partly internal and energized by factors such as an approval motive, avoidance of shame, ego-involvements and contingent self-esteem. With controlled motivation the individual feels pressured to feel, behave or act a certain way. A relevant example of controlled behaviour would be social pressure. (Deci & Ryan, 2011). External factors are most commonly extrinsic rewards. Rewards come in two forms: extrinsic and intrinsic rewards. Extrinsic rewards (sometimes also called external rewards) are tangible (money, objects or benefits), while intrinsic rewards (or internal rewards) are non-tangible (sense of accomplishment, praise and recognition).

Important to consider is the effect of extrinsic rewards on somebody's intrinsic motivation, the following has been concluded:

- Rewards do not decrease intrinsic motivation
- When expected tangible rewards are given to individuals simply for doing a task, intrinsic motivation decreases
- verbal praise increases intrinsic motivation

(Cameron & Pierce, Reinforcement, Reward, and Intrinsic Motivation: A Meta-Analysis, 1994).

The first and second may sound contradictory, but it comes down to the expectations. If a reward is expected, the intrinsic motivation is negatively impacted because the attention shifts from enjoyment to gaining the reward. (Cameron & Pierce, Reinforcement, Reward, and Intrinsic Motivation: A Meta-Analysis, 1994) (Cameron, Bank, & Pierce, Pervasive Negative Effects of Rewards on Intrinsic Motivation: The Myth Continues, 2001) (Lindenberg, 2005).

Based on the budget, wishes of the caretaker and the target group, non-tangible rewards are preferred.

3   GAMIFICATION FOR ELDERLY PEOPLE

Games have traditionally been known as an entertainment medium. Originally a trivial activity played in arcades, games have come a long way to the social accepted product it is now (McCallum, 2012). More than merely a form of entertainment, games have come a long way in the last half century. Nowadays, there are two kinds of games: Serious games and Entertainment games. This chapter focuses on serious games and gamification. Providing a model for effective gamification: the kaleidoscope of effective gamification.

3.1   THE DEFINITION OF A (SERIOUS) GAME

In game studies there is a difference between *game* and *play*. On a high abstract level, the difference is that games are structured with rules, while play is a more free-form. Salen and Zimmerman define games as: *a game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome*. While they define play as: *play is free movement within a more rigid structure* (Salen & Zimmerman, 2004). To elaborate Roger Callois categorised in his 1958 book *Man, Play and Games* four fundamental types of play:

1.   Competitive play, or agôn
2.   Chance-based play, or alea
3.   Make-believe play, or mimicry
4.   Vertigo play, or ilinx

Callois further divides these with the concepts of ludus, or rule-based play, and paida, or free-form, improvisational play, see table 2. (Caillois, 1961)

	Free-form play (Paida)	Rules-based play (Ludus)
Competitive play (agôn)	Unregulated athletics (foot racing, wrestling9	Boxing, billiards, fencing, checkers, football, chess
Chance-based play (alea)	Counting-out rhymes	Betting, roulette, lotteries
Make-believe play (mimicry)	Children's initiations, masks, disguises	Theatre, spectacles in general

Table 2. Examples of different types of play (Caillois, 1961)

There is a lot more substance to the concept of play. However, "gamification" relates to game (Ludus), and not Play (Paida) (Deterding, Dixon, Khaled, & Nacke, 2011). Therefore, the rest of this thesis focuses on Game rather than Play.

As defined earlier, "a *game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome*". Games exist of rules, rewards, mechanics, feedback and other elements which will be discussed in 3.3 Relevant game design elements

Serious Games

As mentioned above all games have a certain set of standard features which they have common. This set of features such as mechanics, rules and conflicts make them a game. Most of these games have entertainment as their primary purpose (Video Game). However, next to this type of games are the serious games (Serious Game). Serious Games are defined as: *"Games that do not have entertainment, enjoyment or fun as their primary purpose"* (Michael & Chen, 2005)

In figure 4 Wattanasoontorn, Boada, Garcia and Sbert breaks Serious Games apart in three main components: Developer Team, Serious Games and Player. The Developer Team are the people who are creating the Serious Game. The Developer Team uses Tools, Content and Technology to make a Serious Game. The Serious Game will be used by the Player through Special Equipment on a Platform. The components within the dashed red box are the ones relevant to this project.

A Serious Game has both an objective and a genre. A game can have two types of objectives: Explicit and Implicit. An explicit objective is entertainment, while an implicit objective includes increasing skills and abilities, gaining knowledge or acquiring experiences. Serious games have both an implicit and explicit objective (Wattanasoontorn, Boada, García, &

Figure 4. The individual components of a serious game

Sbert, 2013). Most of the Serious Games have education, training and informing in an effective and incisive manner as objective, but also practiceing, testing, simulation, diagnosis and treatment can be objectives (implicit). While entertainment games solely focus on entertaining the player (explicit). Next to an objective a Serious Game has a genre, which are categorizations for a game's gameplay. Exergames combines exercising with gaming, while action games test your reflexes, hand-eye cordination and response time to overcome obstacles e.g.

The players are the target group of the product. At the core this group influences every decision surrounding the game design. Their player type, age, culture, game experience and even gender influences the design. Paragraph 3.3 will go deeper in on the different player types and how to design for them.

Furthermore a Serious Game has both a platform on which it will be publishes and special equipments which it needs to function. The platform and equipment choice will be influenced by both the players and objectives & genres.

The relationship between Video Game and Serious Game

As mentioned earlier a Serious Game is a game that does *not* have entertainment as his primary purpose. However, this does not rule out an entertainment game could be used as a Serious Game. Djaouti, Alvarez and Jessel have created a model which represents the relationship between a Serious Game and Video Game, see figure 5. From left to right starting with the Video Game which is *designed* and used as a form of entertainment. Next comes the Video Game which purpose has been "shifted" by the user. These games are considered "purpose-shifted" video games. Example would be
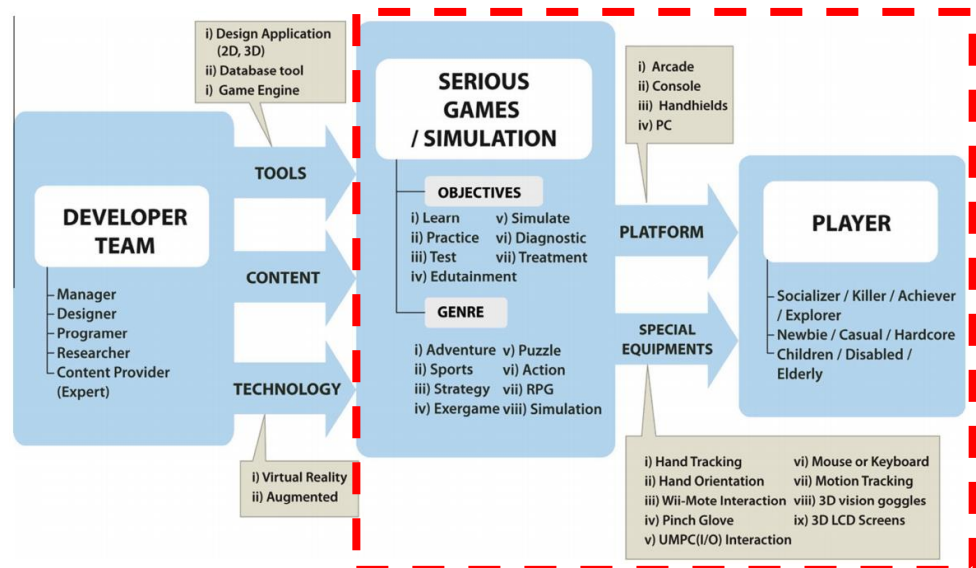
Simcity, which teachers can use to teach students about city planning. In the middle you will find "mods", abbrevation for modification. These are software modications to existing Video Games to make them serious. The difference between mods and Serious Games designed from scratch is in the relationship between the designer of both the "game" and "serious" dimensions. While a designer from a
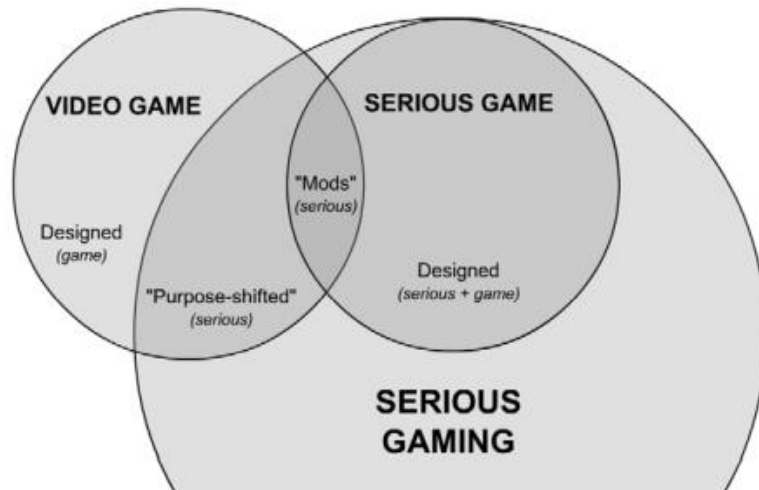

Figure 5. The relationship between Video Game and Serious Game (Djaouti, Alvarez, & Jessel, 2011)

Serious Game has full creative control, the other only designed the "serious" dimension which they then had to fit into a pre-existing "game". Last there is the Serious Game which has been designed from scratch to be serious, while maintaining the "game" part of the Video Game which makes it "fun". Djaouti et al. propose that Serious Gaming is the umbrella term for the use other than simple entertainment, whatever the original intention of its designer was (Djaouti, Alvarez, & Jessel, 2011). In the case of this project, a designed serious game is made. It is created from scratch especially for this target group.

3.2   THE DEFINITION OF GAMIFICATION

Gamification uses motivation principles to engage human behaviour and it can make dull tasks more playful (Flatla, Gutwin, Nacke, Bateman, & Mandryk, 2011). Playful systems incorporate aspects of fun, motivation, challenge and experience. (Kappen & Nacke, 2013). Unlike Serious Games, "gamified" applications only use several game design elements. Essentially not making them considered full proper games. Full proper in this context meaning that they fulfil all necessary conditions for being a game. From the perspective of the designer what sets the two apart is the intention; is the designer developing a system with game elements, or a proper full game (Deterding, Dixon, Khaled, & Nacke, 2011). Deterding, Dixon, Khaled and Nacke propose the definition of gamification as: *the use of game design elements in non-game contexts* (Deterding, Dixon, Khaled, & Nacke, 2011). They broke down each of the different elements of this description:

- *The use* (rather than extension) *of*
- *design* (rather than game-based technology or other game related practises)
- *elements* (rather than full-fledged games)
- *characteristics for games* (rather than play or playfulness)
- *in non-gaming contexts* (regardless of specific usage intentions, contexts or media of implementation)

On a high level this means that gamification exists of the four parts: system, game elements, game design and context. Below described what each of these four building blocks consists of.

System

This is the application/system that is going to be "gamified". This can be anything from a website, mobile application, installation to an experience.

Game Element

As mentioned earlier there is a subset of elements which every game should have to be considered a game. In the "Ten Ingredients of Great Games" Reeves and Read identify a set of 'game elements' which are essential to games: Self-Representation with Avatars; Three-Dimensional Environments; Narrative Context; Feedback; Reputations, Ranks and Levels; Marketplaces and Economies; Competition Under Rules that Are Explicit and Enforced; Teams; Parallel Communication Systems That Can Be Easily Reconfigured; Time Pressure (Reeves & Leighton Read, 2009). It is important to take into consideration that this list vastly differs depending on the game, target group and type of game. Let alone which elements are considered fun to the target group and which not.

Game Design

Gamification is not the only place where elements of games have been repurposed. In Human Centred Interaction it has been a long tradition to use game controllers as input for other tools. Game tools have been used for non-entertainment purposes such as scientific visualizations, fan art and simulations. For the purpose of terminological and conceptual clarity, this definition applies to the usage of game *design*, not game-based technologies. Game design elements can be divided into five different layers. The layers express how abstract or concrete a game design element is. In order from concrete to abstract: Interface design patterns; game design patterns or game mechanics; game design principles, heuristics or 'lenses'; conceptual models of game design units; game design methods and design processes. See table 3.

Level	Description	Example
Game interface design patterns	Common, successful interaction design components and design solutions for a known problem in a context, including prototypical implementations	Badge, leader board, level
Game design patterns and mechanics	Commonly reoccurring parts of the design of a game that concern gameplay	Time constraint, limited resources, turns
Game design principles and heuristics	Evaluative guidelines to approach a design problem or analyze a given design solution	Enduring play, clear goals, variety of game styles
Game models	Conceptual models of the components of games or game experience	MDA; challenge, fantasy, curiosity; game design atoms; CEGE
Game design methods	Game design-specific practices and processes	Playtesting, playcentric design, value conscious game design

Table 3. Levels of Game Design Elements (Deterding, Dixon, Khaled, & Nacke, 2011)

Non-Game contexts

Regardless of where gamification is going to be used, for it to be considered gamification it has to be used for a different purpose than their normal expected use. Deterding et al. argue that while 'normal' is a socially, historically and culturally contingent word, it is fair to assume that currently

entertainment is the dominant purpose of games. While 'joy of use', engagement, or more generally speaking, improvement of the user experience represents the predominant use of "gamification".

3.3 RELEVANT GAME DESIGN ELEMENTS

Below are three game design elements described: mechanics, player types and rewards. These three are considered the most important in relation to this project.

Mechanics

Mechanics are the basis of a game. They are concrete and detailed rules, method or actions. They enable interaction with the game, thus creating gameplay. While closely related to rules, mechanics differ in the sense that the player does not have to know them beforehand. As example in Monopoly it would be unfair if only half the team knows about the "pass start get $200"- rule. A game is essentially a system with tons of mechanics interacting with each other, creating dynamics which in turn create aesthetics. The Mechanics Dynamics Aesthetics (MDA)-framework is a tool to visualize a game's system. The Dynamics are the behaviour that occurs when mechanics are interacting with each other on player input. Finally, there are aesthetics which are the emotional response from the player, also known as "fun". There are eight types of aesthetics:

1. Sensation
   Game as sense-pleasure
2. Fantasy
   Game as make-believe
3. Narrative
   Game as drama
4. Challenge
   Game as obstacle course
5. Fellowship
   Game as social framework
6. Discovery
   Game as uncharted territory
7. Expression
   Game as self-discovery
8. Submission
   Game as pastime

(Hunicke, LeBlanc, & Zubek, 2004)

It is important to notice that the player type (discussed below), age, gender to even cultural background can influence the MDA-framework of a game. Different people find different things fun, and this asks for a different approach to game design.

Player Types

Based on the type of players playing multiplayer online games, the Bartle taxonomy of player types was proposed by Richard Bartle in 1996 paper (Bartle, 1996). Tracy Fullerton expanded on these player types in her book 'Game Design Workshop'. She describes the following types:

- Competitor: Plays to best other players, regardless of the game
- Explorer: Curious about the world, loves to go adventuring; seeks outside boundaries— physical or mental
- Collector: Acquires items, trophies, or knowledge; likes to create sets, organize history, etc.
- Achiever: Plays for varying levels of achievement; ladders and levels incentivize the achiever
- Joker: Doesn't take the game seriously—plays for the fun of playing; there's a potential for jokers to annoy serious players, but on the other hand, jokers can make the game more social than competitive
- Artist: Driven by creativity, creation, design
- Director: Loves to be in charge, direct the play
- Storyteller: Loves to create or live in worlds of fantasy and imagination

- Performer: Loves to put on a show for others
- Craftsman: Wants to build, craft, engineer, or puzzle things out
(Fullerton, 2008)

Consider the player types on an axis, the horizontal-axis represents preference for interaction with another players vs the world. The vertical-axis represents interaction with something vs interaction on something. All the player types above fall on this axis. It is important to notice that a player is not rigid, a player can have multiple player types.

Rewards

A reward is an object, either tangible or non-tangible, which rewards the player for their actions. There is no such thing as "one reward meets all demands". Rewards are context sensitive objects that you give to the player depending on their skill, expectations, effort and challenge.

> A reward can take several forms, but it must be in correlation with the universe and with the player's expectations. A reward is related to a challenge, a test or an effort, and thus must be proportional to the difficulty to obtain it. (Ghozland, 2007)

Hallford and Hallford identified four different type of rewards:

- **Rewards of glory**: all the things you're going to give to the player that have absolutely no impact on the game play itself but will be things they end up taking away from the experience (Hallford & Hallford, 2002).
- **Rewards of sustenance**: given so the player can maintain their avatar's status quo and keep all the things they've gained in the game so far (Hallford & Hallford, 2002).
- **Rewards of access**: three critical features: they allow a player access to new locations or resources that were preciously inaccessible. They are generally used only once, and they have no other value to the player once they've been used. Examples could be keys, picklocks and passwords (Hallford & Hallford, 2002).
- **Rewards of facility**: enable a player's avatar to do things they couldn't do before or enhance abilities they already possess (Hallford & Hallford, 2002).

3.4 EFFECTIVE GAMIFICATION FOR ELDERLY PEOPLE

The Kaleidoscope of Effective Gamification is a model which aims to *influence human behaviour through engaging experiences, using game design principles in decision-making applications and services* (Kappen & Nacke, 2013)*. The vocal point of this model is the word *effectiveness*, this word might feel misplaced in the context of games. Activities are more about engagement rather than productivity after all. However, in this context effectiveness means the *successful engagement* from a player through effective game design. Figure 6 shows a top down view of the model. The layers are like those of an onion. Starting at its core in the middle, peeling to the outside. To make the model easier to read there is a side view in figure 7. The designer perceives the model from the top, while a player does it from the bottom.
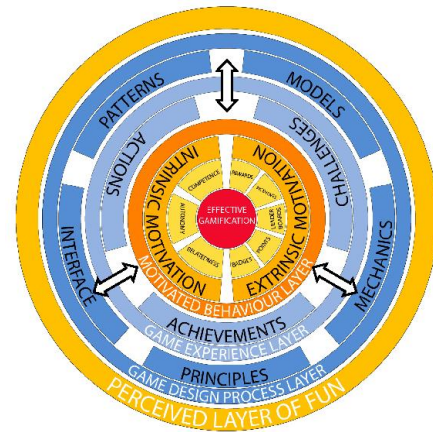
Figure 6. The kaleidoscope of effective gamification

Gamification Core

The core of the player experience, it represents the core objective. In the case of this project it is motivating the residents to go outside.

