Motivating social interaction through mobile ICT

Design of a motivating application

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Abstract

Limited social interaction can lead to a repetitive and inactive lifestyle. For the elderly, this can further lead to reduced cognitive ability, in addition to physical decay. Our preliminary study showed that metaphors and game elements have been used successfully to promote physical activity. The aim of this study is to apply these elements to a mobile application in order to promote social interaction.

This thesis presents a developed mobile application which allows the user to sign up for social events in the Trondheim area. The application featured an apple tree metaphor, where the amount of apples represented the users level of social activity. Additionally, a game element in the form of a quiz was developed. This provided a safer environment for social interaction before and during the events. A Participatory Design process, including three elderly users, helped determining design elements that contributes to increased motivation to attend social events. The process provided user feedback and ideas in regards to the use of metaphors, game elements, and the general graphical user interface. A three week field experiment was conducted, where ten elderly participants used the application. When evaluating the application, all the participants received a SUS-questionnaire. Five users took part in semi-structured interviews.

Our research goal was:

> *To design and develop a mobile application that motivates elderly to socially interact*

Our supporting research questions were:

RQ1 *Which factors motivates the focus group to attend social activities?*

RQ2 *Which design elements and concepts contributes to motivating mobile applications?*

The most important motivating factors attending social activities were found to be friendship, social interaction, and the interest level of the hosted events. To a smaller degree, competitiveness could influence if the user would attend activities. Further, the study shows that the use of graphical metaphors contributed to increased motivation, but did not apply equally to all test users. Game elements like the implemented quiz had a positive effect, and served as a good mediator for social interaction.

Keywords: Participatory Design, ICT, elderly, mobile application, social interaction, motivation

Sammendrag

Begrenset sosial interaksjon kan føre til en repeterende og inaktiv livsstil. For eldre kan dette videre føre til redusert kognitiv evne og fysisk forfall. Vårt studie i forkant av denne avhandlingen viste at metaforer og spillelementer har blitt brukt med suksess til å promotere fysisk aktivitet. Målet med denne oppgaven er å anvende disse elementene i en mobil applikasjon for å fremme sosial interaksjon.

Denne avhandlingen presenter en utviklet mobilapplikasjon som lar brukeren melde seg på sosiale arrangementer i Trondheim kommune. Applikasjonen bruker en metafor i form av et epletre til å representere brukerens sosiale aktivitetsnivå. Et innslag av spill er også lagt til, i form av en quiz. Denne quizen skal skape et trygt og enklere miljø for sosial interaksjon før og under arrangementer. Participatory Design ble valgt som forskningmetode, hvor tre eldre brukere bidro til å fastslå hvilke elementer som bidrar til økt motivasjon til å delta på sosiale arrangementer. Gjennom denne prosessen fikk vi tilbakemeldinger og forslag fra brukerne om hvilke metaforer, spillelementer og grafiske innslag de ønsket i applikasjonen. Et tre uker langt felteksperiment ble gjennomført etter at applikasjonen var ferdigutviklet, der ti eldre deltakere fikk brukt applikasjonen. Evalueringen av denne perioden ble kartlagt gjennom semi-strukturete intervjuer og spørreskjemaer.

Vårt forskingsmål var som følger:

Designe og utvikle en mobilapplikasjon som motiverer eldre til å interagere sosialt

Til å støtte opp om dette målet hadde vi følgende forskningsspørsmål:

RQ1 *Hvilke faktorer motiverer fokusgruppen til å delta på sosiale aktiviteter?*

RQ2 *Hvilke design-elementer og konsepter bidrar til økt motivasjon i en mobilapplikasjon?*

De viktigste motiverende faktorene brukergruppen hadde for å delta på sosiale aktiviteter ble funnet til å være; venner, sosial interaksjon, og hvor interessant aktiviteten var. Brukerne ble også motivert av konkurranseelementer, men i en mindre grad enn de andre faktorene. Videre fant vi at bruken av grafiske metaforer økte motivasjonen til flere av brukerne. Dette var derimot ikke noe som gjaldt alle. Innslag av spill i applikasjonen hadde en positiv effekt, hvor quizen fungerte som et godt hjelpemiddel til sosial interaksjon.

Nøkkelord: Participatory Design, ICT, eldre, mobilapplikasjon, sosial interaksjon, motivasjon

Preface

This project report is a part of the deliveries in the course TDT4900 Computer Science, Software Engineering Master Thesis. The project continues from a specialization project done during the fall of 2012. In addition to this report, source code and a mobile application is uploaded to DAIM (Digital Arkivering og Innlevering av Masteroppgaver). The work has been carried out at the Department of Science and Information Science (IDI), at the Norwegian University of Science and Technology (NTNU).

We would like to thank our supervisors Anders Kofod-Petersen, First amanuensis II at NTNU and Senior Research Scientist at SINTEF, and Yngve Dahl, Research Scientist at SINTEF, for their continuous counseling and assistance throughout both fall of 2012 and spring of 2013. In addition we have had ten very dedicated test subjects, and two Specialist Nurses helping us throughout our design and test phase. We would also like to thank Brynjar Viken at SINTEF IKT for all the help and guidance with the backend of our application. Finally we would like to thank Silje Bøthun, Product designer at SINTEF, for guidance with our design process.

Steinar Haram and Stian Sørebø
Trondheim, June 10, 2013

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Chapter 1

Introduction

This chapter contains the motivation for this study as well as a statement of the research goal and research questions. This is followed by a representation of our research method, a brief summary of the main contributions and an outline of the report.

1.1   Background and Motivation

With the population of elderly people steadily increasing [United Nations, 2001], there is a necessity in many countries to keep people out of care homes and hospitals by keeping them in their own home as long as possible. An evident problem among many elderly is loneliness and the impact it has on the persons quality of life [Mullins et al., 1990]. Much of this loneliness tends to be a result of emotional and social isolation [Weiss, 1973]. One way to prevent this is to keep elderly socially and physically active through different activities. Co-Living is a project trying to provide solutions to solve such problems. We intend to develop a mobile application connected to this project. The following three paragraphs describe the Co-Living project, while the last paragraph describes our work in relation to this.

The main goal of the Co-Living project is the development of an ICT-based (Information and Communication Technology) Virtual Collaborative Social Living Community for Elderly people. Its aim is to stimulate and prolong the independent and active living of the elderly, in an outward environment through an advancement in elderly people social interaction, contributing thus positively to their well-being.

The target group of Co-Living is a big group of healthy elderly or with light physical or psychological health problems who are self-supporting, able to move around, and can still contribute actively. They find pleasure in getting help or stimulation to be active in an outward environment. The aim of choosing the specific target group is to prevent, or reduce the risk, that these people are spending most of their time at home as they get older for a variety of accumulated (physical, psychological, psycho-social and cultural) reasons.

The way the system works prior to our work is that the elderly users have a set of activities available to them. These can be activities of any sort such as a concert, dance lessons or hikes to nearby mountains. In their application interface they can sign up, sign off or invite friends to these activities. In addition they have can see what activities their friends have signed up for. In difference from Facebook, this system tries to communicate people to be social outside and not in front of a computer. There are four stakeholders that arranges and post these activities to the system: *Trondheim Kommune*, *Kulturelle Spaserstokk*, *Infosenteret for Seniorer* and *Trondheim Folkebibliotek*. These activities did also exist prior to Co-Living, but this system makes the various activities far more accessible and streamlines the process of advertising for the different stakeholders.

Our focus in regards to Co-Living is to create a mobile application which take best use of what functionality Co-Living can offer, and make it immersive to its users. Today the target group is using a web application made for desktop computers with little or no focus on user interaction and design (See Figure 1.1). Users of the current system has made remarks as *"This application is boring, and because of it I am already losing interest"*. During the course of our work the main focus will be to examine areas that can enhance the target group's willingness to use the application. More specifically we will look at different kinds of motivational elements and concepts, and how they can contribute to a better user experience.

(a) Todays activities
(b) Available activities
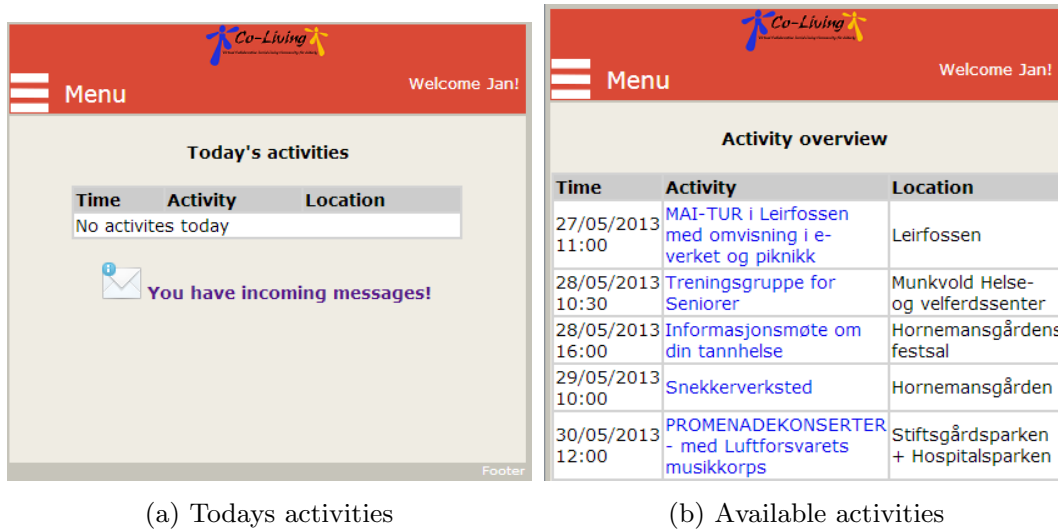
Figure 1.1: Two screens showing activity overviews in the current Co-Living web application.

1.2 Goals and Research Questions

We will conduct a series of workshops with a selected group of elderly people in Trondheim, Norway, and use prototypes created during the course of these workshops in a field experiment. This research should suggest motivational elements that can be used when designing information systems directed at the elderly population.

Our research goal is:

> *To design and develop a mobile application that motivates elderly to socially interact*

In order to achieve this goal, we will answer the following research questions:

Research question 1 *Which factors motivates the focus group to attend social activities?*

Research question 2 *Which design elements and concepts contributes to motivating mobile applications?*

1.3   Research Method

In a preliminary study we have conducted a Systematic Literature Review (SLR), and much of our background theory as well as our solution builds from this research. The results from this report are suggestions for what methods and elements can be used to motivate elderly users through mobile applications.

To achieve our goal we intend to carry out workshops and experiments with a representative group of people that fits our target group. In addition to testing the product, the users will take part of every step of the design process. For this matter we have chosen *Participatory Design* as a research method to address our goals. Although this method sometimes is said to be a design approach characterized by user involvement, Participatory Design by definition involve research as well as design. It is a research method which focus on designing *with the users*, instead of *for the users*. Participatory Design is described in detail in Chapter 3.

Evaluation happens in two stages of our project. First during the iterative Participatory Design workshops, where we continuously gain feedback on concepts and prototypes. And later after a field experiment, semi-structured interviews with our test subjects will be conducted. Also, all test users will be handed questionnaires.
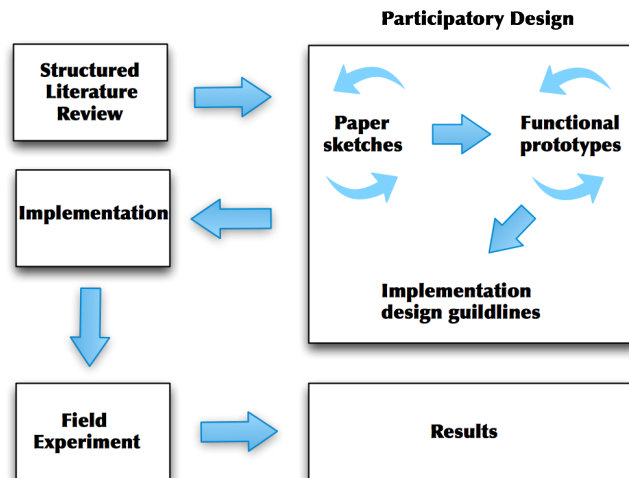
Figure 1.2: The figure shows the planned research method process

1.4   Contributions

The contributions of this project is defined by our research method. Participatory Design projects will provide *tacit knowledge* (knowledge that cannot readily be expressed in words) about the focus group. In this particular project it will uncover the tacit knowledge in regards to what motivates elderly to socially interact, and how this can be used within a mobile application. Our preliminary SLR study it was discovered that the general approach in the field of activating elderly has been through physical activities. Our contributions will therefore prove to be somewhat unique, as we focus on motivating elderly to take part in social activities to promote their health.

1.5   Thesis Structure

The rest of this report is structured as follows. In *Chapter 2* we present the context of the problem, and provide background theory according to the different parts of the project. *Chapter 3* describes our research method in full detail, how we plan to use it and our reasoning for choosing it. *Chapter 4* holds a technical description of Co-Living and its limitations, reasoning for the implementation choices that have been made throughout the process and a description of the tools and frameworks used when developing. *Chapter 5* contains the plan and results of the participatory design process. In *Chapter 6* we write about our experimental plan and results from the field experiment. In *Chapter 7* we reflect on our research method and technical decisions and discuss the results in regards to our goals and research questions (RQs). *Chapter 8* we list the major conclusions from our previous discussion. We write about possible future directions for our work and list our main contributions. A *Bibliography* lists the sources referred to throughout the report. *Appendices* provide the details and material that were left out of the main contents.

Chapter 2

Background

This chapter presents a brief overview of what has been done in the field of physical and social motivation for elderly through mobile applications. Further follows and introduction to different topics regarding motivational literature, gamification, pervasive computing systems and social interaction. This will provide the information needed to understand progress and development in the research field, and in what direction the research is moving. Much of the information gathered is directed towards the motivating to physical exercise, and not our main focus which is motivating social interaction. However, the techniques captured can possibly be reused in our context.

2.1 Background Theory

Motivation is the desire one has to do activities, whether it is getting a glass of water to reduce thirst or reading a book to gain knowledge. It is a crucial element in setting and attaining goals - research shows there are many factors that can influence your levels of motivation and self-control. Motivation is described with three components, activation, persistence and intensity [Myeong-Gu Seo and Bartunek, 2004]. Activation involves the decision to initiate a behaviour, such as enrolling in the military. Persistence is the continued effort to reach a goal, such as obtaining a higher rank in the military. Lastly, intensity can be interpreted as the vigour and dedication that goes into pursuing this goal. The following subsections will all provide insight in motivational theory.

