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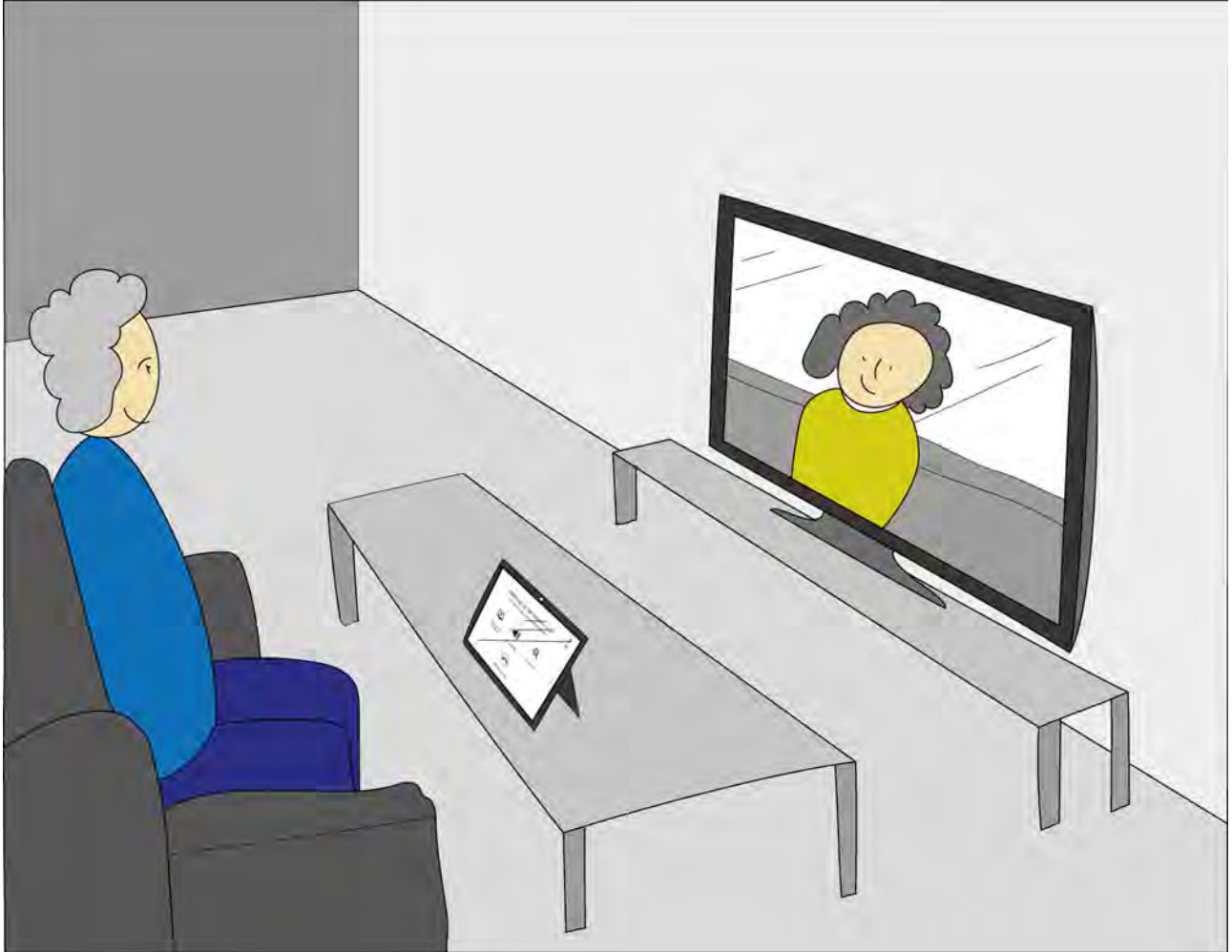
Derived by a PD process with elderly people

Master's thesis in Interaction design and Technologies

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Abstract

The aim with this thesis was to investigate how a video communication system best possible could be designed to fit elderly people's abilities and needs. The interest was to find out what kind of interaction and platform to design for as well as what to consider when designing graphical user interfaces for elderly users. The goal was to conduct a participatory design process and involve elderly users.