Motivational Behaviour Layer

This is split into intrinsic and extrinsic motivation. Intrinsic compromises: competence, autonomy and relatedness. Extrinsic: badges, points, leader boards, incentives and rewards. Even though the model shows it as 50/50, in reality there can be more extrinsic motivation, less intrinsic motivation and vice versa.

Game Experience Layer

In the analogy of a theme park this is the "brand experience". Once a person has the motivation to go somewhere, the experience layer supports the motivation and lift its to a higher level. Actions, challenges and achievements are used to create an engaging experience in this layer.
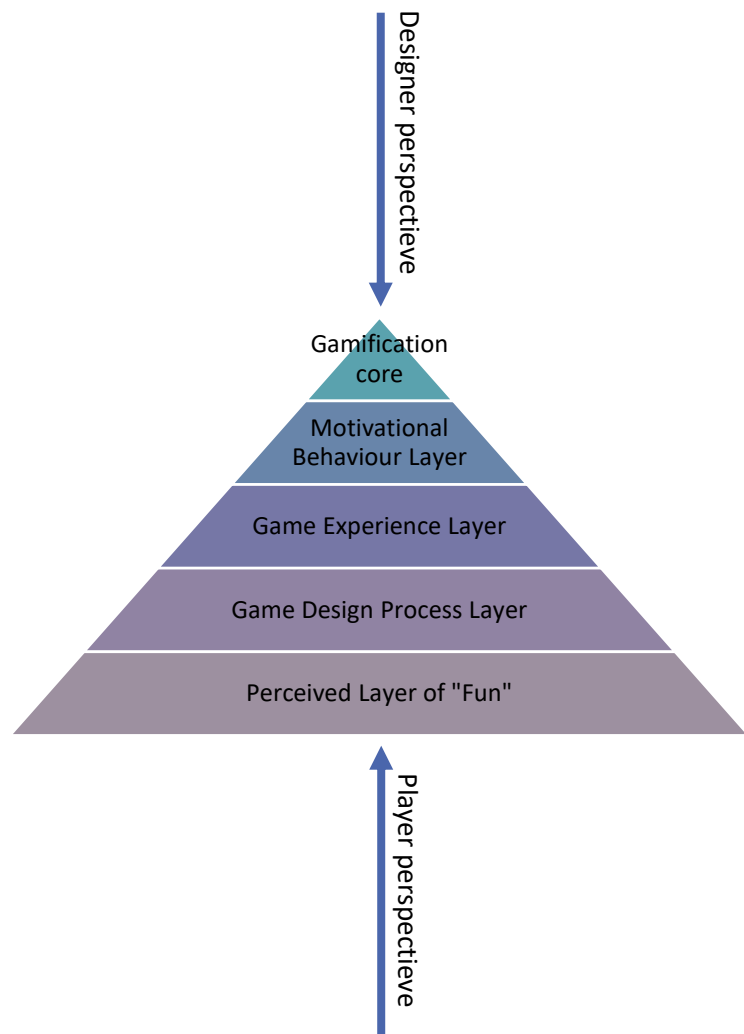

Figure 7. Side view of the effective gamification model

Game Design Process Layer

The game design elements which create a fun experience to the user. These are the experience touchpoints and is what the player is actually playing.

Perceived Layer of "Fun"

This is what the player eventually experiences. The feeling that arises from all the inner layers accumulated. This layer overlaps with the aesthetics component of the MDA framework.

Below is a list of the games that the residents play at this moment:

- Schnapsen or Sixty-Six: A multiplayer card game
- Halma: A 1 vs 1 or 2 vs 2 board game
- Mensch ärgere Dich nicht: A 1 to 4 player board game
- Uno: A 1 to 10 player card game
- Skip Bo: a 2 to 6 player card game like Uno
- Triominos: A 4 player variation on Domino
- Sentence making game: A game where you have to make sentences from "blocks" of words

Most of the game described above are not highly competitive, rather they fall into the category "party games". However, every game does have a form of strategy, there is no game which is (complete) random (like Monopoly). Based on the games that the residents already play, the following gamification elements are provided: a social aspect, no competition in the form of social comparison. The most applicable player type would be: Joker, they are not highly competitive, and they play for the "fun". Sometimes this is also known as player type social.

4 DESIGN OF THE PROTOTYPE

This chapter described the design and implementation of the concept. Starting with a collection of known data to use for the brainstorm session. These ideation sessions took place in Amsterdam in October 2017 during the welcome week of this project. Described below is the ideation of the original concept as conceived in this week by the five team members. This prototype functions as a starting point for further development onto the concept. A part of this concept has been chosen to fully fledge out, design, develop and evaluate. Separately from the other parts of the concept.

4.1 REQUIREMENT ENGINEERING

Requirement engineering is the process of defining and documenting the requirements. These requirements can be both functional and non-functional requirements. There are three phases in requirement engineering: collecting, documenting and validating (Pandey, Suman, & Ramani, 2010).

In Amsterdam a brainstorm session has been done based on the information which were known at the time. This includes: motivating to go outside and elderly people with some mental restrictions. Only one team member had visited Haus Koblach (and done a project with them) before. Based on these requirements a brainstorm session has been conducted. Residents and caretakers have mentioned that walking is a popular activity among them. Thus, walking was chosen as the vocal point of the proposed concept. During the ideation process this was combined with photography, because it is an activity that stimulates exploration and physical activity but is also possible to be executed inside when the weather does not allow outdoor activities. These brainstorm sessions resulted in the concept: Pic to go. The concept was presented in Amsterdam and based on the agreement from the client and additional feedback, more requirements were collected.

Collecting requirements is done through interviews, empirical research, and brainstorming. In addition to this the design goal, *making residents go outside on their own incentive*, has been consulted. Based on the following above the requirements have been made. They are divided into functional and non-functional requirements, followed by a MOSCOW. MOSCOW divided the requirements into "must, should, could and want" to prioritize their importance (Clegg & Barker, 1994). Together with the caretakers, the desired behaviour has also been described:

> *"The residents go outside daily for at least 30 to 60 minutes. They take their own incentive to go outside without the "push" from the caretakers. Plus, point if residents perceive going outside as more enjoyable."*

Currently nine out of the eleven residents already have an intrinsic motivation to go outside. The two other residents lack an intrinsic motivation to go outside at all. This means that there are two groups: a group of lightly motivated and a group of not motivated residents. The group of lightly motivated residents need a small verbal push from the caretakers as motivator to work. While the other ones need a big push. According to the caretakers, the focus should be on the first group. This group is already lightly motivated to go outside. However, they need a small verbal push from the caretakers. The caretakers could ask a resident to throw the trash out, pick up the mail, ask to do the groceries or simply tell them the weather is nice. Especially telling them vitamin D is healthy works.

Based on all these actions above a list of requirements have been documented, the list below encompasses all requirements including the wants (figure 4):

Functional Requirements
- There is a theme for the pictures.   - The webpage shows the pictures taken by the residents.   - Every resident has a personal profile with their: name, statistics, picture and virtual badges.   - Residents receive virtual badges for their feasts.   - Resident can use their credits to print their favourite pictures.   - The settings are behind a log in screen.   - Caretakers can do the following in the settings: - Change the theme, select new themes.   - Add, delete and edit the resident's profiles.   - Approve flagged pictures (to be shown onto the big screen).   - The smartphone can take pictures, these pictures get metadata attached to it.   - Each theme automatically creates a slideshow which can be watched at any time.   - There is a photo album where you can look at all the pictures, regardless of theme.

Non-functional Requirements
- Everything is in German.   - The computer website uses the Django framework.   - There is no use of internet, everything runs locally.   - Everything needs to run on a raspberry Pi   - The camera must look like an old camera to match the resident's mental model   - Ease of use matches the resident's level

Table 4. A table of the functional and non-functional requirements

Prioritizing these requirements is done in a MOSCOW (figure 5). Throughout the design and development of the application the MOSCOW is constantly updated and monitored to prioritize the features. It functions as a checklist and guidance during development:

Must	Should

• There is a theme for the pictures
• The webpage shows the pictures taken by the residents
• There is a slideshow which mixes pictures by theme
• Residents can print pictures
• Caretakers can do the following in the settings:
   ○ Change the theme, select new themes
   ○ Add, delete and edit the resident's profiles
   ○ Approve flagged pictures (to be shown onto the big screen.
• The smartphone can take pictures, stores them and send them to the server.
• Everything is in German
• The website is built in the Django framework
• There is no internet, everything runs locally
• The camera must look like an old camera to match the resident's mental model
• Ease of use matches the resident's level
	• Every resident has a personal profile with their: name, statistics, picture and virtual badges.
	• Residents have credits which they can spend on printing pictures
	• The settings are behind a log in screen

Could	**Want**
• Residents receive virtual badges for their feasts • Residents have a personal photo album where they can see all the pictures that they have taken • The settings are behind a log in screen	• Personalization of topics per user through live data

Table 5. The MOSCOW

4.2 PREVIOUS DONE RESEARCH

To prevent designing something that already exists, research is done regarding past implementations. These implementations bared similarities to the goal that should be achieved. Search terms were: Elderly, outside, physically active, motivate.

Flowie is a persuasive virtual coach to motivate elderly individuals to walk. Users would set their goals with the help of a health professional. They would then go outside with a pedometer, once they are back home the data will be automatically sent to the photo frame (figure 8). Flowie provides instant feedback on progress, swiping to the right side will show your daily and weekly progress. The testers indicated that they were more motivated to exercise by the system. Furthermore, they explicitly indicated that showing your progress is desired. And using incentives (such as rewards) were considered to be childish and not necessary. (Albaina, Visser, van der Mast, & Vastenburg, 2009)

Figure 8. The photo frame where Flowie shows your progress (Albaina, Visser, van der Mast, & Vastenburg, 2009)

Pearls in the North is a service to motivate elderly people to go outside and explorer new places. Every month there is a personal invitation from spots around the neighbourhood. The spots could be a: restaurant, cafés, ice cream shop, shop, bakery or cultural place. This invitation offers a discount for two people, motivating users to take someone else with them. This spot is called the Pearl of the month. Users can also leave reviews behind, which can be seen in the atrium. They are fun to read and can inspire other users to visit the Pearl of the month as well. The tests show that the general concept works very well, however the social aspect of inviting somebody else turned out to be more difficult than expected. (Siemerink, 2011)

Takashi, Maeda, Kawasaki and Nakamura of the NTT Corp, developed a walking game which improves the physically health behaviour and motivates elderly people to explore a city and let them discover new places which they haven't explored before. Next to that they developed a group walking program which utilizes the above mention walking game to promote face-to-face social interaction. The walking game is called "*San-Poki*" and is an electronic version of a stamp rally. A stamp rally is a very popular Japanese event where you go around the city to collect stamps. Each location has a unique stamp. Stamp rallies lead to the discovery of new places around the city. The results of both the application and the walking program argue that "the intrinsic motivation to enjoy collecting stamps and the sense of responsibility toward town development … were more effective for encouraging the participants than the extrinsic motivation to get prizes" (Takahashi, Maeda, Kawasaki, & Nakamura, 2016). They argue as well that finding new places to visit again was important for the improvement of ones' healthy behaviour. They conclude that health benefits, game elements and social contributions make an application more persuasive towards elderly adults.

4.3   DESCRIBING PIC TO GO

Pic to go (stylized as Pic to Go) is a photography concept which combines walking/hiking and photography into one. The goal is to increase the resident's physical health style by motivating them to go outside and be physically active. In the common room is a monitor which shows the current theme and the progress towards this goal. The theme could be food, nature, Christmas, holidays, flowers e.g. There is no goal, the residents are free to take as many pictures as they desire, using the theme as an inspiration. There is a hardware and software component.

Figure 9. A camera from 1960 (Digicamhistory, 2018)

Hardware

The core of Pic to go is the camera. To maintain the resident's current mental model, it should look and behave like the one that they are familiar with. Most of the residents are around the eighty years old, so their perspective of a camera is the example in figure 9. However, a smartphone is mandatory for this concept, because it needs to wirelessly send the pictures to the computer. The solution was to mimic and old vintage camera. A custom-made camera case with physical buttons was made (figure 10). It hides all the technology and complexity from the resident and reduces their chance of making unintentional mistakes. On the backside, only the touchscreen is visible with the three operating buttons of the phone. They are lower than the case. This way the residents can rest their fingers on the frame, without accidentally touching the buttons. On the right side is a thickened part, which functions as a grip for the residents to hold on to. Above this is a black trigger, which you can click left and right. In the middle is a physical circular shaped button. Physical buttons are mapped through the

Figure 10. The backside and frontside of the camera.

headphone jacket, and they can be programmed to take pictures. The trigger to the left and right is recognized by the phone as volume up and down. The single button is recognized as the single button on a headset remote. The other hardware component is the minicomputer (raspberry pi) which is connected to a monitor.

Software

The smartphone runs an open source camera application, which has been expanded with an upload function. The camera application was made by somebody else. A custom camera application was necessary, because the photos need a set of metadata associated with them. The metadata has different properties for the pictures such as the theme and when it was taken. On the raspberry pi there are three programs running: A Spring server, database and Django website. The Spring server takes care of uploading the images, the database stores their associated metadata and the Django website showcases the pictures. The Spring server and database were developed by the same person who takes care of the camera application.

Figure 11 shows the user story and an overview of the different elements of Pic to go and their relationship. In the use case is the resident on the left and the caretaker on the right. The resident has only an indirect interaction with the website through the camera. The caretakers adds/edits themes, validate pictures, logs in, scrolls through the photo album, print pictures and starts the

slideshow. Essentially all direct interaction with the computer is done by the caretakers. The application can only be controlled with a mouse and should only be directly interacted with by the caretakers. The mouse should be unplugged by the caretaker to prevent the residents from using it and making mistakes.
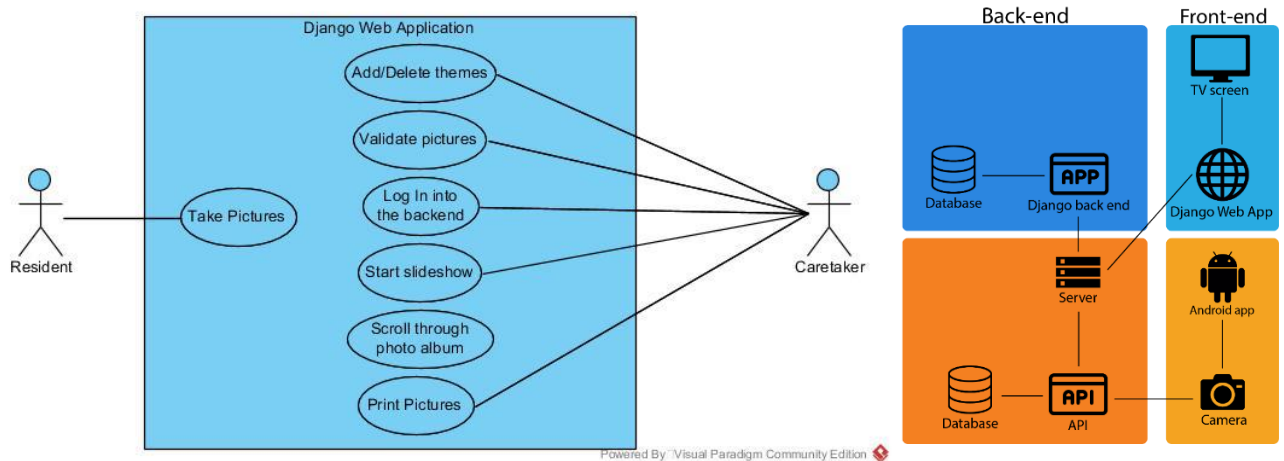

Figure 11. Left: Use Case of Pic To Go. Note that the resident has no direct interaction with the concept. They take pictures through the smartphone application. Right: Overview of the different components of Pic to Go and their relationship

Since the target group is solely elderly people with almost no digital game experience, the game elements must be chosen carefully. Both San-Poki and Pearls of the North work with "points" to attract the user to, letting the user discover new spots around the city. However, this also creates a linear experience, the stamps/pearls steer the users into a certain direction. Instead of using navigation points, Pic to go gives a theme to inspire the user, providing them with the freedom they desire. They are motivated to discover new locations, take pictures and show them to the others through the slideshow. This approach creates a more open-ended experience opposite the linear approach from San-Poki/Pearls of the North. It is hoped that the residents get inspired by the pictures to start conversations with each other, stimulating their social needs. Flowie shows it is important to integrate visual progress. Progress shows the achievements the user has made. Caretakers mentioned that competition between the residents should be prevented. Multiple residents have mental health restrictions and creating a social status might affect them negatively. Therefore, the rewards had to be carefully crafted. Even though Flowie discourages the use of incentives, it is believed that these might work in this setting based on observations of one resident. It was recalled that he was very proud of his certificates (for walking) that he received. These certificates were little acknowledgements for his feats. And shown off the hard work that he did. A digital equivalent, badges, were chosen as a result. The resident can open their personal page (with the help of a caretaker) at any time and see their badges. Badges are awarded for feats such as: number of taken pictures, participated in different themes, seasonal badges or number of collected credits. They show progress and, it is assumed, motive residents to achieve more. The second reward is a digital currency: credits. These credits are collected for every picture taken. They can then be used to print pictures and, as example, glue them in their personal photobook.

4.4 PROTOTYPING

The first step is the creation of a paper prototype. A prototype is a low fidelity version of your application, visualized through sketches on paper. This form of prototyping has as advantage that you can make fast and cheap prototypes, and quickly & easily apply changes. Figure 12 shows two screens of the paper prototype as example.There are multiple screens drawn like this and put next to each other to create a wireframe. The paper prototype has no use of colour, it is completely black and white to put the emphasis on the form rather than detail.