2.1.1   Motivational theory

To better understand how people are motivated, and how this motivation is divided into different groups we look towards Richard M. Ryan who wrote a paper on Intrinsic and Extrinsic Motivations [Ryan and Deci, 2000]. The paper describes motivation as a desire to do an activity, whether it was influenced purely by your own will or from expectancy of others. In light of this, the majority of people who work or play with others are in some way concerned with motivation.

In Self-Determination Theory (SDT) the different types of motivation are distinguished based on the different reasons or goals one might have to do an activity. The most basic distinction between different types of motivation are intrinsic and extrinsic motivation. Intrinsic motivation is when someone chooses to perform a task for its inherent satisfactions rather than for some separable outcome, such as a good grade or pay raise. Examples of actions that can enhance intrinsic motivation is positive performance feedback, and a sense of choice and self-direction during an activity. On the other hand, actions such as negative performance feedback and a controlled behaviour will diminish the intrinsic motivation. Extrinsic motivation on the other hand is when an activity is performed to attain a separable outcome, and this is commonly the type of motivation that encourage most people to perform an activity. Given many activities are not intrinsically interesting, there is a need to motivate people to change the way they value and self-regulate such activities. This is described within SDT in terms of fostering the *internalization and integration* of values and behavioural regulations.

In Figure 2.1 a sub-theory of SDT is introduced, *Organismic Integration Theory* (OIT), this illustrates the different forms of extrinsic motivation in detail and what contextual factors that promote or hinder internalization and integration of the regulation for these behaviours. First we see *amotivation*, which is the state where a person have no intention to perform an activity. This state can derive from not feeling competent to do it, not seeing any value of completing the activity or not believing it will yield a desired outcome. To the right of amotivation there are different types of motivation organized in differing degrees of self-determination. The least self-deterministic form of extrinsic motivation, *external regulation*, are behaviours that are altered to satisfy an external demand or to obtain an externally imposed reward. Next we have *introjected regulation* which is still quite controlling, this is when people perform actions to avoid guilt or to enhance their pride. Regulation through *Identification* is a more self-determined form of extrinsic motivation, this is when the person has identified the personal importance of the behaviour and thus accepted its regulation as his or her own. Finally, *integrated regulation*, the most self-deterministic form of extrinsic motivation, occurs when the identified regulations has been fully integrated into the
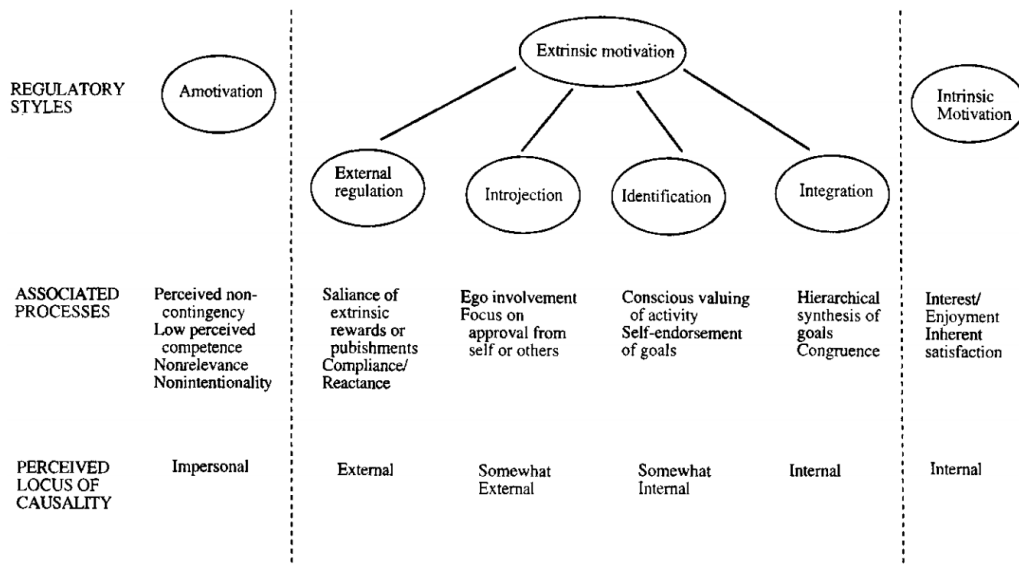
Figure 2.1: A taxonomy of human motivation (Adapted from Ryan and Deci [2000]

persons self-consciousness. At the far right of Figure 2.1 is intrinsic motivation. This emphasizes that intrinsic motivation is an archetype of self-determined activity.

2.1.2 Motivating elderly

Motivating elderly people to engage in social and physical activities has been a complex subject that has been studied for a long time [Phillips et al., 2004]. The importance of this subject is expected to rise as the years pass by. The number of people aged 60 or more is estimated to reach 22 percent of the worlds population by 2050, compared to 11 percent in 2009. Spending on pensions, health and long term care is expected to triple by this time [United Nations, 2001]. Promotion of exercise among elderly is proven to be highly beneficial, yet it is very underused [National Center for Chronic Disease Prevention and Health Promotion, 1995]. A common theme among elders is to neglect the importance of exercise, reporting that they cannot, will not or should not exercise. Elders have developed a set of beliefs that differ from the rest of the population, based on their educational background and life experiences [Schuster C, 1995]. They experienced a health care system very different from the one we have today, where the focus then was

mostly on curse and less on prevention. As a result of this, many elderly today may have outdated conceptions of the importance of doing activities in everyday life.

When trying to motivate elderly to be more active, both socially and physically, it is important to notice the challenges the they face. These challenges can be illness, misinformed belief systems, lack of social support, financial concerns, fear of injury, accessibility and a sense of dis-empowerment to name some [Phillips et al., 2004]. When tailoring activity schedules for elderly, it is important to take into account the different motivational limitations each have, and address each of the issues accordingly.

2.1.3   Computer games as motivator

In the last 50 years there has been a tremendous change within the gaming industry, first with the emergence of traditional board and card games and more recently with video games. Along with the video games played on consoles and PCs, we now see video games with more interaction with the user and their surroundings, often called live-action role playing games and pervasive games. With the rise of gaming into everyday life, the difference from real life and a fantasy life within a game has diminished a lot. When walking around in a crowded city today, you would detect examples people of all ages interacting with games. Whether it would be school kids playing on their hand held Playstation, businessmen playing on their iPad or elderly playing the slot machines at the mall. Due to the emergence of gaming in society a technique to motivate people through gaming has been popularized. This is called gamification, and is defined as the use of game mechanics and design to encourage user to engage into desired behaviours. Elements often seen is the use of achievements, levels, leader boards, progress bars and virtual currency.

Figure 2.2: Zombies, Run! application (Adapted from Alterman [2012])

A good example of gamification is the smart phone application *Zombies, Run!*
[Alterman, 2012]. This is an immersive game for the iPhone where you through
actual running and physical exercise also play a game by going out and running
in the real world. You can collect medicine, ammunition, batteries and spare
parts that you can use to build up and expand your base to protect you from the
zombies in the storyline. Through your headphones you hear groaning, breathing
and yelling from zombies. If you are not fulfilling your training goals the zombies
will overtake you. So while exercising, you might still enjoy the thrill of playing.

Gamification is said to emphasize both intrinsic and extrinsic motivations
[Ahmed et al., 2012], thus making activities feel more engaging. But there are
also people claiming that use of gamification can also negatively affect the mo-
tivation behind it. Alfe Kohn describes that extrinsic benefits such as money or
status can destroy the very purpose of gamification [Kohn, 1999]. Studies have
shown that extrinsic benefits motivate people to do things of lesser quality up to a
certain point in time, when the extrinsic benefit is gone the activity is discarded.
Yet gamification is showing to have a big impact on both businesses and people.
In a research report by Gartner in 2011, it was estimated that by 2015 more
than 50 percent of organizations that manage innovation processes will gamify
those processes [Goasduff and Pettey, 2011]. In a statement made by industry
heavy weight Al Gore at the 2011 Games for Change Festival, Gore proclaimed:
"Games are the new normal".

One concept related to gamification is the concept of pervasive games, which
are games or activities that make use of real spaces and blur the border between
real life and games. Pervasive games are built upon three core technologies:
mobile devices, wireless communication, and sensing technologies that capture
players contexts. With the emerging field of pervasive computing together with
the highly accessible, cheap and powerful smart phones, many new opportunities
arise. In addition, older adults perceive mobile phones to be the most useful
medium where they should receive reminders for when to carry out their daily
routines. The mobile phone is considered a more private and available medium
compared to other devices such as TVs [Lee et al., 2009]. However this brings
up big concerns regarding privacy [M. Satyanarayanan, 2001]. Mechanisms such
as location tracking and smart spaces can monitor user actions on an almost
continuous basis. Unless this information is strictly controlled, it can be put into
a variety of unsavoury uses.

2.1.4   What motivates to social interaction

Studies have shown that people, specially senior citizens, are hesitant to converse with other people they are unacquainted with. There is a need for an excuse or a basis to initiate a conversation. This phenomenon is referred to as a *ticket-to-talk*, and is based on the work of Jefferson and Sacks [1995]. Sacks gives examples of tickets to talk when walking the dog in a park, striking conversations with other dog owners. Other examples can be people attending the same event or simply sharing a frustrating line at the airport. In these situations the initiation of the conversation is not seen as an unwelcome advance, even though the people are unacquainted with each other. The ticket-to-talk concept can be a potential resource for turning casual encounters into an opportunity for social interaction [Svensson and Sokoler, 2008].

People will in general turn to everyday activities such as sports, the daily news, or the weather as a resource for opening a social encounter [Sacks, 1992]. In order to support interaction with technology one has to construct a resource. Svensson and Sokoler [2008] suggest the following in order to create such a technological resource:

- Embrace the ambiguity of intentions that that seems to be inherent to many everyday activities

- Use everyday activities as a way of accomplishing the embracing of ambiguity

- Rely on people's social and practical intelligence in view of digital technology as one resource in emerging socio-material practices

Chapter 3

Participatory Design

This chapter contains information about Participatory Design. In the first section we present the methodology. In the second section we take a look back at the history of Participatory Design to deduce the important aspects of the process and how it came to life. The third and last section clarifies our approach to Participatory Design in this project, and our reasons for doing so.

3.1 Methodology

Participatory Design is a methodology for designing collaboratively with users, and its foundation is based upon that users have just as valuable skills and knowledge as the developers when it comes to contributing to a design process. [Greenbaum J, 1991]. Participatory Design is a research method, even though it has been seen as design approach characterized by user involvement [Johnson et al., 2007]. The methodology is derived from participatory action research, and while they both have similar interest in participation, they have different strategies for doing so and with a different intent [Foth and Axup, 2006]. Usually participants are invited to cooperate with designers, researchers and developers during an innovation process. During this time they help to define the problem, gather ideas for a solution, and help evaluating the solutions once developed. From this the researchers and users create a list of common aims that represents the users interests. This list must remain flexible as the users tend to critically evaluate their own aims. Continual participation is a key factor to keep a sustained and iterative reflection on the design artefacts [Spinuzzi, 2005]. Therefore Participatory Design is done in iterations over a longer period, where in between of each iteration the researchers work with the material gathered from the previous meeting. When working with participants on the design of a new system the researchers

gain knowledge about the people they are designing for. Additionally, the design will better reflect the users needs and values. The general characteristics in Participatory Design can be separated into three stages:

- Initial exploration of work: During this stage, the researchers present themselves and the establish a relationship with the users. Afterwards they explore the way users work together and their usage of technology. This also includes work flow, routines, and procedures.

- Discovery processes: This is the stage where researchers and users interact the most, and the goals and values of the users are identified. In addition the group tend to agree on a desired outcome of the project. This usually occur at workshops with several users involved.

- Prototyping: In this stage the researchers and users iteratively create prototypes that solve problems the users had in their workplace. Different types of prototypes are often used, both handmade and digital. Finally test results are collected from the users exploring the final prototype. These results can vary from forms to depth interviews.

3.2   History

There has been two distinct approaches to Participatory Design, one Scandinavian and one American. Participatory Design originated in Scandinavia and its approach involves heavy direct interaction between the researchers and the users. The users were usually gathered through worker and trade unions, which would ensure that the participants have good knowledge and ideas for the system. In contrast the American approach is less intrusive and use observation and artefact analysis to a greater extent. In addition participants are usually not gathered through worker unions but rather through advertisements [Y., 2011].

UTOPIA is one of the more known Participatory Design projects, as it was one of the first projects with a more offensive strategy for worker involvement [S. et al., 1987]. It had direct participation in all design and development phases of computerized tools and systems in the workplace. The overall research objective of UTOPIA was to contribute to the development of methods for involving end users in all phases of design and development. They produced twenty "UTOPIA reports" on different aspects of technology, work organization and work environment. This project has been of utmost importance for forming the design practice of today, demonstrating already in the 1970s and 80s what is achievable [S. et al., 1987].

3.3 Our approach

Our approach to Participatory Design differs somewhat to the original Scandinavian approach, where the users are familiar and often expert users of the previous system. This is not the case in our project, as the goal is to create an alternative representation of the system. Participatory Design projects are often related to improving the working lives of co-participants. This is done by reducing the tediousness associated with work tasks, and co-designing new opportunities to increase worker control. In our project, however, we are not seeking to improve the users' work tasks, as they are retired, instead we are creating new tasks that can improve their quality of life. While this is not the common use of Participatory Design, there are projects successful in using Participatory Design in similar fashion. One such project created by Skeels et al. [2010] is a good example. Using the Participatory Design process they created a social support system for breast cancer patients, and while the subjects are not familiar with a current system they use the process which provide them with good results.

We chose this methodology because we wanted to create a system that the elderly would react positively to, and find interesting. We feel that knowing their opinion in every step of the process, and take advantage of their experience and knowledge is key to creating a system they are satisfied with. Participatory Design can be seen as a move of end-users into the world of researchers and developers, which is exactly what we were looking for.

Chapter 4

Tools and Co-Living Framework

This chapter contains a description of the architecture of the system our application communicates with and its limitations. Further, an evaluation of required device support and frameworks best suited for these devices. Lastly the chosen framework, and a simple overview of the system is presented.

4.1   Co-Living backend architecture

Co-Living is based on an innovative Social Community network (SoCo-net), integrating different mobile wireless ICT based services addressing the elderly social interaction context categories of Care & Wellness, Guidance and Mobility monitoring.