A field study was conducted, where 9 elderly users were interviewed. This was followed by observations in weekly technology classes at a Senior centre in Oslo. The two field studies resulted in insights about elderly people's life situations, technology use and common problems that appear during use of technology. One important insight was that touch and tablets are widely used and accepted among elderly people. It was therefore decided to use tablets as platform for the video communication system. A prototype of a tablet interface was then developed and tested with elderly users.

The project resulted in recommendations to use when designing a video communication system and touch interfaces for elderly users. It also resulted in a designed video communication system, OldPhone, derived by the use of these recommendations.

Elderly people are a highly diverse user group, with many and changing needs. This creates a challenge for designers since the interfaces need to meet many different abilities. A recommendation is to use functions for adaptation, so the interface can be customised for the specific user. Some other recommendations are to avoid more than two level menus, and different commands for similar touch actions. An insight was also gained about the involvement of elderly users in participatory design - the importance of creating relationships with users for conducting a successful process.

Keywords; video communication, elderly users, touch interaction, interaction design

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1. Introduction

The life expectancy of people is constantly growing. The EU commission mention in a report from 2007 that it has increased with 25 years in Europe since 1920 [1]. These statistics alerts us on that there will be an increasing amount of elderly people in the upcoming years, as much as 50% more in 2035 according to [2] and that this will result in challenges for today's society. Followed by this, the demand for health and social care will rise, which will create a lot more pressure on the health care services. As the birth rates are low [3] the workforce will not grow, which will cause more pressure.

Today one of the largest problems among elderly people is social isolation [1]. Studies done by the Swedish PRO [4] and Statistics Sweden (SCB) showed that for elderly people it is important to live at home as long as possible and preferably close to family and friends. The study also showed that it was essential not to feel lonely. Social interaction is essential for satisfying the human needs [5] and the problem of social isolation among elderly people will presumably rise with the increased population, which makes it an area of concern.

To be able to manage this challenge there is need for alternative solutions that can keep up the welfare for elderly people these upcoming years. Welfare technologies and Information Communication Technologies (ICT) have great potential. Those technologies can contribute to a better well being for elderly people by helping them live longer at home and be more independent, by using assistive technologies. It will also engage them to expand their social and communicative network [6].

However, it is relevant to question whether welfare technology products are simple enough to use by a group of people that did not grow up in the digital society, and if elderly people have a demand for them. The statistics mentioned by Newell et al [7], show that 56 % of the assistive technologies in USA are quickly abandoned, and 15 % are never used at all.

In the design process it has historically been bad cooperation between elderly users and designers [3]. This can quickly result in products that do not meet the needs of the elderly people and that quickly are abandoned. To be able to design accepted products which meet elderly users needs, an essential part is to involve them in the design process [1], for gathering requirements and to create empathy and understanding. Traditional human centred and participatory design (PD) processes provide great possibilities for this assignment, but a challenge will appear due to the diversity in the group of elderly people.

BRIS (Brukergrensesnitt for velferdteknologi i stua) standing for *User interfaces for welfare technology in the living room*, is a research project driven by the University of Oslo, UiO, and the startup company Velferdsfabrikken AS[1]. The project aims at investigating how welfare technology can increase elderly people's social life and wellbeing. Today a video communication system for TV is under construction and the project group is trying out different alternatives with elderly users.

1.1. Aim and goal

The *aim* with this thesis was to investigate how a video communication system best possible could be designed to fit elderly people's abilities and needs. The interest was to find out what kind of interaction and platform that suits best, as well as what a designer needs to consider when designing graphical user interfaces for elderly people.

The hope was to contribute to the BRIS project's work, and evaluate the idea of using TV as included technology. The hope was also to contribute to the discussion of the societal challenges connected to the increased population of elderly people during the upcoming years, especially regarding the concern of social isolation among those.