Figure 12. The personal profile and main screen of the paper prototype

For the navigation model a 'hub and spoke' model has been chosen. Figure 13 shows a hub and spoke model. In the middle is the main screen, while the other screens can be reached from here. This is very similar to the workflow on a computer where the desktop is the hub. In the case of this concept the main screen will be where the pictures are shown. From this screen you can go to settings, photo albums, profiles and the slide show. The hub and spoke model can be chaotic and difficult to navigate once the application becomes too big and too nested. To prevent this spoke shouldn't be too nested (away from the hub).

Figure 13. A hub and spoke navigational pattern

This paper prototype was presented to a colleague who gave feedback. Applying this feedback, the prototype was digitalized into an interactive wireframe, the second step of prototyping. An interactive wireframe has a higher fidelity than a paper prototype and comes 'closer' to the final product. It is also a functional wireframe where you can click on the buttons to go through different screens to get a better feeling of the product. The interactive wireframe was presented again to a colleague for feedback, in addition to this the opinion of a graphic design student was asked, her feedback was mostly geared towards the typograph and colour usage. All this feedback led to the design in figure 14. See appendix C for the paper prototype and bigger screen of the interactive wireframe.

Figure 14. The main screen from the interactive wireframe

In this original design the pictures were imagined as a "road map". They would be shown in first come first serve order. The current theme would end after 12 pictures had been taken (thus the roadmap complete). Only then the theme would change to the next one. This design was later changed to a timebox because of the following reasons: In the case not enough people participated, it would take a long time before the roadmap would be finished. The opposite is also true. In the case one resident takes more than twelve pictures, the other ones would never show up, because all the boxes are already filled by one resident. And lastly to better integrate this system into the resident's routine, a set number of days per theme is desired.

As mentioned earlier from the main screen the user can go to four other screens. On top are the four navigation buttons. Below is a short description and picture of what each of these screens look like and what their function is. All the screenshot below come directly from the interactive wireframe prototype that has been developed (figure 15).

Photo album

In the photo album all the photos can be seen regardless of topic

Profiles

The profile page is a unique page for every resident. On the right side are the badges that residents can collect for their feast. On the left is a picture, the amount of remaining credits, the number of taken pictures and a button to go to a personal photo album and to print pictures.

Slideshow

The slideshow is a presentation of all the pictures taken within a certain theme. The caretakers choose which theme they want to start a slideshow from, it takes all the pictures from that theme and shows them in a continuous manner behind each other. Every time the slideshow is started, the picture order is random.

Settings

The settings have a passcode as error prevention in case a resident uses the mouse, or the caretaker forgets to unplug it. From the settings screen there are three sub-options: photos, themes and profiles.

In photos, a caretaker can validate the pictures. On default pictures will be set on active is false. Only pictures where active is true will show up on the main screen. Caretakers must manually validate pictures on, as example, blurriness or appropriateness. In the case of an okay, the picture will become active. Otherwise it will get deleted. This step is there to make sure that only appropriate pictures appear on the screen.

In themes the caretaker can add themes to the queue, there is a list of pre-made themes in the inventory list which the caretaker can add. There is also an option to add their own themes.

In residents the caretaker can add, delete and edit new and current residents.
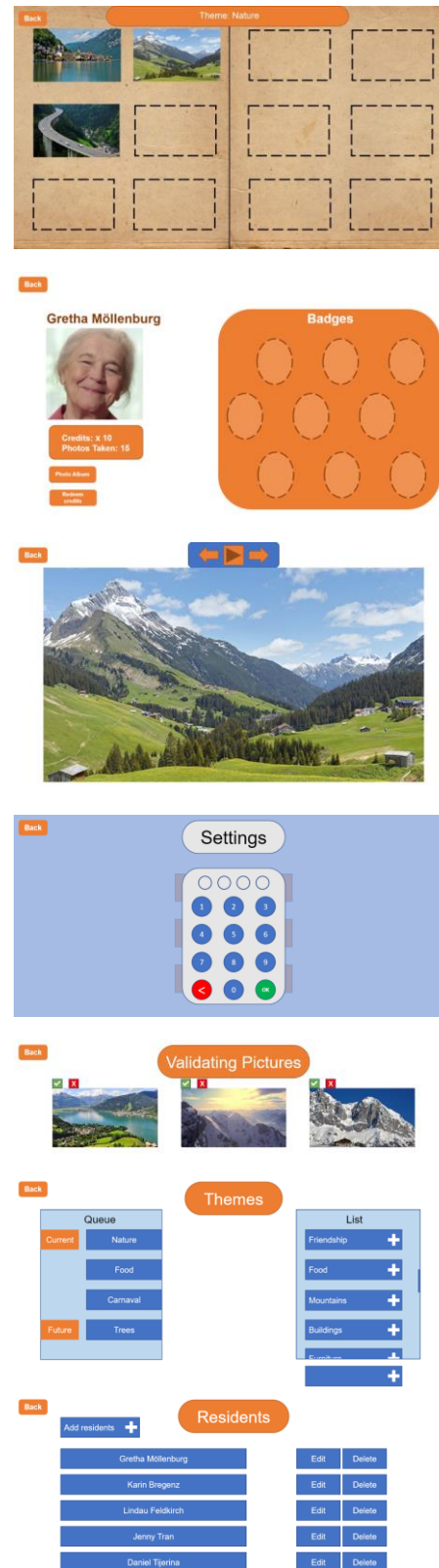
Figure 15. From top to bottom: photo album, profiles, slideshow, settings lock screen, settings photos, settings themes, settings residents.

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4.5 FINAL DESIGN OF THE SCREENS

The next step is to translate this mock-up into the actual product. Feedback on the prototypes are also implemented in this step. Further refinements to the design are made while implementing. Below the final implementation is presented.

Home screen

On top of the screen is the navigation bar, there is a shadow applied underneath to distinguish it from the rest. The left part of this bar is occupied by the current theme and when it ends, the right part by buttons to go to the other screen. The buttons change from colour when the cursor is hovering above it. For consistency every text element has an icon + button. See figure 16. As font family

Figure 16. Above: the shadow underneath the navigation bar makes it look like it is positioned "higher" than the other content. Below: A button without a cursor hovering above it and with. All text has an icon in front to make it better understandable.

"Arial, Helvetica, sans-serif" has been used. This is a neutral font with great clarity, safe to use and standardized.

The icons used in the final product are different from the original prototype. To save development time icons have not been tailormade, instead the "Font Awesome Icons" library has been used. For the colour scheme it has been chosen to use blue and orange.
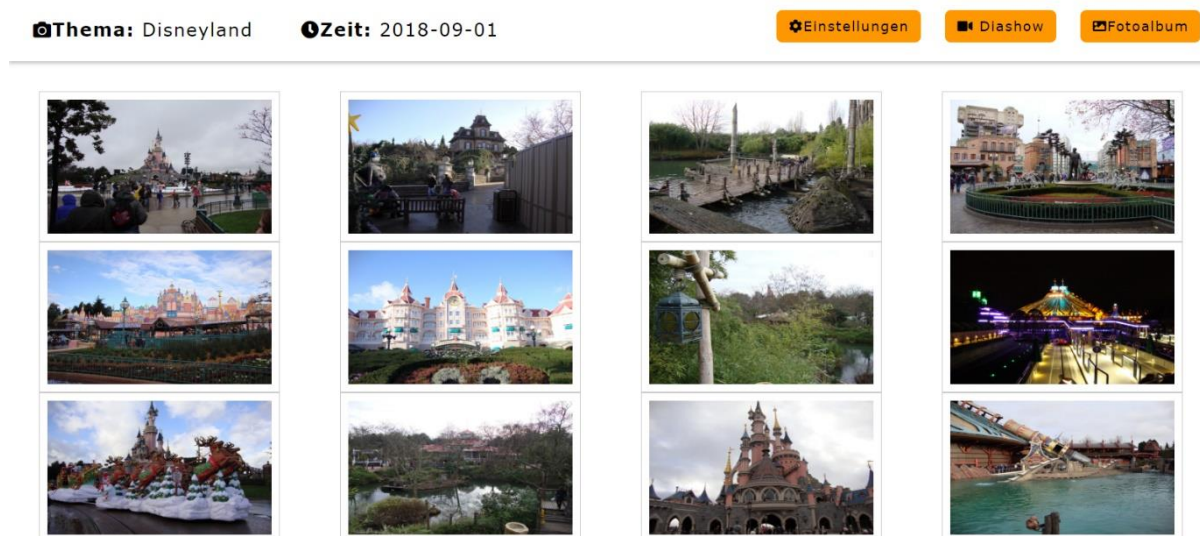
Figure 17. Final design of the main screen

In figure 17 the main screen is shown. On the top from left to right: the current theme, until when the theme lasts, navigation buttons to go to the other screens. Underneath are twelve containers which showcase the pictures taken within the current theme.

To make it fair that every resident can see their pictures appear on the screen the webpage will automatically reload every five minutes. Other options considered were constant moving billboards or a dynamic changing layout, but these were deemed too busy for the residents.

Slideshow

A slideshow is continuous presentation of pictures per theme. Caretakers choose from the list of themes. Starting the slideshow by clicking on the theme they want. Once started, it will create a random order. Every time the slideshow is started the order of pictures is different. See figure 18.
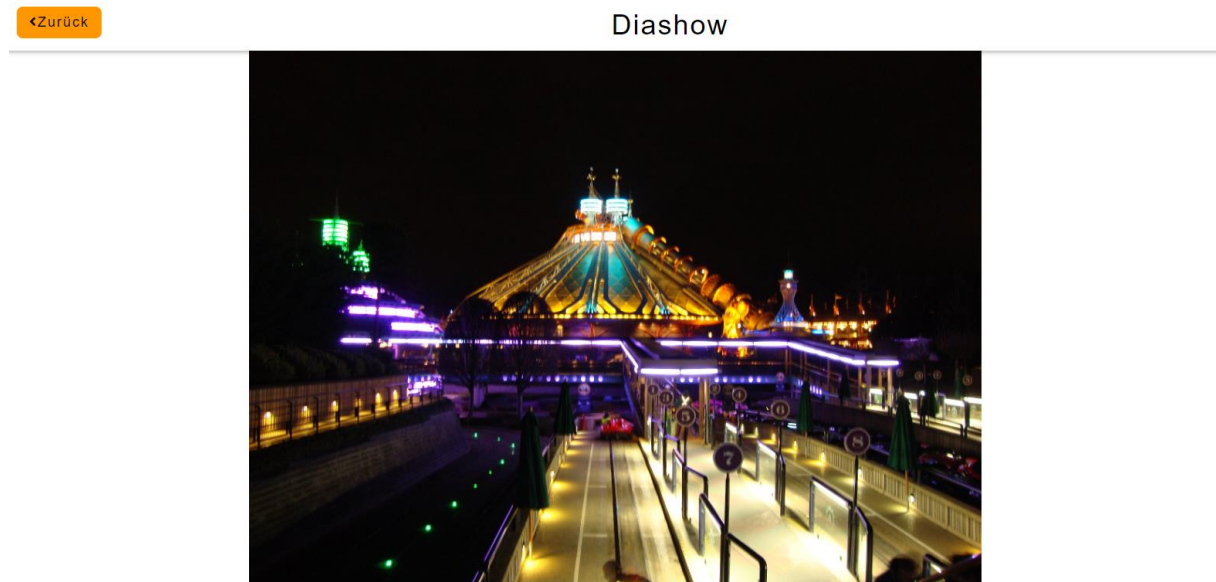
Figure 18. The slideshow.

Photo album

The photo album shows all the pictures that have been taken, regardless of their theme. Residents can scroll down this page and talk about pictures that they like or gain inspiration. Pictures are show in chronicle order from top to bottom. Clicking on a picture will enlarge it. See figure 19.
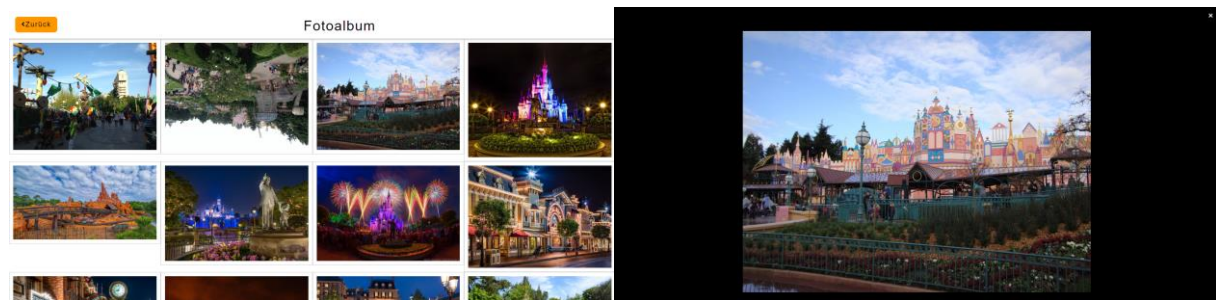
Figure 19. On the left the photo album, on the right if you click on a photo and enlarge it.

Settings

Clicking on the settings menu button will immediately open the different settings options instead of asking for a passcode first. This is because there was no password system built in Django and building it was not worth the time. For the following reasons it was deemed unnecessary: The raspberry pi is running without an internet connection; there is no sensitive information and otherwise the caretakers had to remember another password. Once you open the settings (figure 20) there are two

options: Themen and Bilder validieren.

Figure 20. The settings menu

In Themen (theme) the caretaker can add and delete themes. Adding is done by filling the form on the bottom of the page. Once submitted it will appear in the list of themes above. See figure 21.
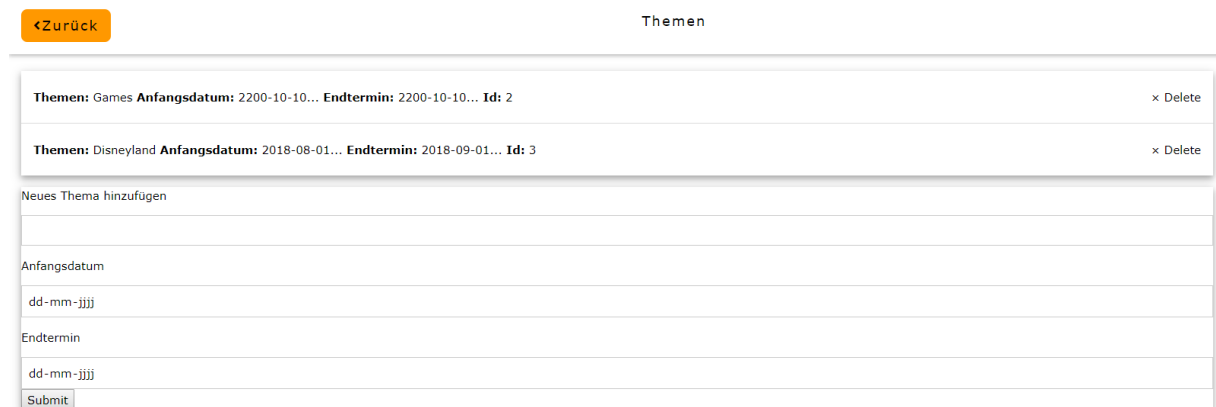
Figure 21. The theme settings screen

In Bilder validieren (validating pictures) all pictures, where active = false, are shown. This screen acts as a human check before the pictures appear on the big screen. This way inappropriate pictures can be taken out before they become visible to the rest. Clicking on the green button will change active into true, thus make it able to appear on the main screen. The red button only deletes the metadata. The server does not support deleting pictures. However, without metadata the pictures will not appear. See figure 22 for the validation screen
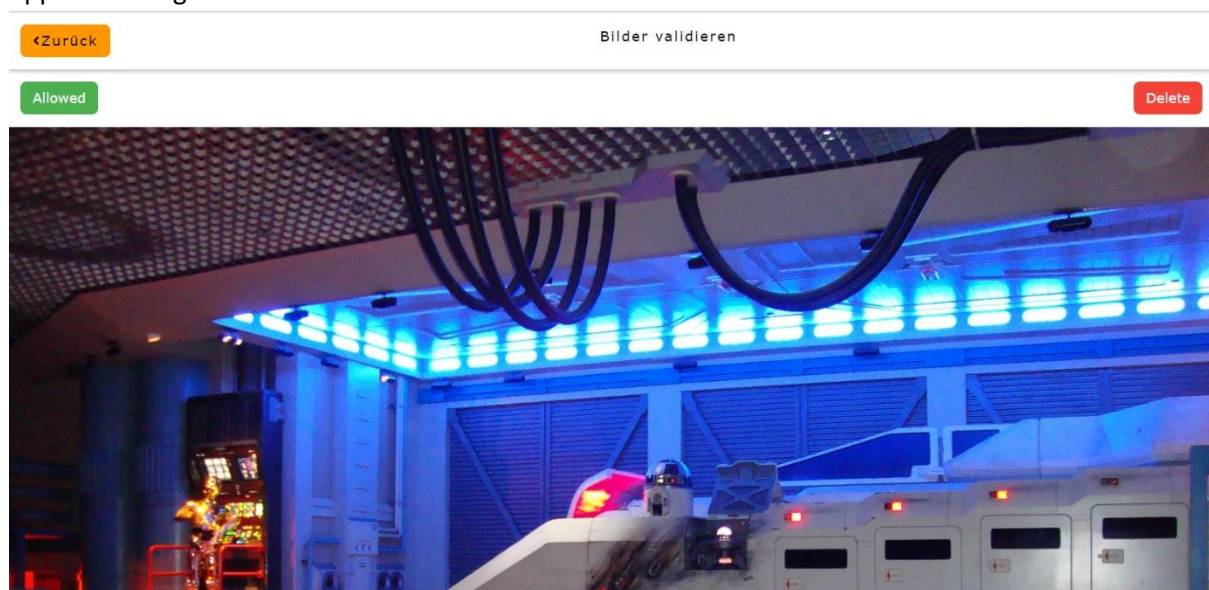
Figure 22. Picture validation screen

5 IMPLEMENTATION OF THE FINAL SYSTEM

The next step after the final design is to implement it. This chapter described the tools that have been used to develop the project and how it was implemented.