An overview of the Co-Living system is presented in Figure 4.1. The solution utilizes and scales up the developed FP6 mPower open source middle ware platform (http://sourceforge.net/projects/free-mpower/) to be applicable to the elderly social community interaction field.

Figure 4.2 shows the options currently available for the users of Co-Living, using the web portal. After logging into the system, they can create events or invite friends to already created events. They can also view invitations, and either accept or decline them. Invitations are received from friends, the user's occupational therapist, or the artificial intelligence based recommender system.
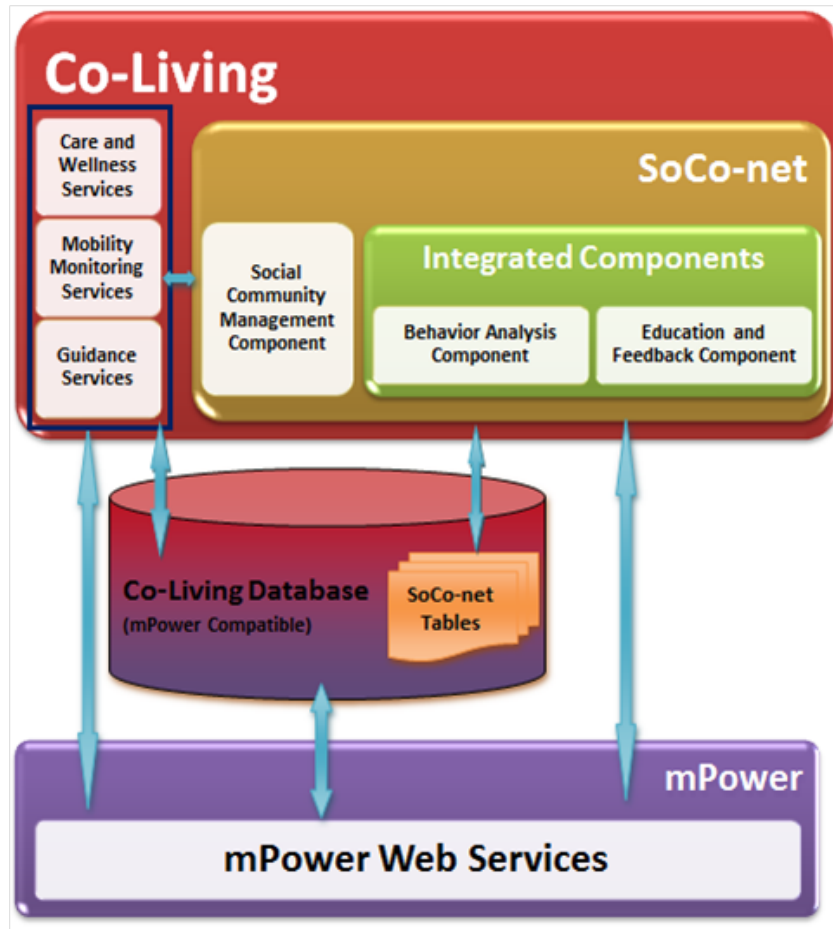
Figure 4.1: Co-Living system components

4.2   Limitations of Co-Living

During our previous work with the Co-Living system, we experienced some limitations that may prove to be challenging in further development. However some of these limitations are currently being addressed and might be of no problem in the future.

4.2.1   Documentation

There is a lack of documentation on the Co-Living system. There is no available up-to-date architecture or requirement documents. This has already proven to be a big factor into increased development time. The only source of informations
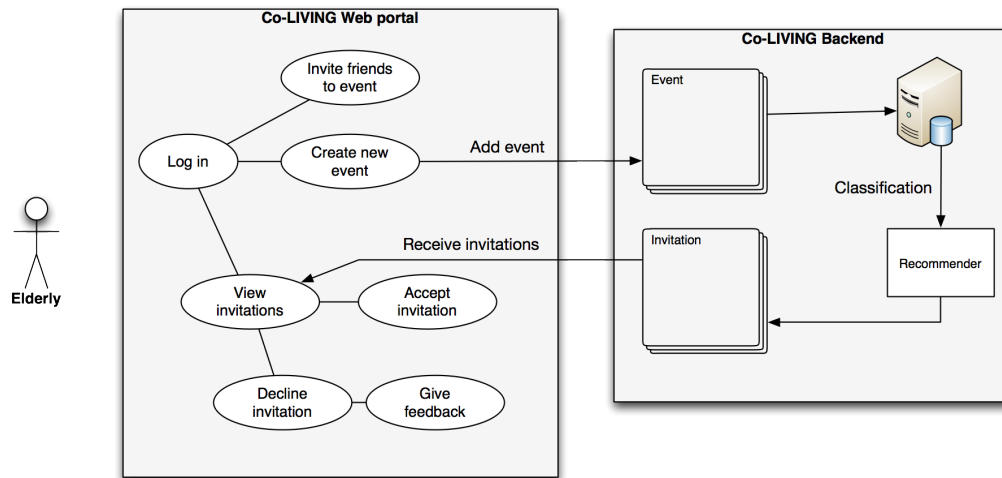
Figure 4.2: Use case diagram of the current system

or reasoning is the developers at SINTEF working on the project.

4.2.2 Backend changes

This is a system that is not fully developed, so changes to both existing and future features are to be expected. This is especially related to the our intended use of their web services, where the application will either require continuous updates or a code generation tool.

4.2.3 Missing Recommender implementation

An important part of Co-Living is the recommender that seek to predict the preference that a user would have in regards to available activities. This could be activities they have yet to consider or look up. Nevertheless this is currently still in development, and not available at this time.

4.2.4 Web service performance

Early during the implementation there were known issues related to the performance of the web services. However, it did not prove to be a problem in our pilot application. The developers at SINTEF are very aware of this issue and have already solved a lot of the bottleneck problems. In the future work it might be important to thoroughly examine the performance of each new feature, and not make more web service calls then necessary.

4.3   Deprecated Android solution

A solution for Android OS was developed during the preliminary study. The intention was to further develop this solution, and have it tested in a field experiment. However, during the participatory design phase, it was discovered that the vast majority of the test subjects had different kinds of phones. iOS, Android and Symbian were all smart phone operating systems represented in the group of our test subjects.

After the Participatory Design process ended it was decided that, for test purposes, it would be unwise to develop for Android OS as this would exclude too many of the intended test users. This led us to discard the created foundation from the preliminary study, and develop a cross platform solution instead. While we gained more test subjects for our field experiment with a cross platform solution, we lost a lot of the performance a native application would have. However we feel like the importance of more test subjects is higher. In regards to this we expect some negative feedback because of inferior performance.

4.4   Framework and implementation details

In this section we describe the details surrounding the final application. This will include our reasoning for choosing the different frameworks, what external plug-ins have been used, problems that may occur and solutions for solving them. In the end we present how the application will be distributed for to test users.

4.4.1   Selection of framework

When the decision was made to make a cross platform solution we had to find an appropriate framework. After a search we found that jQuery Mobile, Sencha Touch, Zepto, and EnyoJS proved to be the best documented and used solutions. Thereafter we rated each of the frameworks in 4 different categories, in this we used a 5-point number rating scale to evaluate its performance in each of the categories. All of the different frameworks are given a final score based on their results in each category. Our categories were as follows:

- Knowledge: This represents the knowledge and experience the researchers have in regards to prior work and research with the framework.

- Documentation: Grades the amount and quality of the documentation available.

- Device Support: Rated in order of how many different platforms they support.

Framework	jQuery Mobile	Zepto	Sencha Touch	EnjoJS
Knowledge	4	2	2	1
Documentation	4	2	4	2
Device Support	5	5	3	5
Extensibility	5	5	2	2
Score	**18**	**14**	**11**	**10**

Table 4.1: Grading of the different frameworks

- Extensibility: The amount of 3rd party extensions, how easy it is to make extensions and the growth of the community.

In our review of the different frameworks we knew that although most of them are JavaScript based frameworks, we have much more experience with jQuery Mobile than any other. Whereas we have some experience with Sencha Touch, we have never developed anything with Zepto or EnyoJS. In regards to documentation, again jQuery Mobile as the most known framework out of the four have a very good base documentation as well as good community support. Sencha Touch does not have the same amount of documentation, but does have a lot of video documentation. Both Zepto and EnyoJS are fairly new frameworks, and because of this doesn't have that good documentation available.

Even though every framework is based on HTML and JavaScript there are some limitations regarding device support on one of the frameworks. Sencha Touch does only support the WebKit (layout engine software for browsers) which in short means all Windows platforms are excluded. Both jQuery Mobile and Zepto can make use of all of the jQuery plugins that have been built over many years. This gives them a big advantage in comparison to Sencha Touch and EnyoJS in regards to Extensibility.

4.4.2 jQuery Mobile

After the review of the different frameworks we chose jQuery Mobile, this was the framework that scored best in our review. We felt most comfortable using a framework that we had prior experience with, especially considering our limited development time. Documentation is also important in order to quickly dismiss problems that occur during the development. jQuery Mobile has a huge community and forum support in addition to their own documentation to lean on if problems are encountered. After a quick search we also found a jQuery SOAP (Simple Object Access Protocol) plugin that was crucial to help us take

full advantage of the Co-Living system. This, in addition to the excellent device support, sealed our choice. With additional time to develop the application other frameworks would be more interesting to look at, specifically Zepto has been given much praise by developers online and is continuously growing.

4.4.3   jQuery SOAP plugin

Using SOAP requests and responses with a web browser is possible but ill advised. However, in our case it would greatly decrease our development time to use SOAP in this manner, seeing as we did not have to create an own solution for the backend logic. We discovered a great up-to-date jQuery plugin to handle soap requests; jQuery Soap. The performance of the SOAP calls with this plugin proved to be very efficient and suitable to our needs.

4.4.4   PhoneGap

PhoneGap allows for effortless bridging of web applications developed with jQuery Mobile, JavaScript, HTML, and CSS. The free service, Adobe PhoneGap Build, was used to automatically build the project to all common platforms, including our main targets iOS and Android OS. The resulting application is hybrid, meaning that it is neither truly native nor purely a web-based application. The main feature of Adobe PhoneGap Build, besides packaging the applications as native, is that it gives applications access to the native API the phone. This allows for usage of the phone's accelerometer, camera, storage and much more.

Same Origin Policy

PhoneGap served more purposes than just mentioned, if we were to create a web-application without PhoneGap we would have problems with *Same origin policy* which restricts how a script loaded from one origin can interact with a resource from another origin. PhoneGap applications embed a web view which loads local HTML files using the file:// protocol, and the same origin policy does not apply to the file:// protocol. The configuration of the application is set to allow all external locations. From a security point of view, this is not an optimal solution, but it will serve well for the test purposes.

4.4.5   AppStore vs Manual installation

Due to having the field test very close to the development deadline we have chosen to not use the different appstores to distribute our application, it is sufficient for the field trial to manual install the application on their phone through our server. This is due to both Apple and Google having a longer evaluation of each

application before accepting it into their appstores. However, this will not impact our field experiment or plans in any degree. Something to be noted is that PhoneGap applications is said to be a bit tedious to evaluate for the different appstores in difference to evaluating native applications.

The manual installation works different for the various types of smartphones. To be able to install the application on an iPhone, it needs to be connect directly to the developer's computer. Android users only need to click a link provided, and install the application normally.

4.4.6   Overview

All communication with the server is done via SOAP. Logged in users receive a security token, with an expiration timer, which is stored locally. This token is required for all server communication.
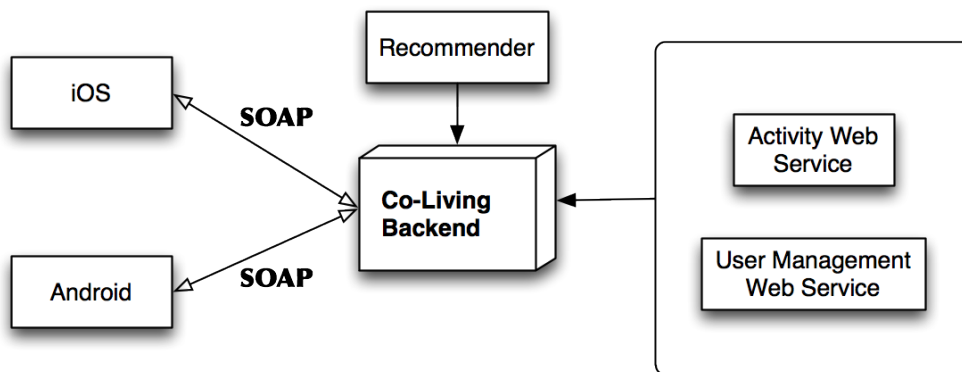
Figure 4.3: General system architecture

Chapter 5

Participatory Design process and results

This chapter presents how the Participatory Design process was conducted and what results it yielded. This includes a description of the process plan, how data was gathered, and detailed information of the design choices from all seven sessions with the focus group.
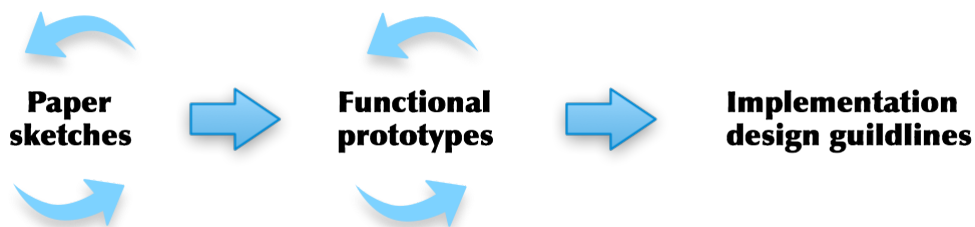
Figure 5.1: Overview of the Participatory Design process

5.1 Process plan

A total of seven meetings were scheduled with a focus group of three seniors. In addition to these seniors, a specialist nurse attended every meeting. The startup

meeting was to be held on Friday the 1st of February, with weekly meetings the coming Fridays. In compliance with our research method Participatory Design, the goal is to establish a relationship with the users at the first meeting. The users and the researchers are told to verbalize their background story, why they want to participate, their experiences with the problem at hand and experiences with the technologies that are going to be used throughout the project.