The *goal* was to conduct a participatory design (PD) process where elderly users would be involved to have a chance to influence the design of the video system. This included conducting user tests for evaluating a designed system.

A research question was formulated to support the investigation;

What device and interaction is best suited for a video communication system connected to the TV, and how should the GUI on the device be designed, to ensure that elderly people will understand and be able to use it independently at home?

1.2. Deliverable results

Results regarding the elicited knowledge and insights about interaction are presented in the report, with a suggestion for what kind of interaction you should use when designing a video communication system for elderly people. Insights gathered regarding what to consider when designing GUI design for elderly users are also presented in form of design recommendations. A design suggestion of OldPhone, a video communication system based on a tablet, is at last presented, derived from the suggested recommendations.

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[1] www.velferdsfabrikken.no

2.   Background

In this chapter more information about welfare technology is presented, how it is defined and how it is used and by whom. The importance of socialisation among elderly people and ethical challenges within the field are also presented and at last similar products to the one to be developed during this project.

2.1. Welfare technologies

Welfare technology products are products that can improve the welfare society [6], such as health and social services, education and employment, and can take the form of assistive devices, educational equipment, solutions for home adaptation or different tools. Welfare technologies can strengthen people's security, safety, daily activities and mobility both at home or on the move [8] and provide opportunities for a greater functionality, a more independent living and greater participation in society [2]. People provided with those supportive technologies are believed to be able to live longer at home before going to nursing homes. Medicine reminders, emergency alarms, safety monitors, stove timers or game consoles for physical rehabilitation are examples of products [2].

The term *welfare technology* is widely used in the Scandinavian countries [8] while in EU the most used term is *Ambient Assisted Living* (AAL) with a definition "*to enhance the quality of life of older people...[]...through the use of Information and Communication Technologies*" [9]. The definitions seem to be almost the same, although welfare technology seems to aim at a broader user group, not only pointing to elderly people. Although welfare technology often is aimed at elderly people it touches a much larger user group including other people with physical or cognitive impairments, disabilities and chronic diseases.

2.2. The importance of socialisation

Sense of belonging and social connectedness are of great importance for all humans and have an essential influence on our well being [5]. One of the largest problems among elderly people today is social isolation [1]. These problems are most usual at the countryside or sparsely populated areas due to long distances to family and friends, but problems in inhabited areas are also appearing if the support from family is limited [1]. Studies done by the Swedish PRO [4] and Statistics Sweden (SCB) showed that for elderly people it is important to stay at home as long as possible and close to family and friends. To not feel lonely was also essential. Physical or psychological impairments often go hand in hand with social isolation and cognitive impairments [8]. Decreased mobility,

decreased health or less socialisation due to retirement are causes that create the isolation and sometimes fear of falling or fear of not managing transporting one self can make it worse.

It is essential to encourage elderly people to be engaged and social even though impairments or mobility complicates it. Welfare technologies and ICT products have the ability to make this a bit easier for elderly people and allow greater social participation for them.

2.3. Industry and resources

Welfare technologies will not just gain elderly people with a better well being but resources can be saved and new market opportunities for the industry and companies can be created [1]. If the technologies can make people more independent and give abilities to increased mastery of own life, the need for health care will decrease [8] and save resources in the health sector. As mentioned earlier, the health sector will be under pressure in the future years and saving resources is essential for meeting the challenge. Norwegian Directory of Health's mention in a report [8] that by using welfare technologies around 2500-3000 workplaces can be moved from administration to direct care, which is a great opportunity.

2.4. Challenges and ethics with welfare technology

With all these positive thoughts in mind around welfare technologies, questions rise about why these are not used more widely. In studies made around municipalities and their use of welfare technologies in different areas of Norway and Sweden problems were detected as e.g. lack of competence and expertise in the field, large costs for implementation of systems, and issues regarding organisational changes [8] [10].