5.1 CHOOSING THE RIGHT TOOLS

Hardware

For the technology two products had to be bought: a computer to run the application and a smartphone to capture the pictures. A monitor to connect the computer to is provided. The technology was chosen and purchased by the Austrian and German student of the team with a small budget. They based their purchases on the following criteria: The computer must be placed underneath the TV and is solely dedicated to running this system. This means that it must be small, does not have to be powerful and as cheap as possible. The smartphone's main use would be to take pictures and send these over a local Wi-Fi network. The challenge was to find the best camera for the cheapest price, Wi-Fi is built in most phones nowadays anyway. The cute note plus is promoted as a "camera phone" and provides a very powerful camera while having mediocre hardware. This is fine, because the phone doesn't have to be fast or powerful. The phone was bought for 85 euros, while the raspberry pi was approximately 40 euros. This brings the total investment to 125 euros for this project, a low-cost investment which made it less difficult to get this project realised.

Software

The computer application has the following requirements and functionalities:

- Receive pictures from an API.
- Show pictures in a visually appealing set up.
- Lightweight.
- Independent from an internet connection.
- Support rapid development, because of the limited time.

Researching the possible implementations, three options were shortlisted: creating a Java application, building a Unity game and making a website through the Django framework. The three different options were put against the required functionalities and requirements. Java was the original choice because it fits all the requirements above. However, it turned out to be time consuming to achieve the desired layout in Java. Figure 23 shows a typical example of a Java graphical user interface. Timewise it would be faster to do it with the alternative two options. Unity is considered easier to make layouts than Java but is too heavy performance

Figure 23. Examples of typical Java programs

wise. Researching the possible ways to make web requests, Unity requires more work than the Django framework. The Django framework supports rapid development, is light weighted, and achieves the desired look and feel feasible within the given timeframe. Requests, an open python library, is used to make web requests to the Spring backend. Furthermore, the triad of technologies of web development are used: HTML to specify the content of web pages, CSS to specify the presentation of web pages, and JavaScript to specify the behaviour of web pages (Flanagan, 2011). To further speed up development, additional libraries such as Bootstrap and W3CSS are used. Not
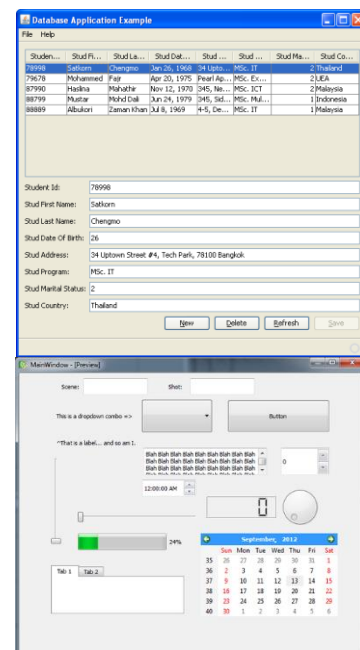
only do these libraries speed up development, they also support standardization of the design across the entire website. As development environment Visual Studio code by Microsoft is used, while GIT extensions are used for version control.

5.2 DESCRIBING DJANGO

Django is an open source framework for web development, it is written in the python programming language and follows a model-view-template (MVT) design pattern. Django is light weighted, highly customizable and supports rapid development. To aid in rapid development, Django works with apps. Django apps are pluggable and reusable package of code that provide some features. The template system, database, admin management and server being some of the default installed ones. This means that when setting up a Django project, all the above-mentioned features are provided out of the box. As mentioned earlier Django uses the model view template (MVT) design pattern, which is a variant on the model view controller pattern (MVC), see figure 24. MVC is a popular design pattern to create client web application. It separates the internal representation of the external representation.
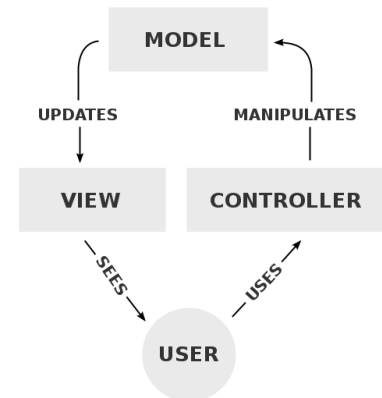
Figure 24. A MVC design pattern

Model: Representation of the data. This is not the actual data, rather an interface of the data. The model gets the data from the database.

View: What the user sees. It is a visual representation of the data. It is also the user interface that receives user input.

Controller: Controls the flow of information between the view and the model. It receives information from the view on what it needs to manipulate to the model and tells the view what it should update based on the model.

In short, the model passes the data to the view, the view presents the data to the user. It receives user input and passes this on to the controller, the controller manipulates the model, and the model updates the view etc. Django differentiates in the naming convention to the classical MVC design pattern. In Django there are three main components in every project: model, view and template (MVT).

Model: The blueprint that will be used by Django to automatically create/update the database tables, it represents the data.

View: The bridge between the model and the template. It communicates which template is shown on the screen and what data it receives. While it is possible to process data in the templates, it is preferred to not touch the data after sending it to the template. This way, all the logic stays in the view, and the template only expresses the presentation.

*Template***:** The presentation layer of Django. Templates are blueprints for the presentation of a website. Most commonly, these are writing in HTML. While it is capable to produce text-based format templates, that won't be the case for this project. Templates separate the presentation from its data. When making a template, all the values are tagged with a template variable name. These variable names will receive their actual value from the context, which is passed along when rendering the template. A context is a set of template variables names and their associated values.

The render will then replace all the template variable names with the actual values. By separating the presentation from the data, one template can be rendered with different contexts.

A high-level overview of the workflow is as follows: When a user goes to a Django URL, Django will search for a matching URL in the URL conf file. Once found, it automatically creates a HTTP request. This request will call the associated view. It is up to the developer to return a HTTP response in this view, this could contain a single string or render a template. All the logic of the data will be processed in this view and passed along as a context with the template. Django loads the templates and shows it on the screen. See figure 25 for a flowchart of the workflow.

5.3   Building the website's skeleton

When creating a project most of the early steps are the same. Therefore, Django automated this process. With one command in command prompt, Django will create an entire project, including the directories, initial code, a collection of settings and necessary configurations. Appendix D shows the basic setup of
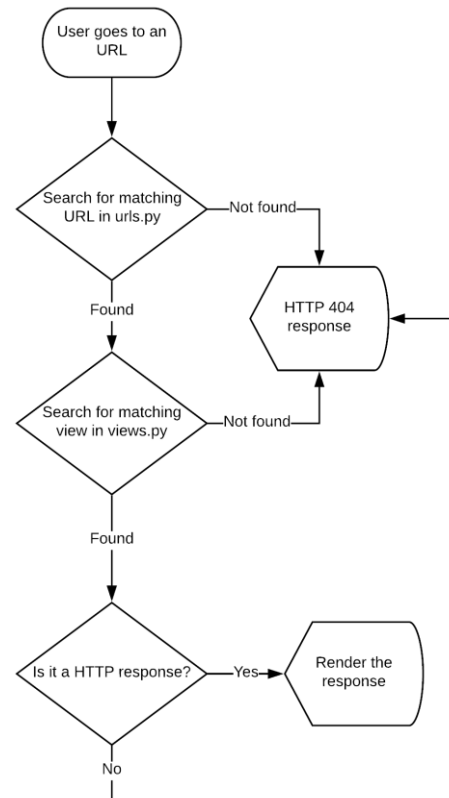
Figure 25. The basic workflow of Django

every Django project. The first step is building a "skeleton" of the website. This framework makes it possible to experience the flow of the website, before implementing the design and functionality of all the pages. Building this framework is done in three steps: Making an URL scheme, writing the views and binding the views to the templates. The templates had only one line of text to identify them, and the necessary buttons to make navigation around the framework possible. Once this step is done the templates can receive their content, and the views logic can be written to pass on the right data to every template.

Building the URLs

Every page of a website is reachable by an URL. URLs, short for Uniform Resource Location, are unique addresses on how to reach a piece of data, in this case a website page. It has a host name and an optional path separated by slashes. The host name could be *www.shop.com*, while you can use slashes to go to certain sections within this website: *www.shop.com/sale* and *ww.shop.com/contact* e.g. In the case of Pic to go the host name is: *http://localhost:8000/*. And possible paths are: */admin, /profiles or /slideshow*. Django stores all these URL path as URL scheme in one location: URL conf (URL configuration). By default, there is only one URL conf file. Assuming the project is going to have multiple applications in the future, it is not desirable to put all the URLs into one file. Better is to make an URL conf per application. In the main URL conf (PicToGo/urls.py) a reference to engine/urls.py can be made with the include function. With the include function the URL omits the application name in the URL. This meant that "*Localhost:8000/engine/pictures*" changes into "*Localhost:8000/pictures*". The result is a more clean and usable URL. Regular expressions are used to map the URLs to make sure that it only accepts URLs as they are intended *to* be. Table 4 is a snippet of the URL scheme. Django searches from top to bottom for a matching URL, in case it doesn't find one, Django will show a default error 404 page. This process is repeated for all other

URLs. The re_path tells Django it should read it as a regular expression (regex) path, the ^ symbol matches the beginning of the string, while $ symbol signifies the end. The second argument tells which function in views should be called. The third argument is the name. The second re_path is a different regex, because it also takes a value. Deleting a picture with ID = 1 will call: *http://localhost:8000/settingsdeletetheme/1* while deleting a picture with ID = 2 would call: *http://localhost:8000/settingsdeletetheme/2* etc. Table 6 contains a snipper of the URL scheme.

```
# Themes
re_path(r'^settings/themes/$', views.settingsThemes,
        name='settingsThemes'),
re_path(r'^settingsdeletetheme/(?P<themePk>.+)$',
        views.settingsThemesDelete, name='deleteTheme'),
re_path(r'^settings/residents/$', views.settingsResidents,
        name='settingsResidents'),
```

Table 6. Snippet of the URL conf file. This shows the three URLs related to themes.

Initiating the views

Once all the URLs are written, the different view methods must be initiated. The views tie the right template to the right URL. It also processes any logic and passes this on as a context to the template. When a user goes to an URL, Django automatically makes a HTTP request, it is up to the developer to return a HTTP response. This can range from a string to rendering a template. Since only the skeleton is made first, every function returned a string identifying the page, later when implementing the templates these strings would be replaced with render methods.

Connecting templates to the views

All templates are HTML files and go into the template folder. In this stage the templates only received a string identifying which template it was, plus the necessary links to go to the other pages. In views the HTTP responses are replaced with the render methods. The render method has three parameters: request, template name and an optional context. The request is the HTPP request; the template name is the template file name and the context is a dictionary of data, which the view passes to the template. Often this is a list of themes, photos or profiles. However, it could also be a string like the current theme. Now instead of returning a HTTP response, it renders the HTML file and shows it.

The result is an URL scheme, all the view methods rendering their associated templates and all the templates themselves in a simplified form. To aid the development an overview is made of all these classes. Figure 26 shows all classes their: associated HTML document name, views name, path name and URL.

HTML document name: The file name of the template.

Views name: The function name in the views.py file.

Path name: The re_path name in the urls.py file.

URL: The URL that leads to this template, only the path is shown.
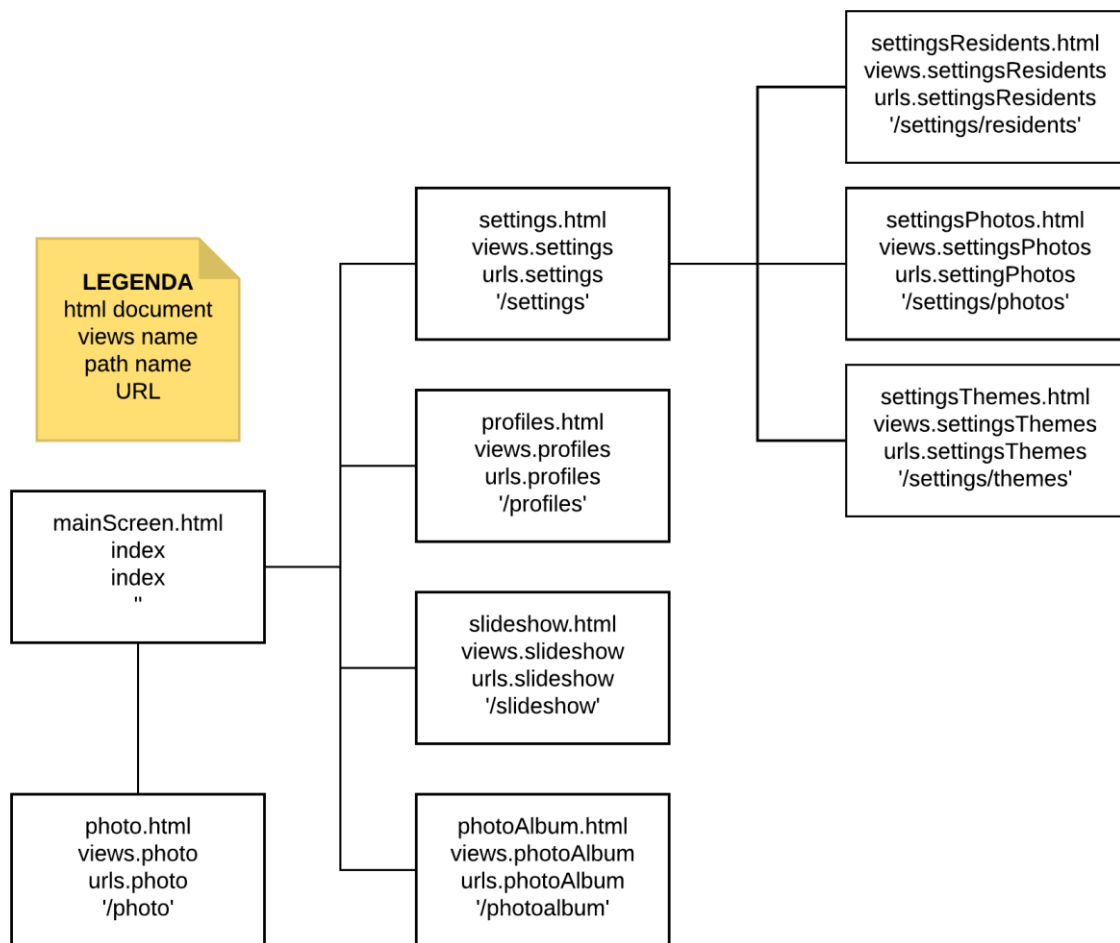
Figure 26. Overview of all the views

5.4   INTEGRATING THE SPRING BACKEND

Running next to the Django server is a Spring backend. It takes care of all the themes, users, images and their associated metadata. This backend is developed by someone else. It has a folder to store the images and a database for the metadata. All communication with the backend is done through a RESTful API, which means that it supports: POST, GET, PUT and DELETE calls. POST is to create data; GET to retrieve; PUT to update and DELETE to delete data. In line with CRUD, the basic functions of persistent storage. Figure 27 shows all the possible calls that can be made divided into four categories: images, metadata, themes and users.

The image upload category is to POST and GET images. The GET returns the file name of the image, which is necessary to retrieve the associated metadata. Showing the picture in the browser is done by attaching the filename behind the domain and path: http://localhost:8080/images/ + file name

The metadata category supports multiple GET methods to get different ranges of metadata, POST to create metadata, DELETE to delete metadata (which does not automatically remove the picture, this is not build in yet) and PUT to update metadata.

The themes and user category do the same as the other categories mentioned above. The GET theme by target date is used to determine the active theme on the current date.

image upload : image hosting, automatically resizing on upload	Show/Hide | List Operations | Expand Operations	
POST	/images	handleFileUpload
GET	/images/{fileURI}	serveFile

meta data	Show/Hide | List Operations | Expand Operations	
GET	/metas	findAllMeta
POST	/metas	saveMeta
GET	/metas/search/findByIsActive	findByIsActiveMeta
GET	/metas/search/findByTheme	findByThemeMeta
GET	/metas/search/findByUserId	findByUserIdMeta
DELETE	/metas/{id}	deleteMeta
GET	/metas/{id}	findOneMeta
PUT	/metas/{id}	saveMeta

themes : manage theme strings with start and end date	Show/Hide | List Operations | Expand Operations	
GET	/themes	findAllTheme
POST	/themes	saveTheme
GET	/themes/findByTargetDate	find themes, if targetDate is between start and end date
DELETE	/themes/{id}	deleteTheme
GET	/themes/{id}	findOneTheme
PUT	/themes/{id}	saveTheme

user data	Show/Hide | List Operations | Expand Operations	
GET	/users	findAllUser
POST	/users	saveUser
GET	/users/search/findByUserId	findByUserIdUser
GET	/users/search/findByUserName	findByUserNameUser
DELETE	/users/{id}	deleteUser
GET	/users/{id}	findOneUser
PUT	/users/{id}	saveUser

Figure 27. All the possible calls that can be made

The themes, users and metadata are treated by the backend as JSON objects. Below are the three JSON objects/models and a small description of them. Note that all of them have an ID field, this one disappears upon posting and can be left empty.