In the following two weeks the main goal was to find a concept that could add extrinsic motivation to the intrinsically motivated wish to become more active. This is part of the second stage of the research method, where we take advantage of the users experience and knowledge. This was planned to be done by exploring the users perspective towards concept ideas generated during the preliminary study. One aspect could be how they perceive elements of gamification such as competition, leader boards, interactive rewards and pervasive games, and how these ideas can possibly change or impact their behaviour. An example could be to explore how the users felt towards competition elements in the application, and monitor if their attitude to competition is as high as it often is with young adults. At the end of these three weeks with concept generation, a concept was to be chosen to be pursued further.

The next two meetings the group would together try to come up with a graphical metaphor presenting the chosen concept. For this we brought pens, paper, post-its, and printed phone frames. Drawing potential solutions on paper normally eliminates the constraints that stem from past experiences, and thereby allows for more alternative paths for the design. The main goal of this phase was to evaluate the effect the metaphor had on the users. As a secondary goal, the general user satisfaction was also to be determined. This goal was also intended to give guidelines for functional improvements for both our application and the already existing Co-Living web application.

In the last two meetings the aim was to convert the paper sketches into a functional prototype, while continuing to improve the graphical user interface. Another goal of this task is to give the users a better understanding of how the concepts and ideas would work as a final product, in order to better judge the validity of the product. Both the paper sketching and functional prototyping is part of the last phase of participatory design.

Prior to all meetings with the focus group, there will be held preparation meetings with the two supervisors, accompanied by a product designer from SINTEF. These meetings will specify the approach and goals for the coming meeting with the seniors.

After an implementation phase of one month, a final application is scheduled to be completed. The application will be tested in a field experiment lasting for three weeks. Both the focus group and other Co-Living users will be invited to participate in this. From the field experiment we will take note of experiences, what went well, and what caused problems. Finally, semi-structured interviews and questionnaires will be given to the test subjects.

5.2 Data gathering, equipment and participants

In order to reproduce our experiment one would need a set of people in which you can conduct the participatory design phase with. These people should have been either using the current system or have good knowledge about it. Our supervisors already had good contact with users of the current system (the Co-Living web application), and got three elderly users to participate in the design phase. The users aged from 67 to 78, and had past experience with the existing solution. In addition all the users have taken courses on how to use smartphones. At the first meeting we got consent from the users to record both audio and video for review and data retrieval after the Participatory Design phase. This ensures that all valuable data is captured, and allows for reviewing the sessions at later stages of the project.

(a) Post-its   (b) Cardboard frames   (c) Phone paper mockup
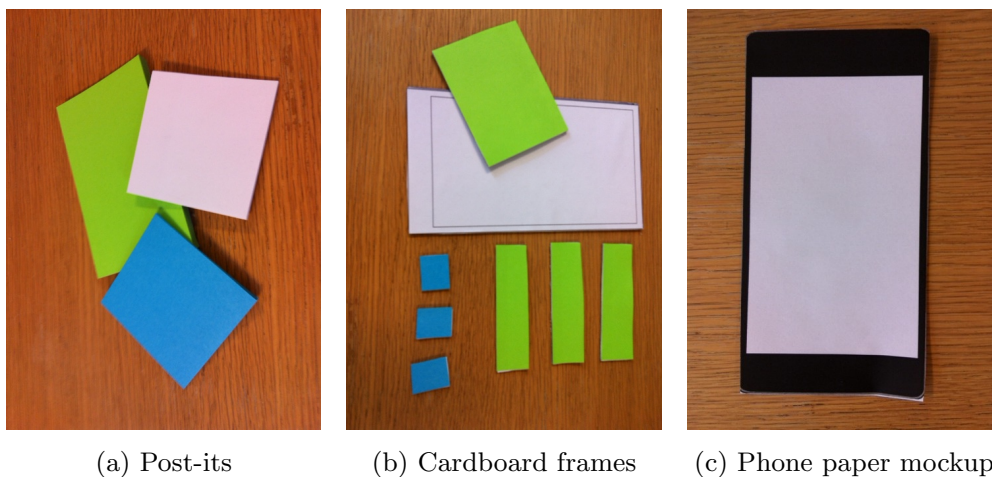
Figure 5.2: Images of our utilities when sketching solutions

In the earlier stages of our workshops we worked a lot with pen and paper, as well as cardboard phones as shown in Figure 5.2a. In addition to these phones,

we had other cardboard frames of different sizes to act as buttons, list elements and screens (See Figure 5.2b for clarification). On these we could either draw directly or place post-its. This ensured a creative and easy environment for trying out different ideas. We also worked with a lot of paper mock-ups of different smartphones, on these the group would sketch as they explained their ideas. In addition we removed all of the details in these mock-ups to establish a low threshold when drawing on them.

Figure 5.3: An image of the devices used to record audio and video during sessions

After the Participatory Design process, a functional application will be imple-

mented. This will be tested in a field experiment with a total of ten participants. The increase in participants will increase the strength of evidence and better our results. The feedback from the field trial were split into a SUS (System Usability Scale) questionnaire, and video recorded semi-structured interviews.

5.3 Results

This section covers the results from the Participatory Design process. The results stem from 7 sessions with the focus group, and gave the basis for developing a working version for the field experiment covered in Chapter 6. The first meeting would allow the students to get to know the focus group. The next three meetings would be focused around using paper sketches, with an increasing level of detail. After this, the meetings would be focused around functional prototypes, with an increasing level of detail and navigation possibilities.

Figure 5.4: The figure illustrates two iterative phases developing paper sketches and functional prototypes.

The input, planned output, and actual output will be presented in tabular form for each of the sessions. The input covers the material that the specific sessions are focus around. This will typically be various paper sketches, or different

screens from functional prototypes. The planned output covers the goal of the session, and the actual output covers what the lessons learnt in the session. The latter may vary based on how successful the session was.
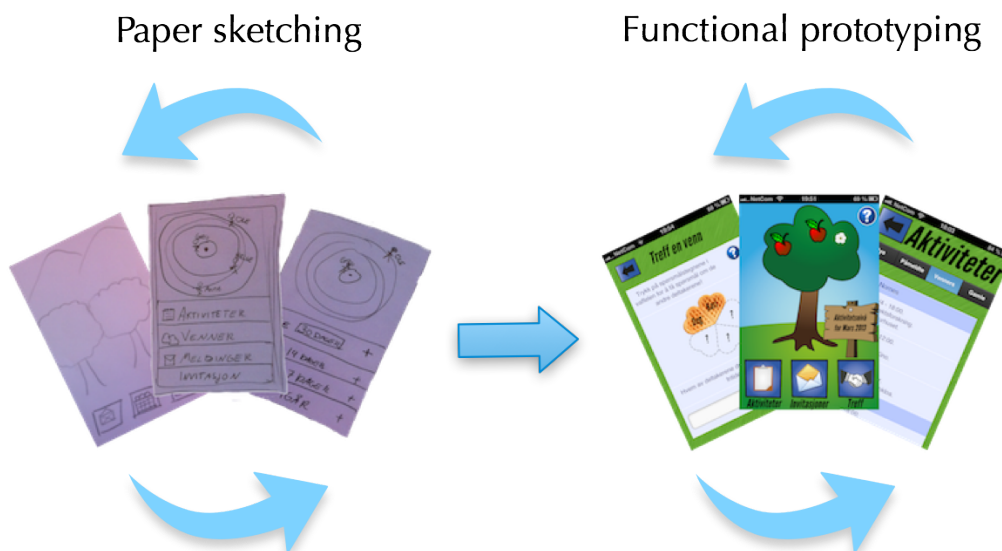
Session 1

01.02.2013	
Input:	Plan for work methodology. Session plan for the Participatory Design phase.
Planned output:	Building relations with the focus group. Acceptance of work methodology and possible revision of the session plan.
Actual output:	Accepted methodology. Planned dates for all future sessions. Paper prototyping was well received for designing initial sketches.

In preparation for the startup meeting, the students were joined by the two supervisors and a product designer, who works at SINTEF. Guidelines for the startup meeting was set, and the goal was to become acquainted with the focus group.

The meeting started with some small talk while the participants were served a cup of coffee and a waffle. The students, along with a supervisor and a specialist nurse, introduced themselves to the focus group. Following, the three seniors of the focus group introduced themselves. They supplied information about experience with the system and their background coming into the project. It became evident that the seniors were well used with accessing the existing web application using their personal smartphones.

The project plan and methods were presented giving, and the idea of using paper prototypes was very well received. Further, the seniors agreed upon the importance of participation when gathering ideas, and giving purely subjective feedback on the presented ideas in future meetings. It was also revealed that some of the users were used to stakeholder involvement in the design phase, and deemed this a key success factor. As the meeting went on, the seniors became more and more eager to give feedback on lacking or inadequately implemented functionality in the existing solution. It was apparent that they were well used to the system, and had both positive and negative feedback.

A minor homework assignment was given to the seniors. The assignment was to set up a timeline for one day. This timeline should contain the various activities throughout the day. If the activity were considered positive or negative, it

should be noted with a smiling or a frowning face. The intention was to map out what activities the seniors enjoyed, and which they did not enjoy. This could prove useful for example scenarios, and could work as a basis for discussion in later sessions. Both students had prepared examples for this timeline, and these were presented to the seniors to prevent confusion.

Design decisions

Based on the acceptance of the plan and good reception of the idea of using paper sketches, it was decided that the sketching of prototypes could start up in the next meeting. It was also decided that we would spend some time in the next meeting discussing the existing solution. This could reveal key factors for user acceptance of our product.

Session 2

08.02.2013	
Input:	Paper phones and post-its for sketching. Recording equipment for audio and video. Plan for determining social triggers.
Planned output:	Sketches for motivating metaphors designed together with the focus group. Feedback on existing solution.
Actual output:	Feedback on proposed motivating metaphors. Feedback on existing solution.

The supervisors had supplied equipment for recording of audio and video. This equipment was brought to this meeting, and the seniors gave verbal consent, allowing us to record all future meetings.

In preparation for the second meeting, we had made some rough paper sketches. One sketch held a leader board with star ratings of the most active users of the previous month. Another sketch held one right and one left shoe. The intention was that randomly chosen participants of a social event would receive one of the shoes, and he or she should try and find the user with the other shoe, completing the pair. This could potentially warrant a reward, or unlock hidden content in the application. The concept could serve as an "ice breaker", or a ticket-to-talk, and possibly create new friendships. The last sketch was of the same nature, but with a Yin and Yang symbol. These sketches, however, would serve as backup as the main objective was to make sketches together with the seniors.

In addition to the primary goal of continued work on paper sketches, we had a secondary goal; to obtain feedback on the functionality of the current web application. A list was created and was forwarded to the development branch at SINTEF. An example of lacking functionality was that the current web application does not give feedback to the user upon successfully inviting friends to social events. This was something that could and should be included in our solution.

Figure 5.5: Supervisor Yngve Dahl drawing a sketch in the second session.

The users had a hard time coming up with ideas on the spot, and were hesitant to drawing when handed sketching equipment. It was preferred that possible solutions would be discussed instead, and drawn by the students or the supervisor. In light of this, the meeting proceeded with a presentation of the prepared sketches. The first sketch that was presented was the leader board. The immediate response was that this was a breach of user privacy, and not all would be interested in sharing their personal activity level. The sketches showing matching of shoes and the Yin Yang symbol also received negative feedback. The idea was seen as problematic, as the users had no way of finding the other Co-Living members. All of the seniors agreed that they would feel awkward while searching for the other participants.

The students proposed a matching of interests, based on the user profiles. This would recommend going to social events with unacquainted users based on

a similarity in their interests. The seniors did not respond well to this proposal, as they felt it would be too similar to a date matching solution.

It was stated that it could be appealing to attend an event based entirely on the fact that friends of the user had signed up for this particular event. This applied even though the user did not have a great deal of interest in the event.

Design decisions

The seniors did not come up with as many ideas as we had hoped for, and the focus should be on getting feedback on proposed ideas and sketches. Based on the importance of attending friends, this should be displayed for each event along with the information that is already displayed in the existing solution.

Summary:

- The profile matching was discarded.

- The symbol matching social game was discarded.

- Attending friends should be displayed in event information for the future application.

Session 3

15.02.2013	
Input:	Conceptual sketches for motivating metaphors and social games to encourage social interaction.
Planned output:	A decision on which metaphor should be further developed.
Actual output:	The fruit tree was seen as the most appealing metaphor. Ideas for implementation of gamification elements in form of a quiz, and monthly overview of social activity.

A second Specialist nurse joined the group for the first time. She was brought up to speed with a summary from the two previous sessions. For this meeting, the students had prepared paper sketches showing a waffle with five hearts, a tree with various fruits, and an image hidden behind a gradually revealing puzzle. In addition, there was one sketch of the home screen on the user's phone showing a smiley face, and one of a gradually flowering potted plant.

The sketched waffle had only one heart when it first was presented to the user. The other four hearts were outlined, but empty. To fill the remaining four hearts,

they would have to find four other users attending the same social event. The fruit tree would contain different fruits representing the various events the user had attended. This sketch was inspired by the Ubifit Garden that was assessed by Consolvo et al. [2008]. The image puzzle would reveal more and more of the image when the user attended more events. When the users had revealed the image completely, they could be allowed to save the picture to the phone. The smiley on the home screen would represent the overall activity level of the user, and would have different moods grading from neutral to very happy depending on activity level. Lastly, the potted plant would grow as the user attended more events. This sketch was inspired by Flowie, as assessed by Albaina et al. [2009]. The intention of the sketches was to trigger discussions and further increase the number of possible designs.

After having presented the sketches for the seniors, the fruit tree and the potted plant stood out as the most appealing metaphors. However, the fruit tree captured more details of the activity levels of the seniors. The potted plant would capture the overall activity level, whereas the fruit tree would display a number of events. It was pointed out that there was no logic in having different fruits in the same tree, and there was a preference to only one type. This would also prevent confusion of what the various fruits represented. In regards to the image puzzle sketch, the seniors indicated that they would feel frustrated if they did not manage to reveal the whole picture. It was also noted that the image could appear with a motivating text.

The waffle social game trigged a discussion that led to the same conclusion as the symbols presented in the second session; the seniors did not feel comfortable searching a crowd for possible matches to their waffle, and they needed a way of recognizing the other participants. When it came to the smiley placed on the home screen of the phone, it held no appeal to the users. It was stated that it was preferred to have their own backgrounds. The level of detail captured by this metaphor was similar to the potted plant. Also, this metaphor would appear differently depending on what phone the users had.