Some problems although regards the user oneself. The acceptance by the user and the fear for using new technologies are areas of concern. Elderly users are sometimes scared that a technology may be hard to use or that they do not have control over it, e.g. if it is activated or not [8] [11]. Users also seem to be concerned about their privacy and if the product may infringe on it, as well as if the technology can affect their health through it's signals and sensors. Concerns are also detected about the trust of the technology in use, if it will work correctly e.g. will alarms trigger when it is needed and not send false ones. If you think about how elderly people navigate the world today and the difficulties that already are present, it might not be surprising that new technology products can be perceived as a challenge [3]. Worth mentioning is that an intuitive solution for a young user might not be intuitive for an elderly user [12].

Concerns are also detected around the cooperation between users, the industry and municipalities.

Needs and requirements of elderly users have historically been defined by a stakeholder or a person other than the elderly user oneself, and the elderly people have rarely been involved in the design process [3]. Working after this approach is believed to result in products that do not meet the actual user requirements, which might lead to limited use or nonacceptance by the users. To be able to elicit requirements from elderly users and create products that meet these, it is essential to put the them in the centre of the process and increase the cooperation between them and the different stakeholders [1]. This is a fact that needs to be taken into account when designing welfare and ICT products for elderly people.

In a report about ethical challenges with welfare technologies [6] a discussion is held regarding who will gain most of the technologies, if is it the user, relatives, the service provider, the industry or society in general. Hoffman [6] claims that in many cases it gains the society and service providers the most. For example, communication technologies used between a nurse and patient can reduce long transportation distances for health personnel which will save resources for the health sector and benefit the economy, but the question is, will it provide better welfare for the user? Discussions are also active around welfare technologies for social interaction and if those products can replace real human contact [6] e.g. video conference systems for socialisation.

To be able to answer these questions and create products that gain both the users and the other stakeholders, it is important to take into account both parts requirements and needs. To place the elderly user in the centre is essential, but this is not always enough as mentioned in [12]. It is not unusual that even if elderly people are involved in the process their opinions are not taken seriously and are more or less stifled. For including elderly people in the design process in a successful way, it is demanding to involve them in an open and genuine manner [12] and listen to their opinions.

2.5. Elderly people as a user group

Elderly people are a large and diverse user group. The spread in age, interest, health and living condition, impairment, income etc. create an extraordinary group which includes people from multiple generations [12][13][14]. With a user group as diverse as this there will appear difficulties regarding the variety of users characteristics, conflicts between interests caused by different levels of disabilities or impairments, and also to find representative users [7]. In this thesis *elderly users* are defined as people in ages over the retirement age usual in Sweden and Norway, namely 65 years old.

Gregoret al [14] talk about dynamic diversity and how important it is to take this into account when designing for elderly people. They point out the fact that elderly people's abilities change over time, and so will their needs. It is therefore not just the variety of the diverse group, but their changing

needs that need to be accounted for [7]. Gregor et al [14] also presents a study where a web browser is designed to meet different levels of visual impairments. The browser has a function called the *voice helper* with functions to speak out content and selection possibilities, as a telephone answering system. The user can ask yes or no questions to confirm choices and a banner is provided on top with the spoken text available for the user. The page has adjustable font sizes and size of text-banner to be able to meet different user's needs. Here it is clear that customisation is a key for designing for diversity and changing needs. It was also found out further in the study that elderly people with cognitive memory loss had difficulties when too much information was spoken at the same time. Customisation for how much information to show at the time was then added, so the needs of this group also could be met.

2.6. What is independent living?

As mentioned earlier, welfare technologies should create a more independent living among elderly people, but it might not be fully clear what is meant by this definition. Independence can be viewed through different perspectives as discussed by McLean [3]. A functional perspective is defined by the author as the ability for oneself to *perform activities* in daily life without significant help from others, which might require some extent of mobility by the person oneself. A normative perspective is presented with the weight on *freedom to decide for oneself* what and when to do personal activities connected to daily life. At last a relational view is presented with the approach that *there are no independent people* but that all human beings are dependent on each other as we are social beings.