Themes has: end date (datetime), start date (datetime) and theme name (string). See table 7.

```
  "endDateOfTheme": "2018-08-11T14:20:35.547Z",
  "id": 0,
  "startDateOfTheme": "2018-08-11T14:20:35.547Z",
  "themeItem": "string"
```

Table 7. Theme model

User has: credits (int), number of taken pictures (int), userId (string) and name (string). The credits are a personal currency which can be redeemed for certain rewards; number of taken pictures is a counter to keep track of how many pictures a resident has taken; userId is to uniquely identify residents; and the username is the resident's name. See table 8.

```
"credits": 0,
"id": 0,
"numberOfTakenPictures": 0,
"userId": "string",
"userName": "string"
```

Table 8. User model

Metadata has: active (Boolean), created (datetime), imageURI (string), tag (string), theme (string), userId (string). The active is whether the picture is visible or not; created is the time and date on which the image is taken; imageURI is the file name of the associated image; tag is to organize pictures; theme is during which theme the image is made and userId is to uniquely identify residents. See table 9.

```
"active": true, ← Whether the image is visible or not
"created": "2018-05-10T18:02:01.932Z",
"id": 0,
"imageURI": "string", ← The image file name
"tag": "string",
"theme": "string", ← During which theme the image is made
"userId": "string"
```

Table 9. Metadata model

When uploading a picture onto the server this must be done in two steps: POST the image (returns a filename) and POST the associated metadata by providing the imageURI as parameter. Other relevant metadata is the theme (which is the current theme when the picture gets taken) and active. The active tag is on default false, only after a caretaker has approved the picture it will go on true and will show up on the main screen. The steps mentioned above are done automatically by the camera once it comes in Wi-Fi range with the raspberry pi. This makes the user journey as follows: A picture gets taken on the smartphone in the custom camera application. The phone attaches the metadata to the picture. The phone transfers the pictures onto the raspberry PI. The pictures are stored in a folder and the meta data gets uploaded onto the database.

5.5   BUILDING DJANGO TEMPLATES

Templates are the core of Django. They are blueprints containing what must be shown on the screen when rendered. Django templates contain a static HTML part as well as some special Django syntax for dynamic content (also known as template tags). To ease development two CSS libraries have been used: Bootstrap and W3CSS. Both contain premade elements and settings which promote faster developer and more consistency in the design. Because there is no internet connection the libraries must be downloaded and included in the project, this way they can be reached locally instead of downloading them from the internet, which is what usually happens. Every template has a <head> and <body> part. The <head> part contains the template title, metadata, linked stylesheets and an optional <style> section with styles. Styles streamline the code and make it more maintainable. They are tags representing a list of parameters. Instead of writing the same parameters down in different elements, they can be put in the <style> section underneath a tag, and this tag can be called for each element that requires this specific makeup. In the <body> part the actual "body" of the template is written. HTML takes care of the placement of the elements; CSS of the presentation and the Django template language of what data must be shown.

Below the process of writing the main screen template is covered because it is the biggest template, the main screen doesn't make POST and DELETE calls, therefore the settings themes template is covered in addition as well.

Before each individual template was made, all shared elements between the templates were mapped. In this case the navigation bar on top of the page. This way the navigation bar could be made first, and once the right: size, colour, typograph and buttons were implemented this "shell template" was copied for every other template and build further upon. The main screen has: three buttons leading to other parts of the website, the current theme, the deadline and twelve random pictures. While all the other templates have a return button and a title identifying the page, see figure 28. Buttons are normal HTML buttons with their hyperlink reference in Django template code. In between a curly bracket and percentage symbol is the destination's URL name from the URL scheme: `href`="`{% url 'photoAlbum' %}`". Django will check the URL conf file for a matching name and load that URL upon finding it.
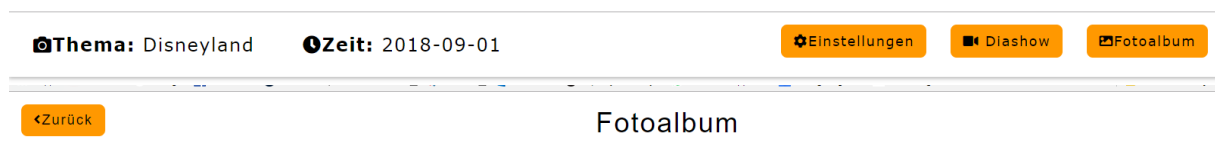
Figure 28. On top the main screen navigation bar. On the bottom the bar for all the other templates. The title identifies which template it is.

All dynamic information of the template is passed by the view through a context. The context is a dictionary, which contains a mix of strings and lists. The main screen view function (index view) has three parts: the current theme, end date and retrieving the pictures. See table 10 for the full function. Making HTTP calls to the backend is done through the python library: requests (mind the naming, request**s** is an external library, while request is a Django class). A request is made to get the current theme. As parameter the current date is passed along. Requests returns a JSON object with the current theme. If there is more than one current theme, it will pick the first one it returns.

To get the end date, a for-loop checks for each theme until it matches the current theme. It will then pick the end date object and truncate the first ten characters, leaving only the date instead of datetime.

To get the pictures, which appear on the main screen, requests makes a call with size 2000. Spring uses pagination and without manually expanding the size to 2000, it would only return the first 20 pictures (and even less if there are pictures which did not meet the conditions). The for-loop checks each picture on whether it matches the current theme and if it is active. It will append the picture to the imagenames list if passed. After, the list is shuffled by the randomize function (see bottom of table 10).

The context becomes a dictionary object of currentTheme (string), endddate (string) and imagenames (list). In the render method this context is passed along with the request and template file name as parameter.

```python
    #Current theme
    today = {'targetDate': date.today()}
    rtheme = requests.get( 'http://localhost:8080/themes/findByTargetDate',
params=today).json()
    if(rtheme == None or len(rtheme) == 0):
        currentTheme = "kein Thema"
    else:
        currentTheme = rtheme[0].get("themeItem")


    #End date
    rdate = requests.get('http://localhost:8080/themes').json()['_embedded']
    if(rdate == None or len(rtheme) == 0):
        endDate = "kein Thema"
    else:
        for theme in rdate['themes']:
            if theme['themeItem'] == currentTheme:
                endDate = theme["endDateOfTheme"][:10]
                break

    #Getting pictures
    r =
requests.get('http://localhost:8080/metas?size=2000').json()['_embedded']
    imagenames = []
    if(r == None or len(rtheme) == 0):
        r = "No meta data was found"
    else:
        for meta in r['metas']:
            if meta['theme'] == currentTheme and meta['active'] == True:
                imagenames.append(meta['imageURI'])
    randomize(imagenames, len(imagenames))
    context = {'theme': currentTheme,
                'endDate': endDate, 'imagenames': imagenames}
    return render(request, 'engine/mainScreen.html', context)

# A function shuffle an array, n = length of array
def randomize (array, n):
    for i in range(n-1,0,-1):
        j = random.randint(0,i)
        array[i],array[j] = array[j],array[i]
    return array
```

Table 10. The view method for the main screen template

GET themes and pictures

In the main screen template, the current theme and end date can be retrieved from the context by using double curly brackets. Double curly brackets signify the template it should read it as Django template tags. {{theme}} will call the theme item of context and {{enddate}} the end date item of context.

Furthermore, there are the twelve random images to be shown. These images are HTML image boxes divided over four columns. Every image box shows an imagine from the imagenames item in context. The view shuffles the list of images, therefore only the first twelve items are used. To show a picture Django needs to know the full URL. This URL is made up of the hostname + path + file name. The first two component are always the same, so they can be hardcoded. The file name is retrieved from the context and put in the source as template tag. Thus, making the source as follows:

```
src="http://localhost:8080/images/{{imagenames.0}}"
```

Every image also has an OnClick method which enlarges the picture upon clicking on it.

Much of the other templates follow a similar pattern of: requesting the data from the back end; processing the data; passing it as context to the template and showcasing the data. However, the setting templates differ because they make POST and DELETE calls as well, and these require a different approach.

POST themes

Posting a theme is done through the post method in requests. In models.py a Theme class is made. This model is necessary to pass a JSON object to the Spring server. Table 11 shows the theme model. It has a name, start date and end date.
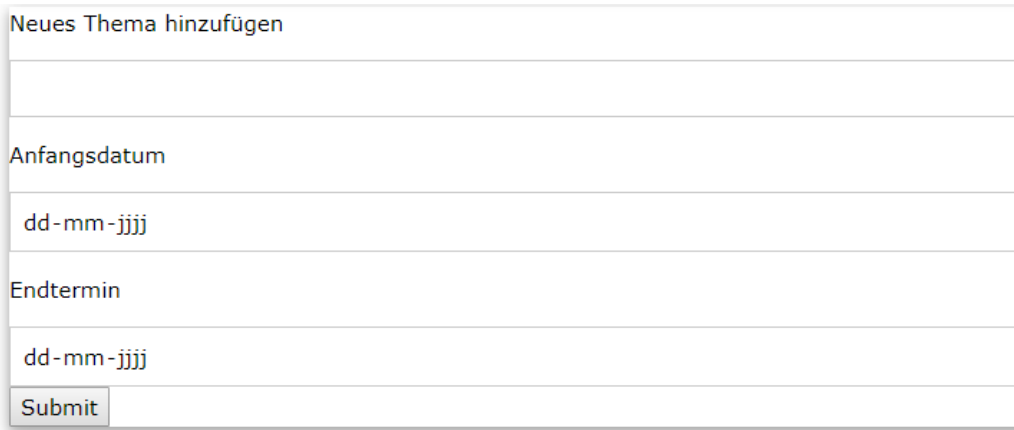
```
class Theme(models.Model):
    name=models.CharField(max_length=256)
    startDate=models.DateField()
    endDate=models.DateField()
```
Table 11. Theme model

In the settingsThemes template a HTML form with POST method is created. It has a field for the name, start date and end date. See table 12 for the HTML code and figure 29 for its presentation.

```
                <form method="POST">
                    {% csrf_token %}
                    <p>Neues Thema hinzufügen</p>
                    <input class="w3-input w3-border w3-hover-blue"
 type="text" name="themename">
                    <p>Anfangsdatum</p>
                    <input class="w3-input w3-border w3-hover-blue"
 type="date" name="startdate">
                    <p>Endtermin</p>
                    <input class="w3-input w3-border w3-hover-blue"
 type="date" name="enddate">
                    <input type="submit" value="Submit">
                </form>
```
Table 12. HTML code for the post form

Figure 29. Above: The HTML code. Below: What the form looks like.

Clicking on the submit button the settingsThemes function in the view will pull the data from these fields and map it into the model made earlier. The theme object is passed as a JSON object parameter with the POST request. See table 13 for the code of retrieving the data from the template and posting it.

```python
def settingsThemes(request):
    # POST (save)
    themename = request.POST.get("themename")
    startdate = request.POST.get("startdate")
    enddate = request.POST.get("enddate")
    theme = {
        'themeItem': themename, 'startDateOfTheme': startdate,
'endDateOfTheme': enddate}
    if themename != None:
        rpost = requests.post('http://localhost:8080/themes', json=theme)
```

Table 13 The view code for posting a theme.

DELETE themes

Deleting themes is done with the requests DELETE function. There is a delete button next to every theme, clicking this button will call the settingsThemesDelete function from the view with the ID as parameter (table 14). It will load this page, delete the theme and (to the human eye) almost instantly redirect back to the settings theme page. While it might look to the naked eye that the page only refreshed, it went to a ghost page to trigger the request. The command prompt (figure 30) confirms this.

Figure 30. Command prompt showing what happens when you click on the delete button.

```python
def settingsThemesDelete(request, themePk=None):
    # DELETE
    rdelete = requests.delete('http://localhost:8080/themes/' + themePk)
    return redirect('settingsThemes')
```

Table 14. The delete theme function in the view

6 TESTING THE WEBSITE

To validate assumptions, record the resident's opinions, challenge the system and bump into unforeseen problems the system must be tested. To get reliable test results, the tests should be demarcated. It is important to note what is going to be tested, and especially what is not going to be tested in the different tests. Three tests have been done: two short tests and one longer test. For each test a table is made containing crucial information regarding the test, followed by the test results.

6.1 TESTING THE EMOTIONAL RESPONSE AND USER EXPERIENCE

The first and second test were focussed on the resident's interaction with the camera (user friendliness) and their emotional response to the concept. The system's functionality was not the primary focus of the test, however any bugs which were found on accident during the process were noted.

The following table (table 15) applies to the first two tests. Each test lasted for one morning and was conducted one week apart from each other. No adjustments were made in-between. The goal of two tests was to collect more data, rather than improve the product in between. For the quality attributes, the list of quality characteristic by Tmap was used (Tmap, 2018).

Testcase name	Short test 1 + 2
ID	PTG_1 + PTG_2
Date	16-05-2018 and 23-05-2018
Location	Haus Koblach
Quality attributes	Effectivity and User-friendliness
Goals	• Do residents enjoy the slideshow? • What is the resident's reaction to taking photos and seeing them appear on the screen? • Do residents initiate social contact based on the slideshow?
Functionalities to test	• Showing pictures in the main screen • The slideshow
Functionalities not to test	• The camera application • The complete workflow of Pic to go • The photo album feature
Condition participants	Residents of Haus Koblach in Götzis.
Procedure	1. Pitch the concept to the resident and see if they want to participate 2. Help the resident with taking the pictures 3. See the residents (emotional) response to their pictures appearing on the main screen 4. Start the slideshow if enough pictures are collected and see the resident's emotional response and potential emergence in social interaction

Table 15. Test case for the short tests

Test results

During the test the main screen did not function as properly. On location it was improvised to use the slideshow instead. Removing step three of the procedure.

A couple of observations from the test:

- In the first test the residents were asked to take pictures with a virtual button on the touchscreen. This way the assumption about elderly people and a touchscreen were challenged. However, the virtual button did not turn out to be the problem, rather the touchscreen. Residents were pressing for too long/hard on the touchscreen; resulting in activating burst mode, or the touchscreen not registering the touch event at all. A physical button is mandatory for the target group, it provides them with the physical feedback they require and expect from a button.

- The camera has only one thickened handle to grab hold on. When residents picked up the camera, they would properly hold onto the right grip, but due to the lack of a left grip, put their left hand on the lens. See figure 31.

- In extension to the previous point, when a resident puts his finger on the lens, they cannot correct themselves. This is most probably because they do not realize their finger is what makes the screen black. Instead, they assume the camera is not working or still loading.

Figure 31. A resident holding the camera

- Touchscreen interactions are difficult, because they press too hard and long. Triggering a long press instead of the normal one. The residents lack the nuances of using a touch screen versus pushing a physical button.

- Residents needed assistance with taking pictures

- Some residents used Pic to go to attract attention for social contact, instead of being interested into using the product.

- Residents seem to be interested in the concept, however were unsure what to think about so much technology at once. It felt overwhelming to them.

- One resident voiced her concern over her privacy. She asked where the data would be used for, assuming her data would be sold.

6.2 TESTING THE COMPLETE WORKFLOW

The third test was a two-week long test. During this time Pic to go was installed in the living room of Haus Koblach. The set up mimicked the final setup: a television screen, attached to that the raspberry pi and the mobile phone enclosed in a camera case. The goal was to test the complete workflow, effectiveness on resident's motivation and engagement rate. See table 16 for the test case.

Testcase name	Long test 1
ID	PTG_3
Date	17-07-2018 until 31-07-2018
Location	Haus Koblach
Quality attributes	Effectivity and User-friendliness
Goals	• Are residents more motivated to go outside as result of Pic to go?

	• What do residents think about Pic to Go?
Functionalities to test	• Showing pictures in the main screen • Does Pic to go motivate residents to go outside? • What are the effects of Pic to go on resident's behaviour?
Functionalities not to test	• The camera application • The workflow of the complete project • The photo album feature
Condition participants	Residents of Haus Koblach in Götzis.
Procedure	1. Set up the system 2. Inform the caretakers that the system is going to stay for two weeks. 3. Teach caretakers how to validate pictures 4. Leave the concept for one week, come back to check on progress 5. Leave for another week and return to pick it up and collect data.

Table 16. Test case for the longer two-week test

The complete test lasted for two weeks. After one week an evaluation of the progress took place, and questionnaires for the residents and caretakers were left behind. Below a summary of the most relevant findings is given. For the full test results including the test data and charts, see appendix F.

Below are the test results from the resident's and caretaker's perspective separated. In addition, there is a third category for test results related to the system's functionality, such as bugs.

Test results - resident's perspective

- Residents are overwhelmed by the camera. It is too difficult to use for the residents, the caretaker had to help with taking the pictures. One resident specifically said, "*Easier to use, should be possible at any time, even without nursing staff*." While another said, *"Good idea, however, too complicated for elderly, improve."*
- The presentation in the living room was perceived as pleasant, while walking with a camera was not pleasant at all. It was once again confirmed; the camera is too much of a hassle to take along.
- One resident was highly interested in the beginning. He took a lot of pictures, especially of people. Which is fine if they are residents of the building. However, he started taking pictures of stranger and their children, so the caretaker had to tell him that he was not allowed to. The caretaker gave further instructions on what kind of photos were allowed, the residents got overwhelmed and lost interest.

Test results – caretaker's perspective

- The photos did not initiate social contact between the residents, however it did start conversations between the caretakers and the resident.
- Pic to go was used daily. However, the residents had to be asked to take the camera along with them, or to go outside with the camera. Defeating the purpose of Pic to go externally motivating the residents, instead of the caretakers. See figure 32 for a chart of the frequency of use.
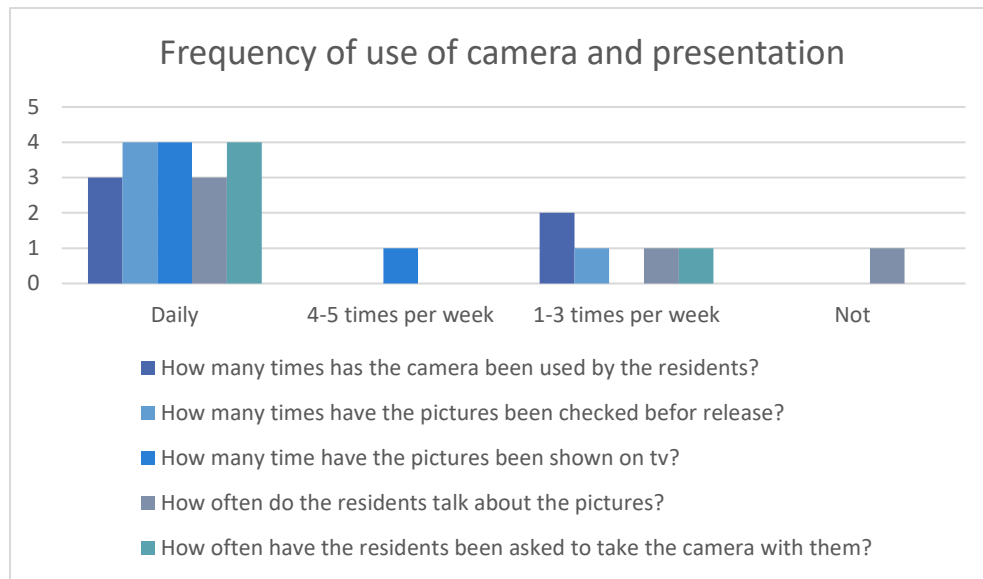
Figure 32. Frequency of engagement with Pic to go

- The presentation was perceived as visually attractive, while the camera was not. Including the feedback from the residents, it is clear the camera needs a redesign.
- Caretakers agree that the camera is too difficult in use, should act more like an "old camera".
- Residents cannot combine the camera with paying attention to their environment. As example, they don't look at the traffic anymore.
- Residents have mental restrictions, this makes it difficult for them to engage in complex activities. The functions and handling had to be explained multiple times to the residents.
- The caretaker's settings part of Pic to go was well received.