Inspired by the content of the Flowie application, assessed by Albaina et al. [2009], the users were questioned about setting weekly or monthly goals for social participation. The response was that this seemed stressful, and that they would feel too much pressure. However, it turned out one of the users had a heart rate monitor that was used while exercising. The others indicated that they liked comparing their own current and previous performances. A proposal of having a history of the activity of past months was made, and all of the seniors responded well to this idea. The seniors were also questioned about their interests and
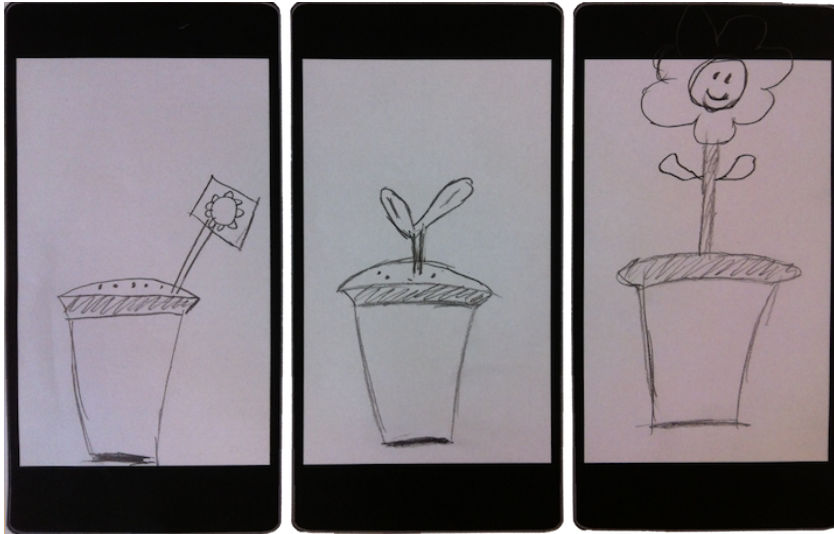
Figure 5.6: The figure shows the three stages of the proposed potted plant metaphor.

hobbies. As a common denominator there was a preference towards quiz and brain games. This could be taken advantage of, and could be turned into a gamification of an event.

Design decisions

The fruit tree metaphor should be further developed and tailored to the users' preferences. It should hold only one type of fruit. The seniors liked the idea of looking at past events. This could be displayed in a monthly overview, using the same metaphor as the front page. Also, a quiz like gamification of an event could be appealing and should be sketched for next meeting.

Summary:

- Fruit tree will be continued and improved. Potted plant discontinued.

- Social games involving searching for other people discontinued.

- Smileys on home screen discontinued.

Session 4

01.03.2013	
Input:	Three different sketches of metaphors suited for the front page. Sketches of a quiz event game.
Planned output:	Feedback on proposed sketches and suggested improvements.
Actual output:	The quiz and the apple tree front page metaphor was well received. Discovered a need for a help page.

Based on the feedback from the last session, the sketches had been further improved. The fruit tree was turned into an apple tree, holding red and hollow apples. Red apples represented activities that the user had already attended. Hollow apples represented invitations. Two alternative front page metaphors were also prepared. One held a star map that would have big and bright stars for attending events, and blinking stars for invitations. The other was a radar-like overview of friends, where the distance from the center of the radar circle would indicate the period of time since the user last interacted with the person. In addition to the metaphors, three menu buttons were added to the front page, allowing for navigation further down the hierarchy of the application. The three buttons linked to the inbox, a calendar with all available activities, and a list of friends.

Since the seniors had previously expressed a liking towards quiz and brain games, a quiz game was also sketched. The quiz had a limitation of five participants, and featured a reused image of a waffle with one of five hearts filled. The filled waffle heart represented the user, while the four other unfilled hearts represented the other participants. The user would fill the four empty hearts of the waffle by answering questions about the other participants of the event. This quiz event could possibly be arranged before another event the users had signed up for. The questions would require the users to interact with each other, thus serving as a ticket-to-talk.

The apple tree was more appealing than the previously sketched tree with various fruits. The hollow apples, representing invitations to events, was confusing, and it was suggested using differently coloured apples instead. A descriptive help page associated to the concept was regarded a must to avoid confusion. There was also a desire to be able to click the apples and get information about the event they represented.

The other two sketched front page metaphors received mixed feedback. The star map was considered too small on a phone, and more suited for a tablet

(a) Front page metaphor   (b) Waffle quiz   (c) Radar reminders
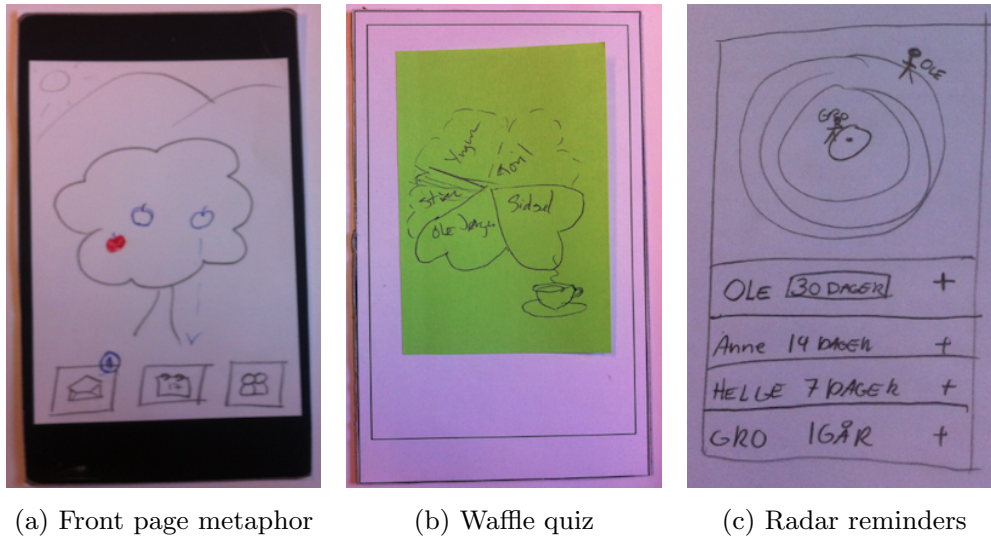
Figure 5.7: Three rough sketches of proposed solutions from the fourth session with the focus group.

device. The radar metaphor was well received, but preferably not on the front page. It should rather be considered added to the friend overview, with the added possibility of including friends from the phone's contact list.

When questioned about where the metaphor should be placed in the application, all users agreed that it should be on the front page. This way it would raise awareness of their activity levels. A front page showing only a menu system was not desirable.

The users responded positively to the quiz game concept, but pointed out that not all events were suited for a meeting beforehand. Events like going to the cinema or the theater was considered appropriate in this context. Also, there was a desire to receive the invitation to the quiz event upon signing up for the cinema or theater event. Personal information regarding primary interests or hobbies, and current residence was considered as a useful basis for the questions.

Design decisions

It was concluded that the future work should be focused around the apple tree and the quiz. The apple tree should be further developed, and contain differently coloured apples. The radar concept can be included in an overview of the user's friends.

Summary:

- The apple tree metaphor will be continued and tailored based on user feedback.

- The quiz game concept should be further developed.

- The radar metaphor will be discontinued due to short implementation time.

- The star map will be discontinued.

Session 5

08.03.2013	
Input:	First functional prototype based on final paper sketches.
Planned output:	Feedback and suggested improvements focused on the front page metaphor and the quiz. Feedback on usability.
Actual output:	Varying apple colours caused confusion. Frustration due to unexpected navigation when signing up for events.

The first functional prototype was developed using HTML, jQuery Mobile, and Javascript. This solution for the prototyping was chosen based on earlier experience with mobile prototyping. The prototype was hosted on a server located at the university, and did not communicate with the Co-Living system.

Two of the pages included in this prototype was the front page and an activity page allowing to navigate to new, attending, friends' , and past events. In addition, there were pages for the inbox, invitation and participation for the quiz, and the event information page. The latter allowed the users to sign up for or sign off an event. Five tasks with different goals were prepared for the seniors. While executing these tasks, all prepared pages of the application would be displayed. The tasks were focused around the perceived usability of the graphical user interface, and to map out desired navigation settings. The instructions were handed out at the start of the meeting, and the idea was that all would have the exact same word phrasing in the scenarios, thus avoiding misconceptions.

(a) Front page metaphor   (b) Quiz signup   (c) Quiz progress
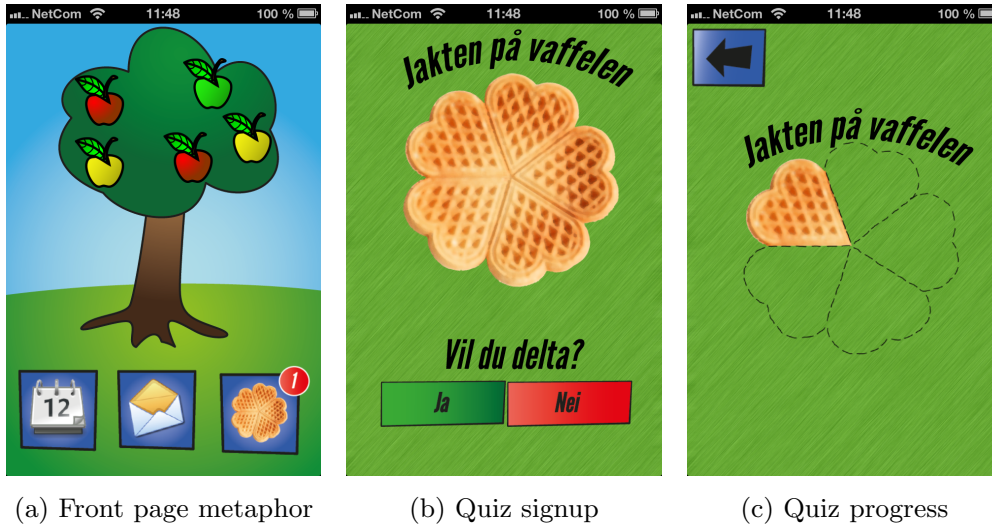
Figure 5.8: The three figures show screens from the first functional prototype.
Figure a shows the front page with the apple tree metaphor and three menu
buttons. Figure b shows signup for the waffle quiz where the seniors could meet
new people, and Figure c shows the quiz progress, where the goal is to get a full
waffle.

- Task 1
  You are planning to get a puppy and want to learn how to properly raise
  it. Sign up for a course on dogs dressage with the application.

- Task 2
  Sign up for a new event using the apple tree.

- Task 3
  You want to get out of the house Thursday 14.March. Check if any of your
  friends have any plans for attending an event. Sign up for a friend event.

- Task 4
  It has been a long time since you were at the cinemas, and you would like
  to go early next week. Sign up for a cinema event, if there is one!

- Task 5
  Something got in the way of your earlier plans, and you have to sign off the
  dogs dressage course. Find the event, and sign off.

The front page contained an apple tree and three menu buttons, as seen in
Figure 5.8a. Hollow apples representing invitations were replaced by green ap-
ples. Yellow apples represented events the user had signed up for, but not yet

attended, while the red apples still represented past events that the user had attended. One of the buttons on the front page was changed to highlight the quiz concept. A button with a waffle icon replaced the button for the friend page. Now, if the user was signed up for a quiz event, the button would get a red notification tag. This button would take the user to the quiz page seen in Figure 5.8c. An activity page had also been created, showing menu buttons for new, attending, friends', and past events. The respective pages for the different event types held a table displaying name, date, and location for the events. Further, the user could click each event to display all event information and possibly sign up for or sign off the event. The inbox page contained a table with all event invitations, displaying the sender of the invitation in addition to the name and the location of the event. In order to receive an invitation to the quiz event, the user would have to sign up for one of the cinema events included under *new activities*. The invitation is displayed in Figure 5.8b.

In regards to the front page metaphor, the amount of different apples still caused confusion. There was a clear preference that invitations should not be displayed in the tree. The tree should only contain attending and past events, represented by yellow and red apples respectively. Another issue was that the users did not understand that the quiz meetings was found via the waffle button from the front page. The descriptive help page for the front page was not implemented, and this could possibly eliminate the confusion around both the apples and the menu buttons.

Some of the navigation in the application caused frustration among the users. When signing up for an event, the users were sent to the front page, with a new apple fading into the tree. Expected navigation was to be redirected to the page showing attending events. The users also expressed a desire to have a solution with four tabs for new, attending, friends', and past events. This would remove one layer of navigation and take the user directly to a page containing all activities.

The invitation to the quiz event held no specific information about what the invitation was for, in addition to time and place. The users were familiar with the concept from the previous session, but it was assumed that this would not be understandable for a first time user. An event description was needed, in addition to specified location, date, and time.

Design decisions

We experienced some problems with connectivity due to wireless restrictions at the location of the meeting. The users were handed one phone each with 3G Internet connection, enabling them to connect to the server. This, however, gave an inferior user experience due to slow loading of the various screens in the application. When connected, the users were eager to try out all the functionality, and not necessarily following the scenarios. Zooming was not disabled in this prototype, and this was particularly problematic. The buttons lacked a pushed state (button down), and were repeatedly pressed. At times this caused double taps, triggering a zooming effect.

Summary:

- The apple tree metaphor should hold only two different apples.

- The invitation for the quiz game needs to have specific information regarding the quiz event.

- Buttons need animations indicating a pushed state.

- When signing up for events, the user should be redirected to the attending event page.

Session 6

15.03.2013	
Input:	Improved prototype featuring a help page and a coupon page, in addition to pop-up messages on user interaction. Specific scenarios for the focus group.
Planned output:	Determine the effect of the help page, and the appeal of coupon rewards. Further specify navigation and pop-up appearance on signup.
Actual output:	Quiz events should appear in the same manner as regular events. Help page should include menu buttons. Pop-ups should remain visible until removed by the user.

The second functional prototype had new screens for three descriptive help pages, quiz meetings and a coupon overview. Links to help pages were placed on the front page, on the quiz invitation page, and on the quiz event page. The help pages gave instructions to the users and offered insight to what was displayed. Pop-up notification texts were also implemented to inform the users about the result of their actions. This was triggered when signing up for a quiz event, and also when clicking an apple in the apple tree. Further, the apple tree metaphor now only had two types of apples, as requested by the users.

The quiz button now redirected to a page giving the user two options; view upcoming quiz events or view coupons. The user could receive a coupon for a waffle if three questions in the quiz was answered. If all questions were answered correctly, the user would be awarded a coupon for a waffle and a cup of coffee. The coupons could be cashed in at *Hornemannsgården*, and were intended as an extrinsic motivating factor. It also offered an opportunity for the participants to meet up once more and enjoy their reward together.