Diversity, independency and who the technology will gain, are all together factors that are worth giving a thought when designing new welfare products. Hopefully, more insights regarding those those areas can be gained by letting the users have their voice heard in the process of development.

2.7. Similar products

In recent years there have been an increased focus on the area of welfare technologies. EU has started projects and conducts research initiatives in the area [9]. Also municipalities in the nordic countries have started programs for providing more welfare technologies for their elderly people [2] [8]. The field of interest in this report is as mentioned video communication systems as support for increased social participation. Similar products can be found on the market today which are important to look over before further development is conducted. A few examples are presented in short below.

2.7.1. *Oscar Senior[2]*

This application is designed for all kinds of touch devices and it's specially developed for elderly users. The application is available at App store and Google play store and compatible with both Apple and Android products. The system includes not only a function for video communication but others such as games, weather forecasts, share pictures and news. A connected smartphone works as admin for the senior's device and can provide assistance and guidance remotely if any problems occur, e.g. by a family member.

2.7.2. *Vidyo[3]*

This application is aimed for a wider user group with business people and health care personnel as a large group but it also includes elderly users. The application is available for both mobile and desktop devices. It includes functions for health care meetings, fitness and rehabilitation on distance as well as providing meetings for socialisation. The application allows up to four users per conference meeting and is available for download at the Vidyo website.

2.7.3. *Grandcare[4]*

Similar application with functions as communication with health care, socialisation with family, medicine reminders, entertainment such as games, calendar and photo collections and is aimed for elderly users specifically. Digital health devices and smart home solutions can be added to the system for more complex support. The application is designed for touch screen devices. The system can be bought at the Grandcare website.

2.7.4. *Tely HD[5]*

A camera device for plugging in to a TV screen through an HDMI cable, which allows video conference through the widespread application Skype. The device is directed to a large user group and seems mainly to be promoted for business people, but is relevant due to the TV connection and use without computer or touch devices.

2.7.5. *Independa[6]*

Smart TV that provides functions as video conference, sharing pictures, reminders and chat. The system is connected to the Independa app which can be installed on touch or desktop devices and makes it possible to call to the TV. The TV is purchased with the system installed on it and it seems

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2   http://www.oscarsenior.com/
3   https://www.vidyo.com/video-conferencing-solutions/healthcare/in-home-care
4   https://www.grandcare.com/
5   http://www.tely.com/conferencing-systems/video-conferencing/hd-series/
6   http://www.independa.com/

not to be possible to purchase the software separately.

Many of these products are based on touch or desktop screen devices while a few are designed for the TV. Some products aim at a wider user group, which creates concern whether the systems are developed with the elderly user in mind. Only a few are available at the Google play store or App Store but most of the products can be bought and downloaded through a specific website. All of the products provide video calls between two persons but only one promote group meetings with up to four participants.

It is necessary to question whether these products are simple enough for independent use by elderly people, especially the products that not seem to be developed for the elderly user group in specific. The systems are in some cases based on more modern technology, as touch screens, and in other cases on TV technology which might be more widespread among elderly users. Studies done by University of California [16] show that elderly people spend a large amount of time in front of the TV each day, which can confirm the assumption.

Most of the similar products had a bunch of other functions beyond video conferencing included and this might increase the complexity of the system.

3.   Theoretical framework

Similar studies done regarding interaction and interfaces for elderly users are presented in this chapter, and also some existing guidelines that can work as support when designing interfaces for elderly people. When involving a diverse user group as elderly people it is relevant to gain knowledge on how to meet so many different needs. The approach of *Inclusive design* is presented below, as it takes this diversity into account. At last, some words about the acceptance of products and technologies among elderly people will be presented and how those can be accounted for.