Test results – System functionality

- Not all the pictures appeared in the slideshow. Due to Spring using pagination, only the first twenty pictures showed up in the slideshow. This problem did not arise earlier, because the system was not stress tested at the time.
- In the main screen pictures did not randomly change on the main screen, resulting in only showing the first twelve pictures. Pictures should change every five minutes to give each resident a fair chance of seeing their own picture.

Improvements

The lack of engagement can be attributed to: the difficulty, how unhandy the camera is, lack of interest and their mental restrictions. All these points come together in the design of the camera. The camera should improve in two points: visual appealing and easy of use. Visually, the camera should look and act more like the old cameras. What might cause confusion is the camera having a case baring similarity to an old camera. However, there is a bigger (touch)screen and more buttons. This leads to a conflicting mental image of the product. The solution would be to, not only make it look like, but also act more like an old camera. As example: disable the screen and put a lens on top of the camera; make all interaction through physical buttons and hide all elements which might give away it is a smartphone. For the ease of use the following improvements are proposed. A second grip should be added to the opposite side of the current grip, making it easier for the residents to keep hold of the camera. This would also solve the "finger in front of lens"-problem. Use lighter material

for the camera case such as plastic to make it less heavy. Make it easier to carry the camera around, a lanyard as example.

It is also believed that the lack of visual progress contributes to a lower engagement rate. The residents have no feedback on whether they are doing it good or not. Virtual feedback through charts, badges or verbal feedback such as praise could all attribute to a higher engagement rate. Because, when the caretakers support and encourage the residents to interact with Pic to go, they do engage along with it.

6.3 SYSTEM FUNCTIONALITY
The system's functionality must be tested as well. The approach to this was to write isolated test cases. Each case covers only one functionality. For each test case a table (figure 17) is been made.

Functionality	What functionality is going to be tested?
Procedure	What are the steps taken to test this?
Expected test result	What should the functionality do?
Actual test result	What did it actually do?
Solution	What is the solution to the problem? (optional)

Table 17. Test case table

First a list is made of all the functionalities that must be tested.

- Server
    - Upload pictures to the server
    - Attach meta data to the pictures
- Main screen
    - Show the current theme and its end date
    - Show twelve random pictures related to the current theme
    - Enlarge pictures when clicking on them
- Slideshow
    - All the available themes are in the list and they redirect to the right slideshow
    - The slideshow shows all pictures related to the theme in a random order and scrolls automatically
- Photo album
    - Shows all pictures, regardless of its theme.
- Settings
    - Check if all pictures with active = false appear in the validating pictures screen
    - Approve pictures
    - Reject pictures

In table 18 the test tables for the server category is shown. The other test cases are in appendix E.

Server

Functionality	Upload pictures to the servers
Procedure	1. Upload a picture to the server 2. Check if the picture is in the image folder
Expected test result	• The pictures are uploaded and stored in the following folder: Spring_Server/Images.
Actual test result	The pictures are stored in the correct folder
Solution	-

Functionality	Attach meta data to the pictures
Procedure	1. Pick a random picture in the image folder 2. POST meta data for this picture 3. Check if the meta data is properly associated by making a GET request and verify the image file name.
Expected test result	• Every picture in the image folder has a set of meta data associated with the picture. • The meta data/image relationship can be verified by comparing the imageURI of the meta data to the file name of the picture.
Actual test result	On the left the image in the folder, on the right the mathing meta data. 1716282279102598.jpg "userId": "string", "created": "2018-08-05T14:51:33.070+0000", "tag": "string", "imageURI": "1716282279102598.jpg", "theme": "Disneyland", "active": true, The picture in the image folder has a set of meta data.
Solution	-

Table 18. Test case for uploading pictures to the server and attaching meta data to the pictures

7 CONCLUSION

The goal of this project is: How can we motivate elderly people between 60 and 80 years old living in an assisted living home to go outside on their own incentive by designing a soft- and hardware tool which uses gamification elements and is integrated into their daily life's as less technologically intrusive as possible? All residents are computer illiterate and require special care, in the sense that they have a mental restriction. Special attention should be paid to prevent creating a competitive scene. And to the mental model of the residents when it comes to technology. The residents have some motivation to go outside but need an external motivation most of the time. This is often the caretakers verbally motivating them. The desired behaviour is that they go outside on their own for 30 to 60 minutes per day. This should be achieved without the use of tangible physical rewards. Researching previous done projects conclude that users want to see their progression and have something to guide them on their journey; a theme, stamp or hotspot as example. Pic to go uses themes and a camera to motivate elderly people to go outside. Three tests were done, and the overall impression is that people are interested. Four out of the five people enjoyed the photos on the tv screen and four out of the five people experienced taking the camera with them for a walk as non-pleasant. They found the camera too difficult to use/too much of a hassle. The camera did not behave enough like an old camera, and because of their mental restrictions the camera had to be explained repeatedly. As a result, residents felt overwhelmed and discouraged. They lost their interest quickly, often within a couple of days.

Improvements would be: disable the touchscreen; hide the navigation buttons; make it less heavy; redesign the case to make it more visually appealing; improve ergonomics and provide something increase portability, such as a lanyard. On the software side: Pic to go should provide insights into your progression; reward the user for their achievements through badges; praise their efforts either verbally or in text form and make simplifying the overall process. The first tests were promising, but Pic to go must be redesigned and grossly simplified. Only when the residents don't feel overwhelmed by the complexity, they can fully engage with the product, and the caretaker's workload can be reduced.

7.1 FUTURE WORK

Based on the conclusion these are the following steps for the future:

Improve the camera

- Redesign the case: hide the buttons, use lighter material, make it more ergonomically, make it more portable and more visually appealing.
- Make the camera act more like an old camera to prevent confusion.
- Simplify the camera, make it only having a power on button and take photo button. The screen can be disable altogether, and taking photos can be done through a lens mounted on top of the camera case.

Make sure the residents can see their progress and feel encouraged to engage with Pic to go

- To implements personalized rewards, a profile system must exist. While this is already implemented in the Spring backend, the camera does not know which user is taking which picture. As a result, implementing a profile system is useless at this moment.
- Residents should be rewarded for their efforts. This way they receive a visual feedback on their progress. Without receiving (visual) feedback on their progress, it might feel they are stagnating.
- It was also noted that in a previous done project, the residents used the product to attract attention from the caretakers and receive praise. Praise can be a powerful motivator. Receiving praise on taken photos, either verbally from the caretaker or digitally from the system, can encourage the user.

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9 APPENDIX A – INTERVIEW QUESTIONS & RESULTS

Interview questions

Life

Describe your daily routine.

What was your job?

What are your aspiration(goal)?

What are your inspirations? || Do you have a hero? (Give examples)

Activities

What are your hobbies?

What are your interests?

What were the physical activities that you liked to do: vacation, biking, skiing?

Do you play games, if yes which games? (Search for a possible connection here)

Technically affinity

What kind of technology do you use or have experience with?

Have you ever used a smartphone before?

Results from the interview + observation

Male: Erich and Mannfred. Female: Slava and Weibler.

- There is a hiking group once a month from the Sozialdienste.
- Slava, Erich and Weibler are already interested into walking and doing it.
- There is a dog from a care taker, one woman likes to take the dog around for a walk.
- Slava likes to pray and meditate for her muscle pain (shoulder and lower back).
- Slava is the only one using a smartphone. She uses it for SMS and phoning
- Slava had a film camera in the past, but no experience with a digital one. Would be nice to be able to take pictures with a digital camera.
- Slava would be interested into taking pictures outside, if it would not be expensive. Erich is sceptical but is willing to give it a try.
- Mannfred liked to travel in his former times. However, the doctor is not recommending him to travel anymore because he needs his oxygen tanks available at all times.
- Mannfred never took pictures himself, but he interested to try it if there is a camera around.
- Mannfred was already thinking about motives to take a picture, such as a specific building during the night which is in a close village.
- Mannfred daily routine: wake up and eat breakfast, reading comics, lunch, talking with people, sometimes nap, and if the weather allows it he goes to a pond nearby. It's a very passive routine where he stays inside/non active most of the time.
- Most of the residents play games nearly every evening. However, Weibler is often tired in the evening, thus it's difficult to concentrate. Besides, she is not really interested into playing games.

- Games they play: Yas, Mensch ärgere Dich nicht, Helma, Uno, Memory, Skip Bo.
  There is also a sentence making game (for your mental health), but they need a push from the care takers to actually play these.
- Mannfred likes to play card games
- They also like to sing occasionally.
- During the night a lot of people watch tv in their own room.
- All of them are going out, some of them for long walks while other for only small amount of time.
- They need a push to go outside. And sometimes the nurses go along with them.
- People in the building have different backgrounds and mental health states such as: Depression, schizophrenia, drugs/alcohol problems and diabetes.
- The overall level of the resident's health is self-sustainable. The 'worst' health is a woman in the beginning 50 with a muscle disease, she can only go outside with somebody else and having a rollator or a wheelchair.
- Some of the residents have a rollator but its more for their safety, rather than a necessity.
- From 21:00 till 7:00 there is nobody in the building. There is one nurse which is 70% of the time here. However, there is a caretaker every day.
- There are some voluntary people, but they are not part of the care system.

10 APPENDIX B – SURVEY

Wie oft in der Woche gehen Sie hinaus um zu spazieren oder für andere körperliche Aktivitäten (Radfahren, Schwimmen etc.)?

_____ Tag(e) pro Woche

Wie lange sind Sie normalerweise für diese Aktivitäten draußen?

_____

_____

Welche Art von körperlichen Aktivitäten machen Sie?

_____

_____

_____

_____

_____

_____

11 Appendix C – Paper prototype and interactive wireframe

Theme: Nature

Photo Album **Slideshow** **Profiles** **Settings**

Back

Back

Back

Gretha Möllenburg

Credits: x 10
Photos Taken: 15

Photo Album

Redeem credits

Badges

Back

Settings

1 2 3
4 5 6
7 8 9
< 0 OK

Back

Settings

Photos

Themes

Profiles

Back

Validating Pictures

✔   ✗

Back

Themes

Queue

Current | Nature

Food

Carnaval

Future | Trees

List

Friendship ➕

Food ➕

Mountains ➕

Buildings ➕

Furniture ➕

➕

Back

Residents

Add residents ➕

Gretha Möllenburg	Edit	Delete
Karin Bregenz	Edit	Delete
Lindau Feldkirch	Edit	Delete
Jenny Tran	Edit	Delete
Daniel Tijerina	Edit	Delete

12 APPENDIX D – SETTING UP A DJANGO PROJECT

This will set up a project directory that looks like this:

```
PicToGo/
    manage.py
    PicToGo/
        __init__.py
        settings.py
        urls.py
        wsgi.py
```

This is an already executable Django project. If you start the server in the command prompt and go to localhost:8000, the browser will acknowledge that a Django website is running. However, it doesn't have any Django applications yet. A Django application, or in short app, are pluggable pieces of code that have one shared goal. A good example is the admin app which comes along with every Django project. The admin app is a premade simple backend to save development time. A Django project is a web application, while a Django application describes Python package which provides a set of features. One project can exist of one or more applications, and an application can be in one or more projects. And create an urls.py file for the URL configuration. That makes the app root:

```
engine/
    __init__.py
    admin.py
    apps.py
    migrations/
        __init__.py
    models.py
    tests.py
    urls.py
    views.py
```

In Django templates are used to generate html. A template contains the static part of html plus some Django specific syntax describing how dynamic content will be inserted. All the templates go into the template folder:

```
engine/
    templates/
        engine/
            mainScreen.html
```

Django treats additional files such as Javascript, CSS, external stylesheets and images as static files. Similar to templates, static files go into their own folder. This static directory has multiple subdirectories for the different static file types (CSS, fonts, javascript, bootstrap etc).

```
engine/
    static/
        engine/
            bootstrap/
                css/
                fonts/
                js/
            css/
```

```
images/
```

To use a static file from a template. Use the *load static* tag to load the static files. After that the files can be called through building a relative URL path with the static tag.

13 APPENDIX E – TEST CASES

Main screen

Functionality	Show the current theme and its end date
Procedure	1. Remove the current theme and make sure there is no current theme 2. Add a theme with the current date within the date span 3. Verify if the right theme and end date appear in the main screen
Expected test result	• When there is no theme, the template will say so. • If there is a current theme, it will display the theme plus the end date.
Actual test result	On top if there is no theme, below that if there is a current theme. 📷**Thema:** kein Thema 🕐**Zeit:** kein Thema 📷**Thema:** Disneyland 🕐**Zeit:** 2018-09-12 If there are multiple themes on the same date, the oldest uploaded one will be shown. (first come first serve)
Solution	-

Table 19. Test case for showing the current theme and its end date

Functionality	Show twelve random pictures related to the current theme
Procedure	1. Upload thirty pictures divided over two themes 2. Refresh the page to check if pictures are random 3. Verify if the first picture is shown 4. Verify if the fifteenth picture is shown
Expected test result	• They appear on the main screen if they match the current theme. • They appear in their matching slideshow • They appear in the photo album regardless of what the current theme is.
Actual test result	Any picture after number 21 would not show on the main screen. When making a GET call to the server, it would only return the first 20 images. If there are pictures in between which did not meet the criteria, even less than 20 pictures would show up in the main screen. This is due to Spring using pagination with a default size of 20.
Solution	The size of the call can be manually changed by adding the size parameter to the URL. Currently the solution is by changing the size to 2000 (this is an exaggerated number to make sure that all the pictures are included).

Table 20. Test case for displaying twelve random pictures

Functionality	Enlarging pictures when clicking on them in the main screen and photo album
Procedure	1. Click on a photo 2. Verify if it enlarges 3. Repeat for all twelve photos to check if it loads the right one
Expected test result	• The photo enlarges
Actual test result	It works as is intended
Solution	-

Table 21. Test case for enlarging pictures on click

Slide show

Functionality	All the available themes are in the list and they redirect to the right slideshow
Procedure	1. Upload five random themes, their dates are not important 2. Verify if all of them appear in the list of available slideshows 3. Test if the five slideshow buttons redirect to the right page
Expected test result	• All the available themes appear in a list of buttons from old on top to new on the bottom.

Actual test result	On the left the list of themes and on the right the buttons in the slideshow theme list.
	
	Themen: A Anfangsdatum: None Endtermin: None **Id:** 5 A
	
	Themen: B Anfangsdatum: None Endtermin: None **Id:** 6 B
	
	Themen: C Anfangsdatum: None Endtermin: None **Id:** 7 C
	
	Themen: D Anfangsdatum: None Endtermin: None **Id:** 8 D
	
	Themen: E Anfangsdatum: None Endtermin: None **Id:** 9 E
	
	Below is a snippet of the log, where it is shown that the buttons lead to the right slideshow
	<pre>[13/Aug/2018 02:55:33] "GET /slideshow/A HTTP/1.1" 200 1729
	[13/Aug/2018 02:55:35] "GET /slideshowThemes/ HTTP/1.1" 200 4951
	[13/Aug/2018 02:55:36] "GET /slideshow/B HTTP/1.1" 200 1729
	[13/Aug/2018 02:55:36] "GET /slideshowThemes/ HTTP/1.1" 200 4951
	[13/Aug/2018 02:55:37] "GET /slideshow/C HTTP/1.1" 200 1729
	[13/Aug/2018 02:55:41] "GET /slideshowThemes/ HTTP/1.1" 200 4951
	[13/Aug/2018 02:55:42] "GET /slideshow/D HTTP/1.1" 200 1729
	[13/Aug/2018 02:55:42] "GET /slideshowThemes/ HTTP/1.1" 200 4951
	[13/Aug/2018 02:55:43] "GET /slideshow/E HTTP/1.1" 200 1729</pre>

Solution	Just like the main screen, there was a pagination problem here which did not appear during the test but would if there were more themes than twenty. Therefore, the size had to be manually changed to 2000 here as well.

Table 22. Test case for the available slideshow themes

Functionality	The slideshow shows all pictures related to the theme in a random order and scrolls automatically
Procedure	1. Upload five pictures for theme A 2. Open the slideshow 3. Confirm if all five the pictures are in the slideshow 4. Confirm if all five pictures are shown in a random order, watch three slideshow and note their order.
Expected test result	• Uploaded pictures will appear in the slideshow • They will automatically change to the next picture • They are shown in a random order every time; the order is made when the page loads.
Actual test result	The uploaded photos did not appear in the slideshow. Reading the metadata, the images had the right file names and themes associated with them. The problem turned out to the be pagination problem

	mentioned earlier. All five pictures are in the slideshow and they change automatically: Switch, goat1, goat2, cat and donkey. Below is the order of the three slideshows to check whether they are random or not: Slideshow 1: Donkey – Goat 1 – Switch – Cat – Goat 2 - repeat Slideshow 2: Goat 1 – Cat – Goat 2 – Switch – Donkey - repeat Slideshow 3: Switch – Cat – Goat 2 – Goat 1 – Donkey - repeat As you can see from the results above, the order is random, but set once loaded.
Solution	The pagination problem is solved the same way.