The quiz invitation had been remade, supplying specific date, time, and location for the event. The same information was included in the description on the quiz event page. This page also had an altered design making the image of the waffle clickable. When clicked, it would redirect the user to a new page with a new question.

(a) Front page help   (b) Waffle quiz progress   (c) Quiz coupon reward
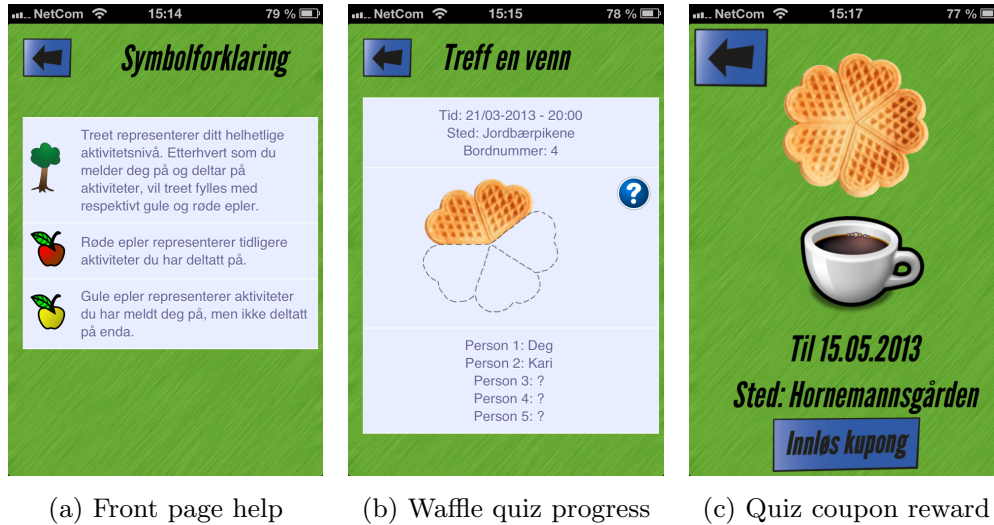
Figure 5.9: The three figures show screens from the second functional prototype. Figure a shows help for the front page apple tree metaphor. Figure b shows quiz progress with three questions remaining, and Figure c shows a coupon reward received for completing the quiz.

The users were given four new tasks mainly focused on the quiz concept. The tasks were as follows:

- Task #01
  You are sitting home in your living room and you feel like going to the cinema. You grab your smartphone to check if there are any events in the Co-Living application. Sign up if there are any cinema events in the near future.

- Task #02
  We fast forward a bit, and you are on your way to the cinema by bus. On your way there you want to check if the location for meetup is specified. Use the application to find out the exact location for the meeting.

- Task #03
  You meet four other people at the specified location. Your friend, Kari, is one of them. You start talking while accessing the quiz in the application. Answer the questions you are given.

- Task #04
  After the quiz meeting you agreed to meet up at *Hornemannsgården* to cash in the coupon you received from the quiz. Find the coupon in the

application and show it to the cashier.

When performing the first task, the users signed up for a cinema event. They were immediately prompted if they wanted to attend a quiz event that would find place one hour before the cinema. The users were only given two options, either accepting or declining. There was no option to delay the response. It was pointed out that it could be a better solution if the user would receive an invitation in their inbox instead. For test purposes they did sign up for the quiz event and got a pop-up with a description of where the details for the event could be found in the application. This pop-up disappeared too quickly, and the users did not have enough time to read it. This caused confusion and they did not know where to find the quiz event. Clicking the waffle icon on the front page did not seem natural to the users. They felt that this quiz event should appear in the same manner as a regular event; in the apple tree, and in the list of attending events. Also, the pop-up message should stay visible until the user explicitly closed it.

Once navigated to the quiz page, the users did not fully understand what to do, but found out that the help symbol could be clicked. The instructions explained how to interact with the quiz page, and the users followed up with clicking the waffle image to receive a question. However, the questions were stated in a new page, and the navigation caused frustration among the users. It was suggested that the questions were included in the same page as the rest of the quiz, along with the answer input text field. In addition, the quiz page could contain a smaller set of instructions of how to play. This removed the need for a separate help page. After completing the quiz, the users had received a coupon for a waffle and a cup of coffee. When choosing to cash in the coupon, the coupon immediately disappeared. This surprised the users and led to a suggestion that there should be a confirm dialog for this action.

In addition to completing the prepared scenarios, the users were questioned about the help function on the front page and where acquired coupons should be placed. It was found that the help page, in addition to explaining the apple tree and its function, should contain explanation of the menu button functionality. Acquired coupons could be placed alongside the planned quiz events. This was to eliminate a redundant layer of navigation.

Design decisions

The users expected the behaviour of a fully developed application. The apple tree displayed the activities of the current month, and the users felt that this should be indicated by a sign beside the apple tree. The invitation for the quiz

event should have a new header text indicating that the user could meet *new* friends. The current wording indicated that the user would meet people whom they were already friends with.

Summary:

- Help page on the front page should include menu button explanations.

- New header needed for the quiz invitation.

- Quiz invitations should be sent to the user's inbox.

- Pop-up messages should stay visible until the user explicitly close them.

- A sign indicating what month is displayed on the front page, should be added.

Session 7

22.03.2013	
Input:	Colour prints of all screens in A4 and A3 format.
Planned output:	Feedback and suggestions for final changes before the implementation phase.
Actual output:	Yellow apples were preferred to apple flowers in the apple tree. The wooden sign should redirect to a history of previous events.

During testing of the two functional prototypes the focus group was distracted by the fact that they were not fully functional. It seemed hard to grasp that all data was hard coded. Also, flawed navigation options in the prototypes broke the concentration of the users. It was decided to go back to paper sketches for the final prototype. The sketches were based on the pages from the functional prototypes, and enhanced manually with Adobe Photoshop and Adobe Illustrator. Before the session all sketches were printed out in full colour in both A4 and A3 formats.

As per user request, a wooden sign had been added to the front page. The sign held information about which month's activity level was displayed in the apple tree. All menu buttons on the front page had added text to improve user understanding. Additionally, the button for the quiz meetings were changed to hold a handshake symbol, also utilized in the invitation to this type of event. This change was made due to user feedback in earlier sessions regarding the button. Using the same symbol on both invitations and the button was intended to help the user make a logical connection between the two. The quiz event page now

(a) Front page metaphor   (b) Quiz event invitation   (c) Quiz page

Figure 5.10: The three figures show printouts from the seventh and last session with the focus group. Figure a shows the front page with the apple tree metaphor, but with an apple flower instead of yellow apples representing events the user had signed up for. Figure b shows the invitation to the quiz where the seniors could meet new people, and Figure c shows the quiz progress, with two questions remaining.

held names of the other participants whose questions the user had answered correctly. Question marks were added to the waffle hearts that were unfilled. Also, the quiz held a header text now saying *"Do you want to meet a new friend?"*. As the user were rewarded with coupons, either from answering one question or answering all questions, there would appear a text that explained where the coupons could be viewed in the application. The question and textual input was moved to the quiz page to minimize required navigation.

Other notable changes was the added text under the menu buttons on the front page. The yellow apples had been replaced by an apple flower in an attempt to separate more clearly between attending and past events. Invitations for quiz events now appeared in the user's invitations page, instead of appearing when the user signed up for certain events. This way the users could respond to the invitation when it suited them. Regular event invitations now had accept and decline options, as opposed to only having an attend button in the previous versions.

Previously, the users had pointed out a preference of minimizing the number

Figure 5.11: The figure shows the presentation of the various printouts for the seventh session.

of navigations in the application. To achieve this, coupons and quiz events were included in the same page, in two separated tables. Additionally, the event page now held a navigation bar with the options; new, attending, friends', and past events. By default, the user would view new events.

The users were given the same tasks as the previous session, but for this session more time was allocated for each page to ensure to capture all aspects of the prototype. The new front page with a wooden sign was presented. The users expressed a desire to click it. Upon clicking the sign, they expected to be presented overview of previous months' apple trees. The users did not like the idea of having a flower in the tree. The previous version with yellow apples was preferred to this, as none of the users understood that it was an apple flower.

After signing up for the cinema event available in the event list, a pop-up message indicated that the users had received a new invitation. The invitation was for a quiz event. The header text of this invitation had been changed, but it turned out that it still needed to be rephrased. The header needed to state that the user could potentially meet several new friends, not only one as the current wording indicated.

Design decisions

Going back to using paper in the form of printouts made it easier to direct the focus to one screen at the time, and ensuring that all users saw the same screen at any given time. The users were better able to think aloud and give better feedback on expected application behaviour.

Summary:

- Apple flowers should be removed and replaced by yellow apples.

- The wooden sign should be clickable, linking to an overview of apple trees of past months.

- The header text of the quiz invitation must indicate that the user can meet *several* new friends.

- The navigation bar for the event page was well received, and will be kept.

Chapter 6

Implemented Application and Field Experiment

After the 7 sessions of the Participatory Design process was finished, three weeks of implementation followed. The implemented solution was to undergo a field experiment with 10 participants from the Trondheim area. The field experiment would run over the course of three weeks.

This chapter introduces the implemented application, with a logical view, a page map, and three screenshots. Further, the experimental design for the testing of this application is described. Next our evaluation methods are explained. And finally the results of the experiment is presented.

6.1 Implemented Application

The application communicates with the Co-Living backend via SOAP envelopes. As seen from Figure 6.3, the application retrieves three different object types. Upon login, the user gets authenticated and receives a security token. This token is a required parameter for all SOAP calls to the web-service. If expired, the users will be required to log in again to renew their token. The event object is distinguished by a unique ID, and contains name, location, a description, along with other parameters. Invitations are also distinguished by a unique ID and contains a Person object that identifies the sender of the invitation. Both event invitations and friend requests are invitation objects, and the type of invitation is separated by differing message types. When a SOAP envelope is received, it is manually parsed by the application, and stored in the mobile phones local storage. The application was wrapped with PhoneGap, thus supporting all major platforms: Android OS, iOS, Windows Phone, Blackberry, WebOS, and Symbian.
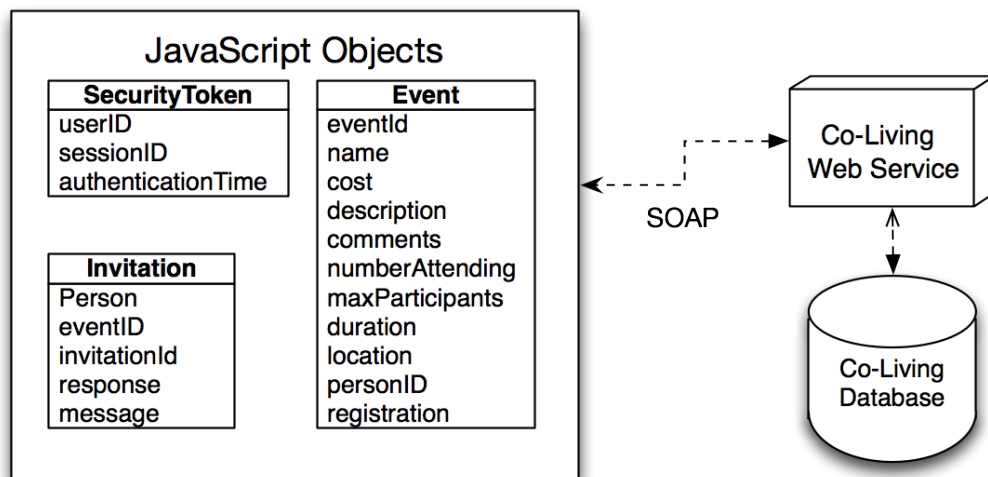
Figure 6.1: The figure shows the three different object types that are retrieved from the Co-Living web service.

The three object types described above represent most of the information that is displayed in the application. The apple tree metaphor represents two of the event types: attending and past. Possible actions are based on the objects, as users can view events, sign up/sign off to events, or accept/decline friend requests or event invitations. In addition, once the user is signed up for an event, it is

possible to invite other friends.

(a) Front page metaphor   (b) Event page   (c) Quiz progress

Figure 6.2: The figure shows three screenshots from the final solution. Figure a shows the frontpage metaphor where the user has clicked an event in the apple tree. Figure b shows the event page, with friend events as the selected tab. Lastly, Figure c shows the quiz with three of four questions answered.

The final solution featured 12 different pages. After the user logged in, the pages were divided into three navigation layers. The number of layers was minimized due to user feedback during the Participatory Design process. The event page held four types of events: new, attending, friends', and past. The different event views were controlled by a navigation bar placed in the header on the event page, as seen in Figure 6.2b. In order to make the graphical interface usable on multiple platforms, every page contained a header and a back-button.
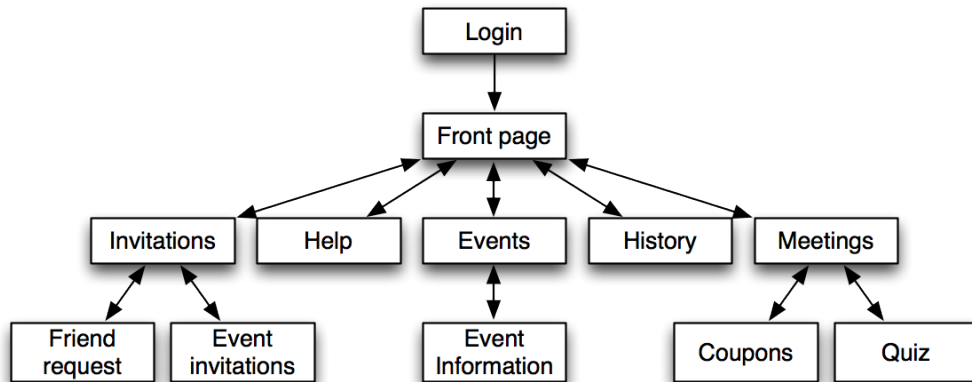
Figure 6.3: The figure shows the possible navigation flow in the application.

6.2 Experimental Design

The goal of this experiment was to test the motivational elements found through series of Participatory Design workshops. The implemented application was to be tested in a three-week field experiment with ten participants. When looking for participants for our field experiment, this was our criteria:

- The participants must be able to participate in the entire three-week field experiment

- The participants must have access to a smartphone with either iOS or Android operating system

- The participants must be in our target group of elderly people

- We also asked them to participate in a given activity, but this was not a complete necessity for joining the experiment.