3.1. Inclusive design

"Inclusive design is defined as 'the design of products and services that should be easily usable by as many people as possible, in particular aiming to meet all the needs of people who have been unable to use mainstream products because of age or disability" - [15]

There are a bunch of similar expressions for the design approach *Inclusive design,* including universal design, design for all, gerontechnology and transgeneration design but all of them aim for the same goal, namely to design for *everyone* including elderly users and people with disabilities. A shared belief within those approaches is that people are disabled due to the designs and environments created as those fail to take into account the capabilities of all potential users. In other words, by designing for all people's capabilities there will not be any disabilities, only impairments [16]. Inclusive design can minimise difficulties users have due to impairments and prevent them from getting disabled. Such a situation is presented by Lindsay, Jackson, Schofield, and Olivier [12], exemplifying a hearing impaired man on a museum that could take part in a video exhibition thanks to subtitles in the movie. Important to add is that, if the museum for some reason had failed to add subtitles this man suddenly had become disabled, not impaired. As stated by Clarkson, Keates, Coleman, and Lebbon [16] *"If people can be disabled and excluded by design, they can also be enabled and included by thoughtful, user-aware design".* To gain better understanding of users' lifestyles, wants and aspirations and to be able to meet their needs it is highly important to conduct user research, which is pointed out in the same book.

The diversity of elderly people is extraordinary as also mentioned earlier, and therefore approaches like inclusive design are highly relevant to take into account. To design only for elderly people might not be necessary, but to design for *everyone* including elderly and people with disabilities is preferable.

This can e.g. be done by the use of a human-centred or a participatory design process where users

are involved in interviews, workshops and evaluations.

3.2. What is easy use for elderly people?

There are many ways to look at ease of use. An easy design can e.g. be a design with few choices. For a remote control this could mean fewer buttons or for a menu in a system only one layer navigation. Culén and Bratteteig [17] present a study with elderly people where investigations were done on how the users interacted with their remote controls. All the users had remote controls with a bunch of buttons, but only 4-5 of the buttons were used. As suggested, an easier design in this case could be a remote control with less buttons, but this simplification could also result in *limitation*s. If the elderly users want to widening their use after created confidence in the first one, the possibilities with a simplified design like that are few. This leads to further interests on how an interface can be designed to provide easy use but still make room for changing needs and the diversity among users with different choices and possibilities. The importance of using adaptive interfaces where users can add more functionalities when the current one is mastered is presented by Gregor et al [14].

In an article by Verne and Bratteteig [18] it is claimed that difficulties using an artefact can be caused by some different factors. Three main causes are presented in the article; the *design of the artefact* itself, the *context* the artefact is used in or *external factors* as errors or actions made by a third party. Badly designed products can e.g. be a mobile phone for elderly users with too small buttons which for old hands are hard to press, or it can be a system not providing enough information for how it should be used. Context difficulties are situation based and are often connected to a user's life situation. The authors mean that this e.g. can be the user's level of experience of the technology involved. Difficulties caused by a third party are often connected to products or systems that are part of a larger system and are often difficult to troubleshoot e.g. an automatic temperature control in a building might cause too high or low temperatures and it might be hard to distinguish the reason for it.

More studies show that prior experience has an essential role for how difficult an artefact might be to use [19]. Langdon claims in the article that prior experience of a technology or product has more to say than the age of the user. It can e.g. be experience with same brand or product family, but with some of the main functionalities and appearance maintained.

There are of course possibilities for elderly people to learn new technology, but it might take long time, and it might also be forgotten without regular use or when the memory fails. Elderly people need much practice and repetition to establish new habits, and not to forget to unlearn the old ones, as mentioned by Bratteteig and Verne [18]. To unlearn deeply automated habits derived from many

years back might be easier said than done. A suggestion from the article is therefore to build new technologies and products on users' old habits, as this might be experienced as less challenging than a totally new ones.