Table 23. Test case for automatically changing pictures in the slideshow and showing the pictures in a random order.

Photo album
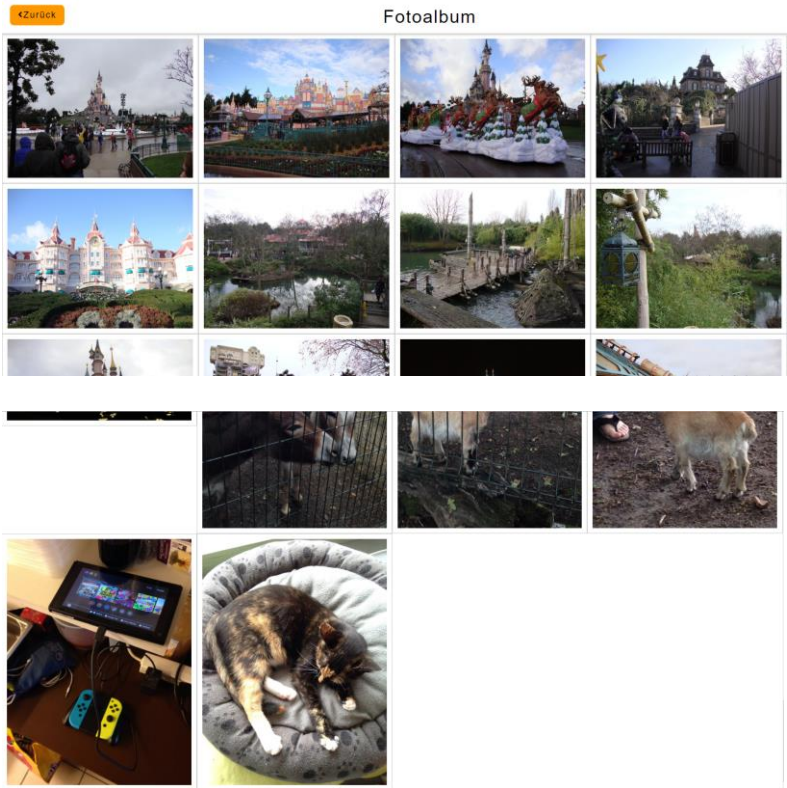
Functionality	Shows all pictures, regardless of its theme.
Procedure	1. Upload pictures divided over different themes 2. Check if all the pictures show up in the photo album
Expected test result	• All pictures, regardless of theme show up in the photo album • The oldest photos on top and the newest one on the bottom
Actual test result	The pagination problem appeared again and was solved in the same way. All the pictures, regardless of the theme appeared. In the first screenshot are the oldest pictures with theme "Disneyland", in the second screenshot are the newest with theme "A".
Solution	The pagination problem is solved the same way.

Table 24. Test case for showing all pictures regardless of its theme

Settings

Functionality	Check if all pictures with active = false appear in the validating pictures screen
Procedure	1. Upload three pictures with active is false and the current theme 2. Check if they do not appear in the main screen/slideshow and photo album
Expected test result	• Pictures where active is false will not show up in the main screen/slideshow and photo album.
Actual test result	The pictures do not appear in the main screen/slideshow and photo album. They do appear in the image validation screen.
Solution	-

Table 25. Test case for checking if pictures which are not active do not show up in: main screen, slideshow and photo album

Functionality	Approve pictures
Procedure	1. Approve a picture 2. Confirm if it shows in the main screen/slideshow and photo album
Expected test result	• Approved pictures will show up in the main screen/slideshow and photo album.
Actual test result	The approved picture showed up (L to R) in the main screen, slideshow and photo album.
Solution	-

Table 26. Test case for approving pictures

Functionality	Delete pictures
Procedure	1. Note the ID of the metadata associated with the image 2. Delete the picture 3. Confirm if the meta data for this picture has been destroyed
Expected test result	• Deleted pictures will remain in the image folder, while the associated metadata is removed
Actual test result	The picture that is going to be validated is on the left with its metadata on the right. The ID of the metadata is 39 (see number at href). After deleting the picture, the image itself is still in the folder, however requesting a GET on metadata ID 39 will return an error 404 (not found).

	Request URL
	http://localhost:8080/metas/39
	Request Headers
	{ "Accept": "*/*" }
	Response Body
	no content
	Response Code
	404
Solution	-

Table 27. Test case for deleting pictures

Request URL

http://localhost:8080/metas/39

Request Headers

{ "Accept": "*/*" }

14 APPENDIX F - TEST RESULTS

During the test a total of 140 photos were taken, 28 of them were approved by the caretaker. The number of taken photos decrease over time (figure 29), day 1 and 7 are the days that testing on location occurred. The presence of more people and asking residents to participate, led to a small renew in interest. Figure 30 shows the number of pictures that get approved, and their percentage in figure 31. The numbers increase with a 100% at the last day, suggesting residents got a better understanding on how to make approvable pictures.
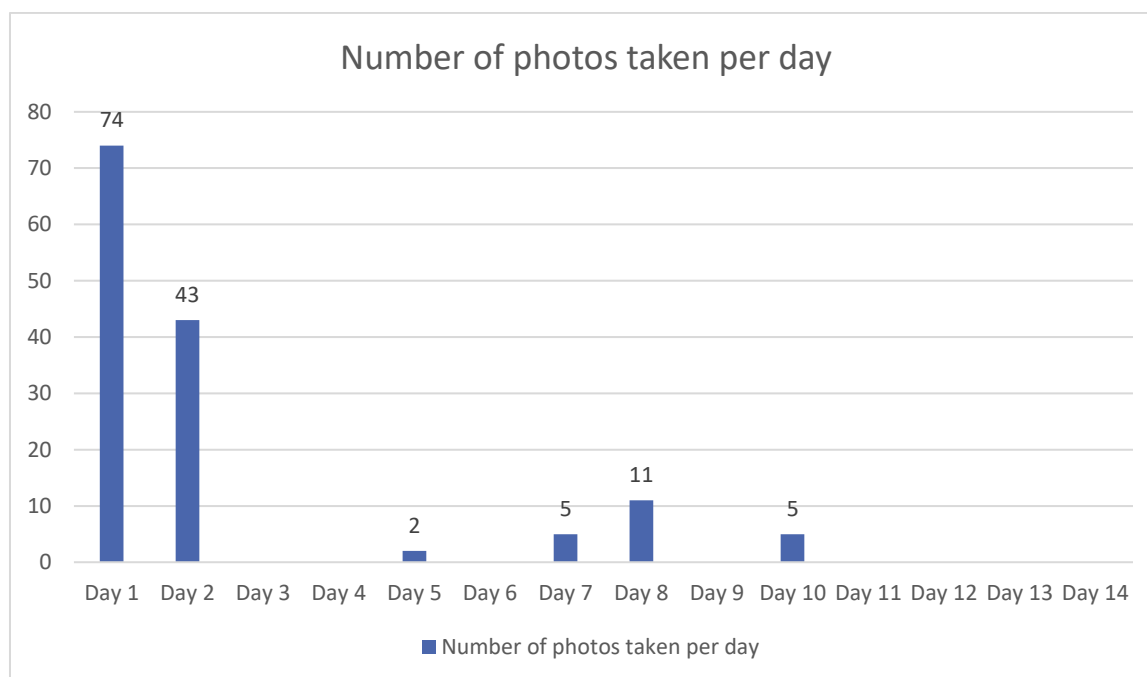
Figure 33. Number of photos taken per day during the long test (Trommelschlaeger, 2018).
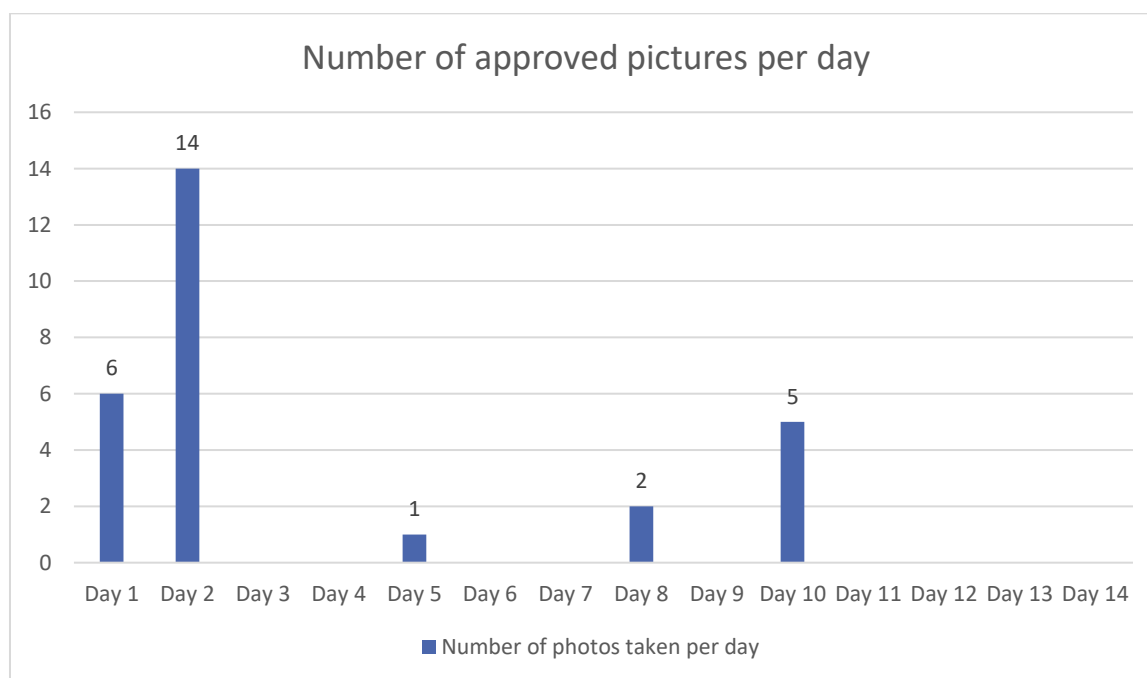
Figure 34. Number of approved photos per day (Trommelschlaeger, 2018).
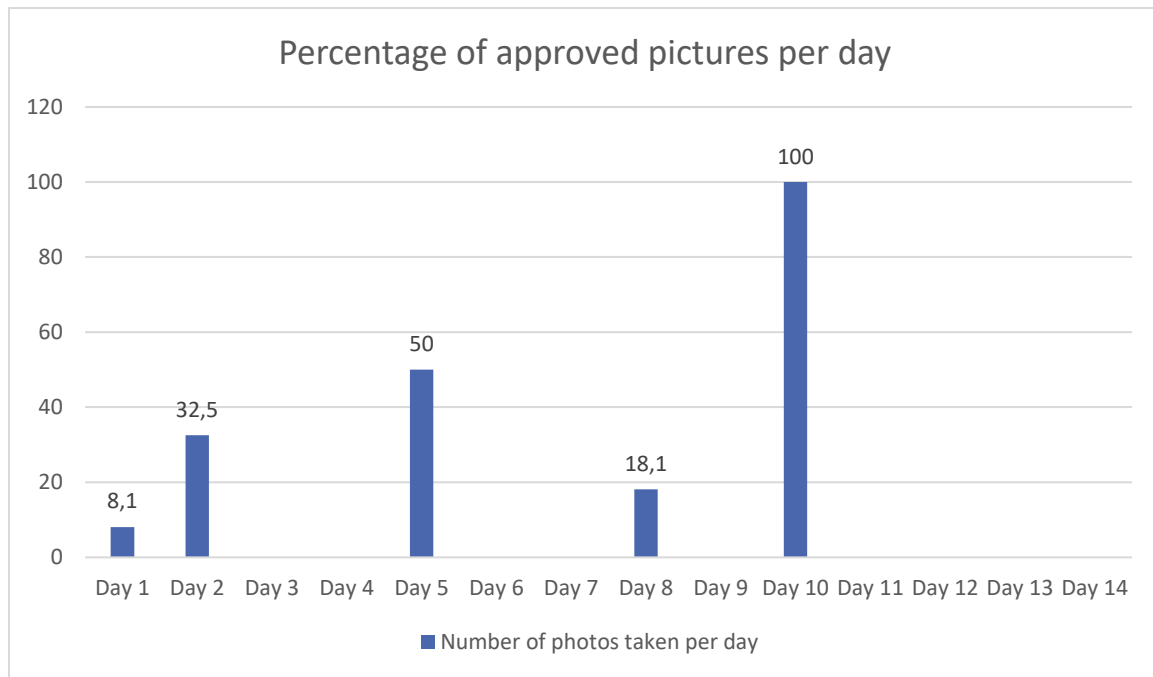
Figure 35. Percentage of approved pictures per day (Trommelschlaeger, 2018).

All the photos were examined according to the subject of the photograph. This way the most favourite topics of the residents could be noted. It is important to realize that this includes all the pictures taken by accident, bad pictures and rejected pictures. Which might explain the high number of ground/floor photos. The three biggest subjects were: buildings, familiar people in the building and the ground/floor.
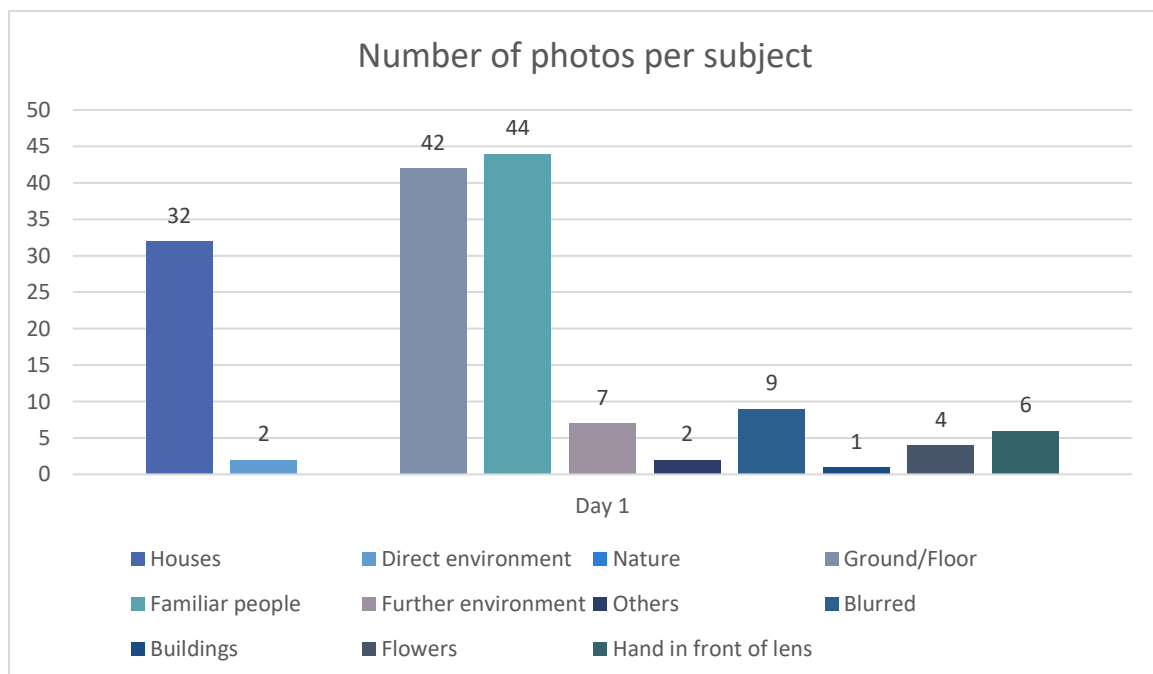
Figure 36. Number of pictures per subject (Trommelschlaeger, 2018).

Evaluation of questionnaires

It is recommended to gain feedback and opinions of the residents and caretakers (separately) as well. These are collected though questionnaires, which were filled in starting at day 7. Both questionnaires are made by K. Trommelschlaeger and can be found at the end of the appendix.

Evaluation of the residents

Five out of the twelve residents filled in the questionnaire. From these five, three residents used the camera. Three residents are between the 66 and 66 years old, the other two are around the 80. Four of them are female, one male. Two found using the camera very easy, one not at all. (Figure 33)
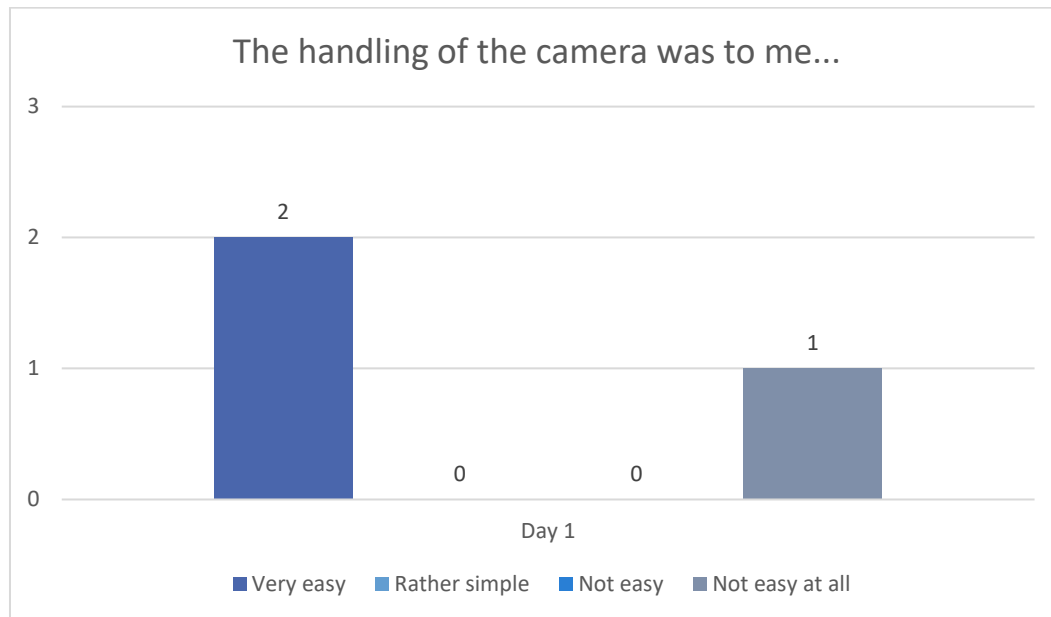
Figure 37. Residents opinion on using the camera (Trommelschlaeger, 2018).