We had eight women and two men volunteer to participate in the field experiment, aged between 66 and 73 year old, that met these requirements. Seven of the participants were recruited through a visit to the Information Centre for Seniors (A municipal initiative for seniors), during this visit we had everyone agree to a consent form (Found in Appendix A.2) informing them of their rights during the entire experiment. In addition everyone received a form to write down their interests and place of birth. This information was to be used the field experiment

Quiz. The remaining three participants were recruited by specialist nurses at the Information Centre. Most of the participants have had training in using smartphones with the exception of one, which had little to no experience. Some of the participants knew each other from previous Co-Living meetings, while others did not know anyone involved.

First off we had a startup meeting with the ten participants were we installed their application and explained the intention of the experiment. We divided the group into two groups of five to better help the participants during the installation process. We had some initial problems with the internet connection on-site which led us to use 3G instead of Wi-Fi, this gave an initial bad impression since it made the installation process and application slower than intended. Also one of the participants had a tablet instead of a smart phone, we did install the application of this as well even though the application was not designed for a tablet. After the installation process all of the participants were told to use the application as they normally would with the previous version. They received information that they would be contacted in 3 weeks time to schedule the evaluation of the application. In the end all of the participants were given contact information to the researchers if any problems or scheduling conflicts occurred.

6.3 Evaluation methods

Semi-structured interviews with three or more of the seniors from the focus group will be carried out. In addition, questionnaires for the all of the users will be part of the evaluation. For the questionnaire we will use the System Usability Scale (SUS), which is a reliable, low-cost usability scale that can be used for global assessments of a systems usability. SUS uses the *Likert scale* which is commonly involved in research that employs questionnaires. These questionnaires will be useful for our quantitative data collection. We have adapted the Norwegian version of SUS interpreted by Professor Dag Svanæs at NTNU, which is based on the original SUS questionnaire by Brooke [1996]. Our SUS questionnaire in Appendix A.1 consists of the ten standard SUS questions, in addition we have added ten questions of our own. All questions are rated by a typical five-level Likert item, with the following five items: Strongly disagree, Disagree, Neither agree nor disagree, Agree and Strongly agree. An example of its structure follows:

Figure 6.4: General SUS questionnaire

We will use semi-structured interviews as our qualitative data collection technique, we have chosen to follow the seven stages of conducting in-depth interviews by Steinar Kvale [1996]. These stages include:

- Thematizing - In this stage we clarify the purpose of the interviews we are conducting, and pinpoint the data we to collect.

- Designing - Here we design a way we can elicit this information from the users, in addition we create an interview guide to help the us (the interviewers) to focus on the topics that are important to explore.

- Interviewing - It is important in the beginning of interviews to introduce ourselves, explain the purpose of the study, and put the interviewee at ease. When recording video or audio obtain the users permission, and test the equipment prior to avoid unnecessary downtime. The main responsibility is however to listen and observe while you guide the users through this entire process.

- Transcribing - This involves creating an exact text of each interview based on the audio response and side notes for every question asked.

- Analyzing - This is where we sit down an re-read every interview transcript to identify emerging themes from the users answers. If the interviews raise more questions than they answer, additional interviews are recommended to examine the issue properly.

- Verifying - Verifying involves checking the credibility of the information gathered, for this we will use a simple form of triangulation. We will read and analyse the same set of transcripts, and the compare our notes. If the notes agree, then we regard the information as credible.

- Reporting - The last of the stages, reporting, is regarding the importance to share the results we gather from these interviews. This will follow later in this report.

Note that this is only some of the key features from the seven stages of conducting in-depth interviews, a full review of the stages can be found at Kvale [1996]. The results of these evaluations will be elaborated in Chapter 6, and will be further discussed in Chapter 7.

6.4 Experiment Results

In this section, we focus on results from the three-week field experiment. We discuss the different concepts to see if the application had some motivational aspects. We also discuss how participants interacted with the application and if the improvements made had any appeal. After the three-week field experiment ended we sent out ten questionnaires and scheduled semi-structured interviews with five of the participants.

6.4.1 Interviews

The following semi-structured interview questions contributed to our evaluation results:

- What was your general impression of the apple tree as a representation of your level of activity?

- How did you feel about history overview? And in what way did you use it?

- What did you think about the gathering before the planned activities, could this work with different types of activities?

- How did you like the quiz at the gathering? Did it help in getting people talking?

- What other new features did you like or dislike in the application, and why?

Additional supportive questions were made for each option, to help out the interviewee in case they got stuck and had a hard time explaining themselves.

Apple tree representing level of activity

Using an apple tree as a representation of their activity level was liked by the participants. They emphasized the good overview and concreteness of the visualization, and many commented that it made viewing at the application less dull and more interesting. A general consensus among the participants was that the apples needed some form of identification to avoid unnecessary searching. One participant had the idea of labelling each apple together with a date, this idea was later complimented by other participants. The intended motivational element of the apple tree was a "hit and miss". Two of the interviewee claimed they were motivated to attend more activities because of their lack of apples, one found herself thinking:

> *"Pull yourself together, attend some activities and fill that apple tree." (female, 66)*

The remaining three interviewees did not get any additional motivation through the apple tree, and said that they are deliberate when choosing activities to attend. Two of these pointed out that this could be because they haven't used the application long enough, and that it might be something that develops after a longer period of using it.

An overview of past events

For all of the participants, having an overview of the attended activities visualized in the form of apple trees were very much liked. The immediate response to the history overview was that it was a fast and efficient way of seeing what they had attended in previous months, and this was something that was both useful and fun to see. As with the front-page apple tree, the motivational element did impact some of the participants but not all. Three did mention that they would probably use it occasionally to compare their activity with previous months. The remaining two would only use this as an overview for practical reasons, such as remembering what they were attending and at what time. One of those brought up that he might be to young and active, saying:

> *"I can't see myself being motivated by this, it might be because my days are already filled with lots of activities." (male, 68)*

Another finding brought up by the interviewees was that the history overview only captures a part of the day, and not a complete picture of it. They said that this could potential backfire, and demotivate the users instead of motivate.

The gathering of potential friends

The gathering event before the planned activity was popular, everyone of the interviewed were excited about having small group meetings before actual activities. This seemed to add an extra dimension to the already planned activities, where they could socialize and have fun without the restrictions some activities might bring. In regards to this, many agreed upon a statement made by one of the interviewee:

> *"This meeting is perfect for less social activities such as the theatre and cinema, where we cannot communicate much during the activity."*
> *(female, 73)*

Others said this is something that could work with any type of activity, and that these meetings did not only need to be placed at cafs. It became apparent that the preferred meeting time was between 60 and 90 minutes, as they are attending an activity afterwards. One brought up that people might be sceptical towards these meeting without a clear understanding of its purpose, and therefore better and more information in the invitation is needed. We got feedback from two people that they found themselves new acquaints and potential friends during the meeting.

Games as an opening for social encounters

Just like the gathering, the quiz was very much liked by the interviewees. Everyone attending the gathering did finish the quiz and got their reward. Everyone pointed out that the quiz did serve as an excellent "icebreaker", and it was a fun and interesting way of getting to know new people. One said:

> *"I have never been too interested in playing games, but I found this fun and I see it's potential."* *(female, 71)*

Regarding the questions received in the quiz the participants had some suggestions, for instance that the level of depth of the questions had should be determined by how well they knew each other. And that in most cases the quiz should avoid questions related to politics and religion, as this may cause more harm than good. The one aspect that people were divided by was the rewards given by the quiz. Two said that the reward in itself had no impact in whether they attended the meeting or finish the quiz. One said that the reward was a motivational factor no matter what the reward was, and found it exciting winning something. The remaining two claimed that it would depend on the reward

whether or not they got motivated. Unfortunately no one got the time to use their coupons, four of them had planned to meet up later that week to use their coupons and have a chat. This was later cancelled as their schedule got to busy, however all of them said that they would have probably used it if the experiment lasted longer. One of the participants got a phone call right as they started to explore the quiz, and when he came back the others were already finished making him feel left out.

General impressions

Most of the participants were pleased with the colour scheme of the application, only one person did not like the repetitive green colour. Many claimed that they liked the bright and happy colours, and that it made the application less dull. One of the biggest concerns however was the performance of the application, it felt really slow and missed some sort of loading image when moving between pages. One person said:

> *"I kept clicking and clicking while nothing was happening, I have little patience with mobile devices and find myself thinking i am doing something wrong when I actually just need need to wait." (male, 68)*

With the performance aspect put aside they were very happy with the usability of the system, they found it very easy to use and liked many of the navigational changes that was made. One change especially brought up was the ability to see who had signed up for any given activity, only this motivated two interviewees to sign up to an activity they hadn't planned on attending. Another idea for future development was to integrate it better with their calendar, they felt it was essential to also make an event in their calendar when signing up for an activity. Four of the five people interviewed would want to keep using this application instead of the old one if it were to be kept well maintained and the performance issue was dealt with. The last person were already accustomed to the old application and felt it had the most important features.

6.4.2   SUS-questionnaire

From the standard SUS questionnaire in Table 6.1 we got anonymous feedback to grade the usability of the system, discussion regarding the validity of the feedback with ten responses is later described in Chapter 7. The response revealed that most of the users thought that this was a system that they would like to use, with 70 percent "agreeing" or "totally agreeing" to the question. In the following questions there was a clear indication that the user felt comfortable using the system, agreeing that it was easy to use and not unnecessarily complex.

Most of the users found it simple to perform the tasks given, while although the navigation in the system was natural and intuitive. While many agreed that the product had the functionality they expected, 90 percent claimed they would like more functionality implemented. While most thought that people could learn to use the system fairly quickly, about 10 percent could imagine some people having difficulties using the system without training. One of the earlier statements that regarding the previous system being dull and cumbersome seems to have been less of a factor in the new system, as only 10 percent found it cumbersome. Finally 70 percent of the users felt comfortable using the system, while the remaining users where undecided about this question. The final SUS score was 68.

The remaining 10 questions presented in Table 6.2 was graded by the same Likert items as the original SUS questions. We did however not see the applicability in calculating a corresponding SUS score to these questions. These questions were aimed towards motivational elements in the system, and issues in the system that could impact their judgement.

As we experienced during the startup meeting many users were unhappy with the slow response of the system, especially while using the system with a 3G connection. We found a similar response in the questionnaire with 70 percent agreeing that the system was slow. However the appearance got better feedback, with 80 percent liking it. In regards to motivational elements the users were split, with 50 percent claiming that the new system could motivate new users. The remaining users were either undecided or disagreed to that statement. The apple tree metaphor split the users in half, with 30 percent on each side and the remaining being undecided. However there was more users liking the apple tree as a representation, even though it didn't have the motivational impact on them. The general response towards the meeting prior to activities as well as the quiz was good, with no negative answers. Finally the history overview received good feedback, with 80 percent liking it.

	Totally disagree	Somewhat disagree	Undecided	Somewhat Agree	Totally agree
I think that I would like to use this system frequently	0,0	0,0	30,0	30,0	40,0
I found the system unnecessarily complex	30,0	30,0	30,0	10,0	0,0
I thought the system was easy to use	0,0	0,0	0,0	70,0	30,0
I thought the navigation was natural and intuitive	0,0	0,0	0,0	90,0	10,0
It was simple to perform the tasks that were given	0,0	0,0	20,0	40,0	40,0
The product had the functionality I expected	0,0	0,0	40,0	60,0	0,0
I would like the product better with more functionality	0,0	10,0	0,0	20,0	70,0
I would imagine that most people would learn to use this system very quickly	0,0	10,0	0,0	60,0	30,0
I found the system very cumbersome to use	30,0	30,0	30,0	0,0	10,0
I felt very confident using the system	0,0	0,0	30,0	40,0	30,0
				SUS Score	68

Table 6.1: Response to SUS questionnaire. The distribution of the responses in percentages, n=10. In addition to the final SUS score

	Totally disagree	Somewhat disagree	Undecided	Somewhat Agree	Totally agree
I thought the system had a slow response	0,0	10,0	20,0	40,0	30,0
I found this application to have a better appearance than the previous	0,0	0,0	20,0	40,0	40,0
I think this system could motivate new users	0,0	20,0	30,0	30,0	20,3
I need training in order to use the new system	40,0	30,0	0,0	20,0	10,0
I think meetings ahead of activities can help people become acquainted	0,0	0,0	10,0	30,0	60,0
I would like to attend activities to fill my apple tree	0,0	30,0	40,0	20,0	10,0
I feel the apple tree was a good way of representing my activity level	0,0	0,0	30,0	40,0	30,0
I think the quiz could work as an "ice-breaker" in meetings ahead of activities	0,0	0,0	50,0	0,0	50,0
I felt motivated by seeing friends attending activities in the overview	0,0	0,0	10,0	30,0	60,0
I thought the history overview in the shape of an apple tree was likeable	0,0	0,0	20,0	30,0	50,0

Table 6.2: Response to the second part of the questionnaire. The distribution of the responses in percentages, n=10

Chapter 7

Discussion

In this chapter the results and method used are discussed. The first part of the chapter is devoted to discussing threats and limitations to our research, the next part is a reflection about the research method used. The next part is the discussion of results regarding design and implementation. Finally we evaluate our research questions in light of the discussion.

7.1 Limitations

If we take a closer look at the service offered by Co-Living and its partners, it has certain limitations. There is an estimated average of three different events per week that the users can attend. This directly sets a limitation for the number of events possibly covered and displayed in our application. In our preliminary study we saw that systems like Flowie [Albaina et al., 2009] and Ubifit Garden [Consolvo et al., 2008] failed to track certain activities. This caused the users to lose interest in the systems. Even though these systems were focused on physical activities, the results from our interviews highlights some of the same issues. Some users stated that they did not feel a need to sign up for more events even though their apple tree held no apples. They attended other events that were not hosted by Co-Living. An empty apple tree indicating low activity levels was overlooked because the users knew they had been more active. We believe that if the application captured a larger aspect of the everyday activities of the users, the motivational impact of the metaphor might have been greater.

For the Participatory Design process we wanted to include three users that were outspoken and had own opinions. As it turned out, the users that were selected had been part of the Co-Living program for a longer period, and attended

more events than the average user of the system. Having less active users in the focus group may have yielded different feedback. There is reason to believe that their opinions on the required functionality would be different, and that they would be less biased towards the existing solution. After being in contact with a larger group of elderly through the field experiment we found both good and bad qualities with the different types of users, whether the users being shy and withdrawn or outspoken and vocal. When interacting with the the more apprehensive users we had more of a struggle in gathering ideas and information, as could be supported by the claim that shy people bring less verbal creativity [Cheek and Stahl, 1986]. But these user could potentially relate to the concepts far more, as they are the ones that have a bigger need for the motivational application. On the other side we have the more outspoken users, which are far more open in sharing thoughts and ideas. We feel that a good mix of of these to types might prove to be optimal in order to capture everyone's perspective.