The presentation of the pictures on the TV screen in the common room was perceived as rather pleasant, while the camera was not comfortable in use for the majority. (figure 34)
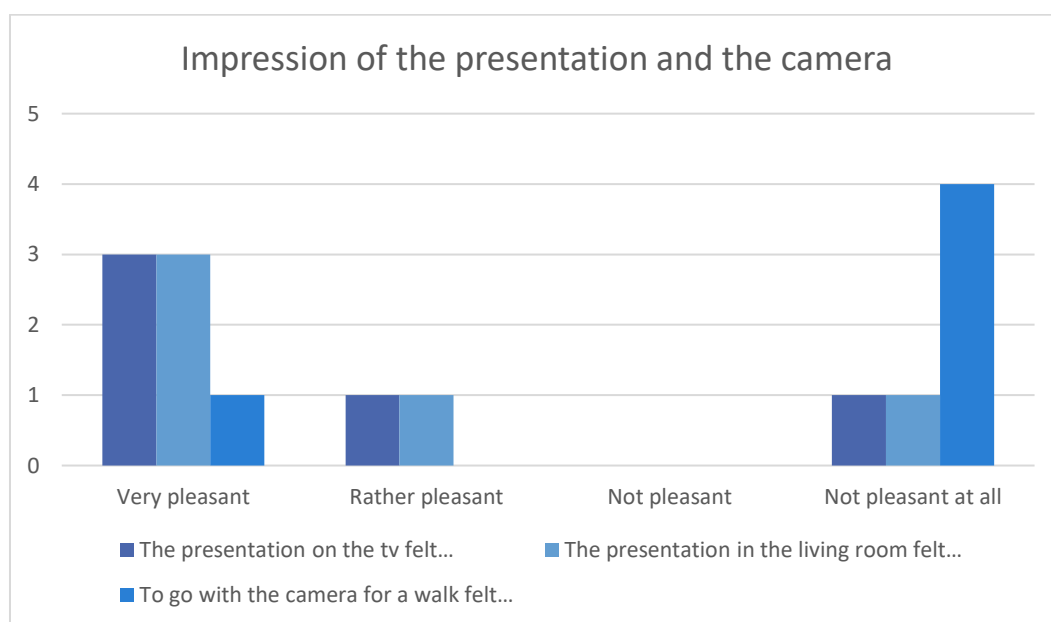
Figure 38. Impression of presentation and the camera (Trommelschlaeger, 2018).

Residents seldom used the camera; however they did look occasionally at the tv screen. However, the residents never initiated social contact based on the images.
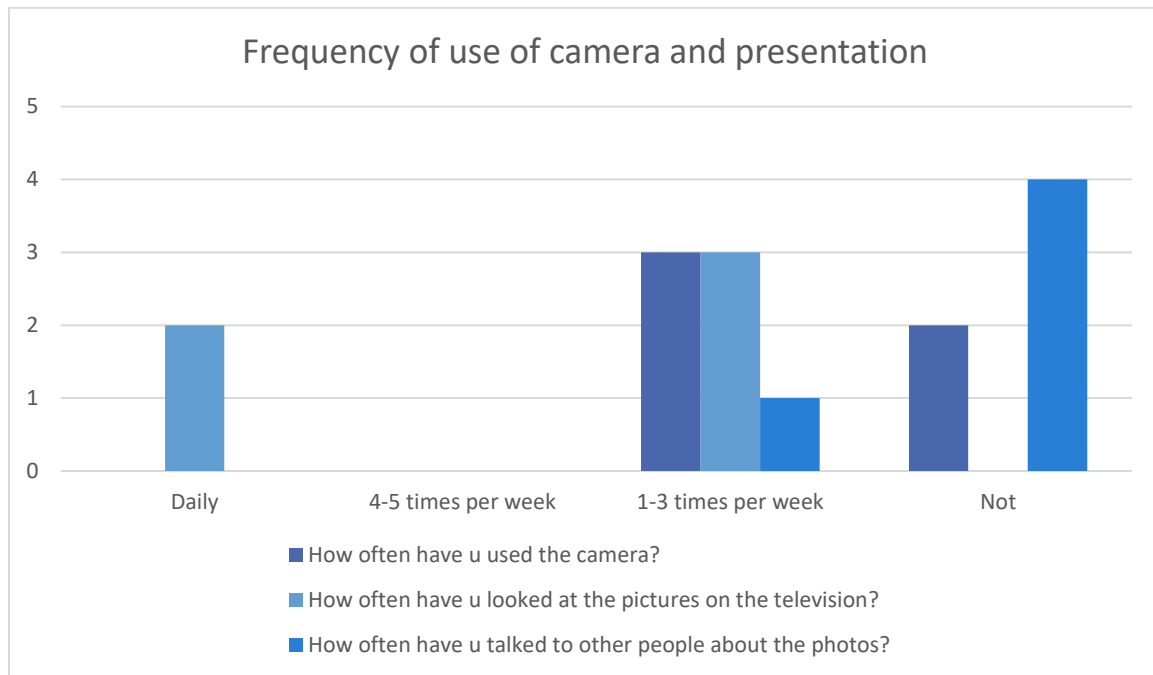
Figure 39. Participation frequency (Trommelschlaeger, 2018).

Following this there were four open questions, their answers were:

1. <u>If you didn't use the camera, why not?</u>
   - Camera should have an attachment. Hiking with walking sticks. Camera too heavy.
   - Something for youth
2. <u>If you have not looked at the images, why not?</u>
   - Boring
   - I always look at the screen for a short time. I have not noticed.
   - I don't know
3. <u>Do you have any suggestions for the design of the camera?</u>
   - Make it look more like the old cameras
   - Easier to Reattach
   - No
   - Lighter, too heavy
4. <u>Do you have any suggestions for the design of the pictures?</u>
   - No
   - Easier to use, should be possible at any time, even without nursing staff.
5. <u>What other Comments do you want to make camera and display the images?</u>
   - Satisfied
   - Good idea, however, too complicated for elderly, improve.
   - Super idea

Evaluation of the caretakers

A separate questionnaire, different than the one for the residents, has been made for the caretakers. The same or similar questions were asked to the caretakers in the hope to retrieve different perspectives on the test results. In addition, the caretakers provided some observations that they made during the test.

The caretakers got the impression that the camera was too difficult to use for the residents. The interactions on the TV (website) were deemed easy and switching from channels as well. (Figure 36)
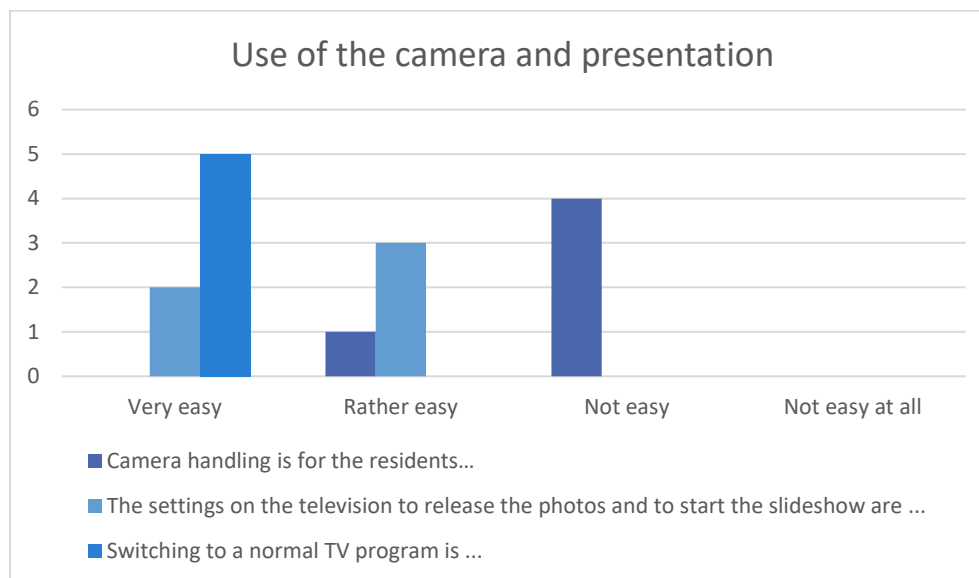
Figure 40. The perceived user friendliness (Trommelschlaeger, 2018).

Figure 37 shows that Pic to go was used daily. However, the residents had to be asked to take the camera along with them, or to go outside with the camera. Defeating the purpose of Pic to go externally motivating the residents, instead of the caretakers.
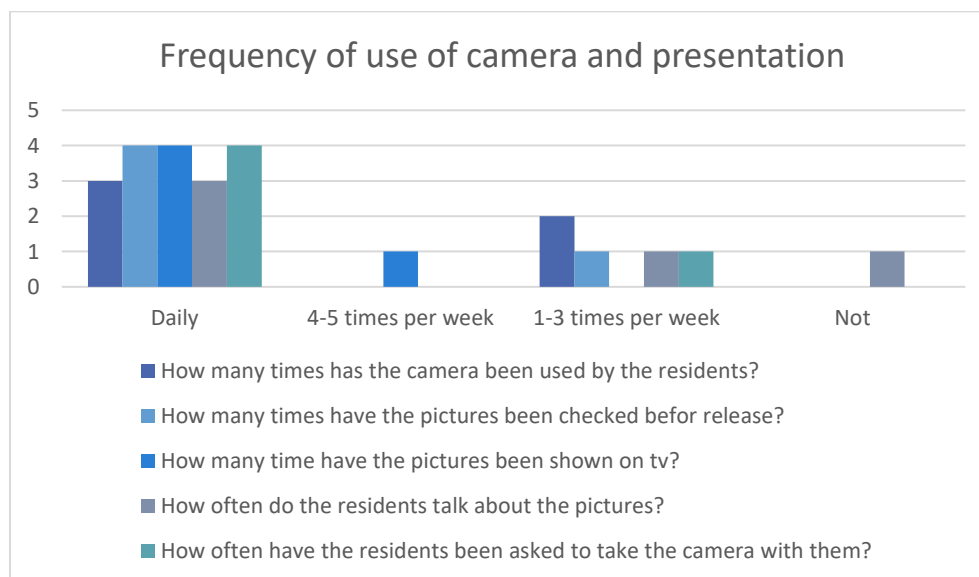
Figure 41. Frequency of camera use and display of photos (Trommelschlaeger, 2018).

Figure 38 show how visually appealing the main screen and the camera was. While the residents liked the website, the visual perception of the camera was negative.
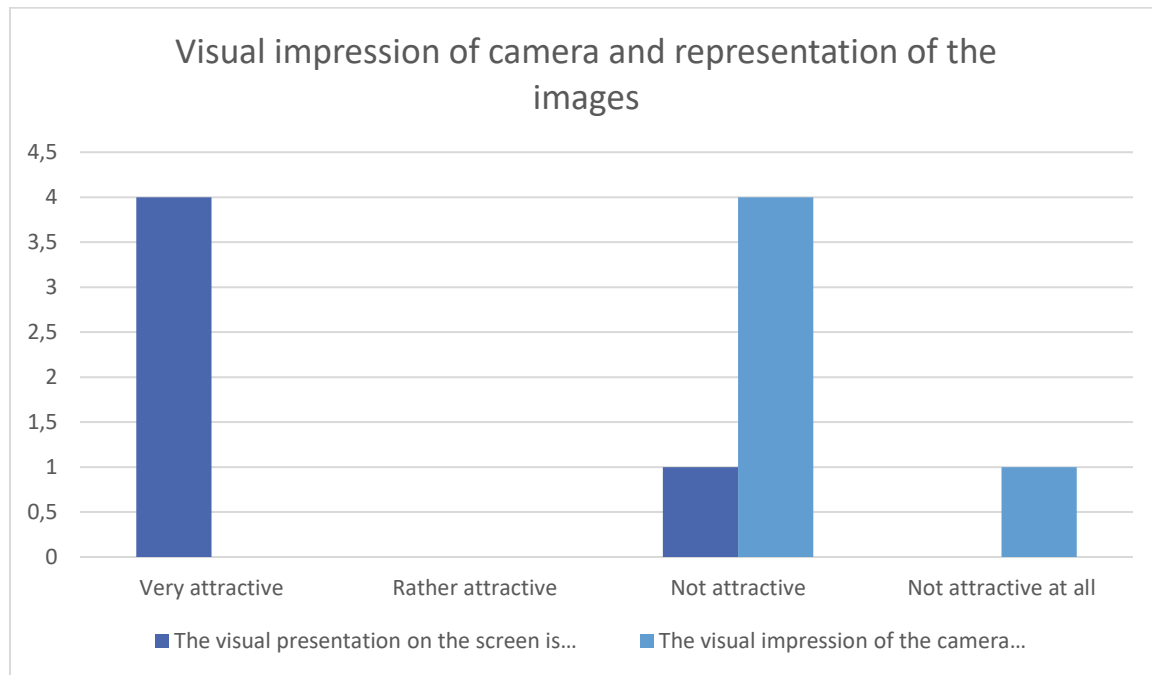
Figure 42. Visual impression of camera and the photos on the main screen (Trommelschlaeger, 2018).

Like the residents, four open questions were asked to the caretakers, providing some valuable insights.

1. <u>Do you have any suggestions for the design of the camera?</u>
   - An old-style camera. Residents cannot start with touch screen.
   - For residents the camera should act more like an old camera
   - The camera was rather not interesting for residents, they did not get along with the touchscreen and they like the old style better
   - As before
   - The camera's cover doesn't look very nice as if the camera is broken.
2. <u>Do you have any suggestions for the design of the presentation?</u>
   - That the images are not only shown as a slideshow.
   - Presentation is OK.
   - The presentation is good, residents sometimes look at these and start talking about where they were and what was there.
   - No
3. <u>Was there any positive or negative feedback from the residents?</u>
   - The interest of the residents was not very big, as they do not have access to the touchscreen.
   - Residents briefly look at the new photos and that's it. No further interest.
   - It's hard to motivate the residents to look at the photos already, but it does not motivate them to take pictures independently without our instructions.
   - The camera is a little slow, but it makes sharp pictures.
   - First, great interest from a resident. Overwhelmed with handling. Interest lost. Caregivers always had to motivate residents to take the camera with them. Photos were made mainly by caregivers.

Other feedback from the caretakers

Any other feedback from the caretakers were:

- Occupants overwhelmed with handling, has lost interest quickly.
- Focuses only on the camera, no longer on (stairs, car...)
- Residents show no motivation/interest on their own. Always from nursing staff.
- Much motivation required by nursing staff.
- Residents show no interest in making photos.
- Camera for residents unhandy/heavy/large
- In the first week already, little interest from residents' side.
- No more interest in the second week.
- function/handling must be explained again and again to the residents.

In discussion with the caretakers the possible cause for the low acceptance rate of the camera is the difficulty to use. The younger residents, around the 60 years old, are physically fit. However, most of them have some mental restrictions. They lack the urge/discipline to learn something new, and in the case of the residents above the 80 years old, they have geriatrics problems as well. Overall, the conclusion is that the residents are a very sensitive target group and the design should be grossly simplified. However, the images on the screen were seen by some residents and some did talk about it with the caretakers.

Improving the quality of life through gamification: Making going outside more fun for elderly people

Questionnaire on the project PicToGo - Residents

Personal details

Age [   ]

Sex   Female ☐   Male ☐

	Very simple	Rather simple	Rather not easy	Not at all easy
The handling of the camera is for me...	☐	☐	☐	☐
Switching to another TV program was...	☐	☐	☐	☐

	Very pleasant	Rather pleasant	Rather not pleasant	Not at all pleasant
I feel the presentation on the TV as...	☐	☐	☐	☐
The presentation in the common room I feel...	☐	☐	☐	☐
The camera to take a walk is...	☐	☐	☐	☐

	Daily	4-5 Times Per week	1-3 Times Per week	Not
How many times have you used the camera?	☐	☐	☐	☐

If you didn't use the camera, why not?

[   ]

	Daily	4-5 Times Per week	1-3 Times Per week	Not
How many times have you looked at the pictures on the TV?	☐	☐	☐	☐

If you haven't looked at the pictures, why not?

	Daily	4-5 Times Per week	1-3 Times Per week	Not
How many times have you talked to other residents about the photos shown?	☐	☐	☐	☐

Do you have any suggestions for the design of the camera?

Do you have any suggestions for designing the presentation of images?

What other comments would you like to make to camera and display the images?

Questionnaire on the Project PicToGo – Caretakers (with validation of images)

	Very simple	Rather simple	Rather not easy	Not at all easy
The handling of the camera is for the residents...	☐	☐	☐	☐
The settings on the TV to share the photos and to start the slideshow are...	☐	☐	☐	☐
Switching to a normal TV program is...	☐	☐	☐	☐

	Pleasant	Rather pleasant	Rather not pleasant	Not at all pleasant
The presentation in the common room is...	☐	☐	☐	☐

	Daily	4-5 Times Per week	1-3 Times Per week	Not
How many times has the camera been used by the residents?	☐	☐	☐	☐
How many times have the images been checked for release?	☐	☐	☐	☐
How many times have the pictures been shown on the TV?	☐	☐	☐	☐
How often do the residents talk about the pictures?	☐	☐	☐	☐
How many times have the residents been asked to take the camera?	☐	☐	☐	☐

	Very appealing	More appealing	Rather not appealing	ÜberhaUpT not appealing

The presentation on the screen is...	☐	☐	☐	☐
The camera is visually...	☐	☐	☐	☐

Do you have any suggestions for the design of the camera?

Do you have any suggestions for the design of the presentation?

Were there any positive or negative feedback from the residents?