The conducted field experiment spanned over three weeks, which is a relatively short period of time. In this period of time the average member of Co-Living would attend two or three events. To some extent this weakens the results gathered from the SUS questionnaire and the depth interviews. We feel that the application should be tested over a longer period of time and by a larger number of users . While it has been claimed that 80 percent of all the usability problems are detected with four or five subjects [Virzi, 1992], this experiment is aimed at finding working motivational elements rather than usability problems with the system. Also, some of the test users were relatively new to Co-Living and would not have the greatest effect when comparing the activity level of the current month to earlier months.

During the course of this project we have frequently been in touch with the test users. We feel that the focus group was able to voice their opinion, and it was repeatedly stated that we were only interested in their honest opinions. However, we can not be completely sure that the results were not influenced by the fact that the users knew they were testing our application. Users that knowingly is under observation or takes part in a field experiment, are often affected by what is called the Hawthorne effect [Landsberger, 1958]. Behavioural patterns and response to the experiment may be optimized to what the users think is expected of them.

7.2   Method Reflection

Our personal notes and session summary protocols from the Participatory Design process were mainly based on response to the different design elements. They

did not cover the exact step by step events of the session. Looking back at the recorded video and audio from these sessions, we realized that taking notes from these sessions might have been unnecessary. We could have fully relied on audio and video recordings and given the focus group our full attention at all times. This could have improved the effectiveness of the sessions, which in turn could have given us even more valuable feedback.

Expectation management

The users believed that they would get a fully functional application that could replace the existing solution. At several occasions it was stated that this was not the aim of the study. It seemed hard for the users to understand that two applications could show the same information, and provide the same service. We believe that the observed high expectations are side effects of the user involvement in the Participatory Design process, this statement was supported in another Participatory Design project [Ellis and Kurniawan, 2000]. In retrospect, expectations could possibly have been managed better, and maybe with a special focus around the recruitment of participants.

SUS Questionnaire

The test subjects are typical elderly people, with a limited knowledge and understanding about IT language. The response from the SUS questionnaire contains some contradictory answers. The users may have had problems understanding the questions, but answered them in the best way they could. A rephrasing of the questions may have improved the accuracy of the questionnaire. In addition, seeing we had ten participants, only a small part of our target group were represented. With more participants we probably experience more differences in social activity.

7.3 Design and implementation

The initial plan was to develop a native Android application. It was stated earlier in the project that most of the members of Co-Living used phones with this operating system. However, the Participatory Design process revealed a need for a cross platform solution. The application was built with the use of JavaScript, HTML, and jQuery Mobile. It was wrapped by the use of PhoneGap, thus supporting all mobile operating systems. We feel that this was the right decision, but the natural drawback of inferior performance caused some frustration. Also,

developing for two different platforms gives different requirements for the graphical user interface. This is best exemplified by the need for a back button for every page in iOS, while the Android design guidelines advises against this. If the performance issues entails that the users will stop using the application, it may have been better to go for a native solution and have it tested by fewer users.

Throughout the Participatory Design process, we gathered user feedback on various design elements. The radar metaphor was one of the elements that was well received, but was not seen fit for our use in this particular project. It was mentioned that this could be implemented in an overview of friends, and in this context it could possibly contribute to increased social interaction.

In regards to the apple tree metaphor as a representation of their social activity we had mostly positive feedback. They found the representation fun and easily understandable. However it did not have a motivational impact for everyone, only about half of the users felt an urge to fill up their trees with apples. The users claiming to not get motivated by the apple tree all said that they were already satisfied with their level of activity and social interactions, and it may be possible that these users did disregard other motivational elements because of this. The metaphor may prove repetitive and dull in the long run. However, if the users grow tired of the metaphor, there may be reason to think they are no longer in need of the application to motivate them. The users that did feel motivated may get less motivated by it given a longer test period. However, they may still find the metaphor useful because it gives a quick overview of events the user is signed up for.

Both the quiz and the meeting prior to Co-Living activities were great successes. Nearly all of the feedback was positive in regards to the meeting, where they said it really had potential in giving users an incentive to attend activities. Even though we didn't have any new Co-Living participants joining the meeting prior to a Co-Living activity, everyone who attended the meeting claimed that it could be a great stage to meet new friends and socialize. While everyone liked the quiz and thought of it as an excellent "icebreaker", the reward that was given got mixed feedback. One reason for why some users weren't engaged by the reward could be that they did not get the chance to use it. Our initial thought process was that the waffle and coffee coupons would act as initiatives to social encounters, where they would meet and claim their prize.

As revealed in one of the interviews, one of the users felt left out of the quiz after having answered a phone call. At this stage, the other participants had already answered some of the questions, and were focusing on their own phones.

This could indicate that focusing a gathering around a phone based quiz may interrupt normal social interactions, rather than promoting it.

7.4 Evaluation of research questions

We take a look back at our research goal and questions to evaluate:

Goal *To design and develop a mobile application that motivates elderly to socially interact*

Research question 1 *Which factors motivates the focus group to attend social activities?*

Research question 2 *Which design elements and concepts contributes to motivating mobile applications?*

Findings related to RQ1 was mostly discovered during the participatory design phase, where we early identified that friends was a big part of their motivation when attending social activities. Their friends acted both as safety, because they would have someone to talk too during activities. But also as an agreement that it was an interesting activity. In addition the users clearly stated that they were specific in attending activities that they found interesting. However the one factor that could make them take part of an activity that they didn't initially found interesting was friends. When airing ideas which led to social encounters all of the users were intrigued, examples of this is the idea of gatherings prior to activities as well as the quiz. Most of the users said that their main motivation for playing a quiz was the social element, rather than the reward they got for completing it.

In regards to RQ2, most of the findings were results of the field experiment. As discussed in Section 7.3 the apple tree metaphor was a "hit and miss". We found through multiple suggestions of metaphors during the participatory design phase that the responses was determined by their personalities. The people that found the apple tree motivating were all female and had an interest in gardening. From this we believe that the metaphors used must directly fit with the personality of the users. A man would much more likely respond different to a metaphor including sports or cars, rather than flowers and fashion [Moss et al., 2006]. As for the quiz game, based on elements of gamification, it had very positive feedback from all of the users. And it may be seen together with factor related to RQ1; interacting with friends and other people. As the quiz was very much a socially interactive game.

Chapter 8

Conclusion

The purpose of this study has been to find applicable motivational elements and concepts that can be used in a mobile application, with the intent of making elderly interact more socially. This has been done by creating an application together with elderly users, using the research method of Participatory Design. The application uses an apple tree metaphor for representing the activity levels of the elderly, as well as a quiz game in order to activate social The application has then been evaluated through a three week field experiment. The participants were interviewed and given questionnaires afterwards.

Our research goal was to:

To design and develop a mobile application that motivates elderly to socially interact

In order to achieve this goal, we will answer the following research questions:

Research question 1 *Which factors motivates the focus group to attend social activities?*

Research question 2 *Which design elements and concepts contributes to motivating mobile applications?*

These questions have been answered through the users both when creating and evaluating the application. RQ1 was answered throughout the Participatory Design phases, with the elderly identifying their goals and values. These results are gathered in Chapter 5. RQ2 was answered by collecting user assessments through post field experiment semi-structured interviews and questionnaires. These are found in Chapter 6. Through analysis and discussion regarding both these results

in Chapter 7, conclusions for each RQ are made below.

In regards to RQ1 we discovered that the main factors that motivates elderly to attend social activities were as follows: attending friends, that the activity were interesting, and interaction with other people. In addition the competitiveness of the users was highly individual. Competing with themselves was far more appealing than competing with others.

For RQ2 we found that using graphical metaphors did contribute to motivation for some, but no all. The apple tree metaphor did activate some users to sign up for activities, while others only used it as an overview for planning. Reasons for this is that people have different perspectives especially between genders, and finding a metaphor that fits all is a nearly impossible task. Elements of gamification appealed to our focus group, and did in our case work as a great mediator for social interaction. The use of a quiz did help people in getting acquainted, but also revealed that mobile devices in some contexts also bring negative consequences.

Note that our findings are just a first step towards complete guidelines for what can motivate this focus group through mobile applications, thus they have to been seen in light of the limitations presented in Chapter 7.1.

8.1   Contributions

Our main contributions found during this project has been the identification of factors, and what elements and concepts that motivates elderly to attend social activities. As our SLR a explored an relatively untested research area, with most of its focus directed towards promoting elderly health through physical rather than social activities. In light of our results, we have findings that could guide others in what elements they should further investigate and elements they should discard.

8.2   Future Work

As highlighted in the discussion in chapter 7, both Co-Living and the application has its limitations. These limitations are the basis to the recommended future work. One of the design elements that was well received during the Participatory Design process, is also included.

1. Improved usability of the front page metaphor

2. Implement friend overview with radar metaphor

3. Extensive user testing and field experiments

4. Develop native applications

As it was discovered in the semi-structured interviews, the usability of the front page metaphor can be improved by adding the date to the apples in the tree. For practical reasons, based on the shape and size of the apples, the month should not be included in the date. Additionally, the radar metaphor could be implemented and tested as an additional element to contribute to increased social interaction. To obtain more accurate and reliable data, the application should be tested over a longer period of time, with an increased number of test users. The results from this testing, including a prolonged field experiment, should be used to develop native applications. This will give better performance and possibly higher user acceptance of the application.

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Appendices

A.1   SUS-Questionnaire

Noen spørsmål om systemet du har brukt.

Vennligst sett kryss i kun én rute per spørsmål.

	Sterkt uenig				Sterkt enig

1. Jeg kunne tenke meg å bruke dette systemet ofte

1	2	3	4	5

2. Jeg synes systemet var unødvendig komplisert

1	2	3	4	5

3. Jeg synes systemet var enkelt i bruk

1	2	3	4	5

4. Jeg synes navigasjonen var naturlig og intuitiv

1	2	3	4	5

5. Det var enkelt å utføre de oppgavene som ble stilt

1	2	3	4	5

6. Produktet hadde den funksjonaliteten jeg forventet

1	2	3	4	5

7. Med mer funksjonalitet vil jeg like produktet bedre

1	2	3	4	5

8. Jeg tror folk flest vil kunne bruke produktet uten problemer

1	2	3	4	5

9. Jeg synes produktet er inkonsistent

1	2	3	4	5

10. Jeg følte meg selvsikker under bruk av systemet

1	2	3	4	5

11. Jeg synes systemet var lite responsivt

1	2	3	4	5

12. Jeg mener produktet har en høyere visuell tiltrekning nå

1	2	3	4	5

13. Jeg tror det nye grafiske kan tiltrekke/motivere nye brukere

1	2	3	4	5

14. Jeg trenger opplæring for å kunne bruke systemet

1	2	3	4	5

15. Jeg tror at treff i forkant av arrangement kan hjelpe nye brukere å komme i kontakt med andre og stifte bekjentskap

1	2	3	4	5

16. Jeg hadde lyst å melde meg på arrangementer slik at jeg fikk flere epler i epletreet

1	2	3	4	5

17. Jeg mener røde og gule epler var en god metafor for å visualisere mitt aktivitetsnivå

1	2	3	4	5

18. Jeg mener quizen kan hjelpe til å få i gang samtalen i møte med nye bekjentskap

1	2	3	4	5

19. Jeg ble motivert av at deltagende venner vistes i ethvert arrangement

1	2	3	4	5

20. Jeg likte å se historikken av mine arrangement i form av epletrær

1	2	3	4	5

A.2   Consent form

I forbindelse med våre mastergrader gjennomfører vi et prosjekt om hvordan man kan utvikle mobile systemer som virker motiverende for å delta på sosiale aktiviteter. Hensikten med prosjektet er å undersøke hvilke elementer innen designet som bidrar til en økning av motivasjonen.

Målet er å kartlegge hvilke av disse elementene som kan videredyrkes og optimaliseres, og danne en grunnpillar for videre arbeid innen prosjektet. Prosjektets helhetlige levetid går ut over perioden for vårt arbeid med masteroppgaven. Prosjektet vil bli utført av undertegnede i samarbeid Yngve Dahl og Anders Kofod-Petersen ved SINTEFs forskningsavdeling i Trondheim.

Sammen med de ca. 10 andre medlemmene av Co-Living, får du denne forespørselen om deltagelse i forskningsprosjektet. Din identitet er ukjent for oss helt til du eventuelt samtykker i delta i denne studien ved å returnere samtykkeerklæringen.

Deltagelse i prosjektet innebærer at du vil få tilgang til en alternativ versjon av mobilapplikasjonen til Co-Living. Denne skal du bruke i en testperiode p tre uker. I etterkant av testen vil vi be deg fylle ut et spørreskjema. Det vil ta 15-20 minutter besvare spørreskjemaet. Vi ønsker å få kunnskap om hvordan du har benyttet applikasjonen, og om den har bidratt til økt motivasjon til å delta på arrangementer i regi Co-Living.

Det er helt frivillig å delta i prosjektet og du kan på hvilket som helst tidspunkt trekke deg og kreve personopplysningene som er gitt anonymisert, uten å måtte begrunne dette nærmere. Hvorvidt du velger delta i prosjektet eller ikke, har ingen betydning for videre deltakelse i Co-Living. Det er ingen andre enn oss og våre veiledere og som vil få tilgang til de personidentifiserbare opplysningene. De er underlagt taushetsplikt og opplysningene vil bli behandlet strengt konfidensielt.

Resultatene av studien vil bli publisert som gruppedata, uten at den enkelte kan gjenkjennes. Mastergradprosjektet forventes å være avsluttet 10.juni, 2013. Etter at prosjektet er avsluttet vil opplysningene bli anonymisert.

Dersom du ønsker å delta i undersøkelsen, er det fint om du signerer den vedlagte samtykkeerklæringen.

Med vennlig hilsen

Steinar Haram og Stian Sørebø
Avdeling for programvareutvikling
NTNU
Tlf. 97 15 82 32

Samtykkeerklæring:

Jeg har mottatt skriftlig informasjon og er villig til delta i studien.

Trondheim, June 10, 2013

_____   _____
Signatur   Telefonnummer