3.3. Designing interfaces for elderly users

Getting older can be connected with a number of age related impairments as decreased hearing, reduced field of vision, loss of cognitive capacities and less mobility [20][13][21]. Those impairments may cause difficulties using modern interfaces. As mentioned before, elderly people are a diverse user group and those impairments will vary a lot among them. By taking into account as many of those as possible when designing interfaces for elderly people, it is possible to create products that meet many individuals. General guidelines to use when designing for elderly people are presented by Clarkson et al [16] based on both visual, hearing and cognitive impairments. Suggestions for visual impairments are; increased contrast, lightning and colour contrast as well as large and distinct fonts and space between text and buttons on all types of screens, as well as representative and clear icons that can work as help to well defined labels and buttons. Suggestions for hearing impairments are to; have combined audio and visual messages as well as make them adjustable so it can be suitable for all users, as well as using low frequency sounds and avoiding ambient. Suggestions for cognitive impairments are; to avoid rapid presentation of information and keep information short and not present too much at the same time, as well as avoiding tasks requiring high memory load.

Sometimes when designing interfaces metaphors are used to create understanding by the user. Metaphors that younger people understand might not be as clear for older users. When designing for elderly people it is important to adjust the design with metaphors they will understand. Examples of metaphors are the icons on a computer desktop, including the bin that helps the user understand that it is the place for throwing away stuff, just as in the real office. These kinds of metaphors are based on reality and differ of course among generations [12].

More about what is needed to be thought of when designing interfaces for elderly people will be presented below with focus on different technologies such as touch screens and TV.

3.4. Touch screens

Touch screens are a widespread technology in products for elderly users, due to the intuitiveness and ease of operation [17] [22]. Although, touch interfaces need to be shaped in proper ways to meet these facts. The size of buttons, size of inactive space between the buttons, font sizes, navigation and colours are some examples that are important to consider for providing ease of use

for elderly users. Studies done by Jin et al [22] show that larger key sizes on touch screens create better performance and decreases the reaction time in use. There should also be space between buttons for best performance, but too large space increases the reaction time due to larger area to search and move on, the study presents. The article suggests button sizes between 16-19 mm and spaces between the buttons in 3-12 mm, depending on the dexterity of the user.

Culén and Bratteteig [17] present studies on elderly people's interaction with touch interfaces. One study showed that elderly users, compared to younger ones, are less precise in their touch movements. Elderly users seemed to touch many places on the screen including the target, while younger users manage to touch only the target. This indicates that elderly people can to a larger extent touch other buttons which might cause more error selections.

Depending on the elderly users' health condition a touch device might be expressed differently regarding ease of use. Studies show that users with hand tremors can express difficulties interacting with touch. Wacharamanotham et al [23] present studies conducted with elderly users with hand tremors, investigating what gestures that might work better for them on touch devices. The results show that sliding motions are easier than tapping as it reduces the tremors and prevents error selections.

Further guidelines for mobile touch devices are presented by Lorenz and Oppermann [13] and include arrangement of buttons on the bottom of the screen to prevent covering parts of the screen while interacting as well as error selections, natural colours on the screen and slow animations or blinking rates. Lorenz and Oppermann also suggest to use one level navigation [13] while Stojmenova et al [20] propose to not use more than two level navigation.

3.5. Interfaces on TV

Studies done by Lorenz and Oppermann [13] on TV interfaces showed that interfaces that worked smoothly on a computer screen gave different result on the TV. The users had to a larger extent problems with readability due to lower resolution and long distance from the TV. In addition to this a recommendation is to add larger features on TV screens compared to computer desktops.

The same study also showed that contrasting colours were problematic and tiresome for the elderly users which led to decreased readability on the screen. This does not match the general guidelines mentioned above, as those suggested to add more contrast and brightness on screens for elderly users, as their vision often has decreased functionality [16]. Those suggestions are important to have in mind when designing a TV interface, as both contrast and colour might appear differently regarding resolution and screen available.

3.6. It is not only about the ease of use

Sometimes when a product or system is easy to use there are other factors that anyway makes it unpopular among users. It is no longer just the question of ease of use, but the user's *will* for using it. In a study by Culén and Bratteteig [17] an elderly user expressed that a smartphone not at all was difficult to use, noting that the only functions used were the call and receive call function. Due to the user's restricted use it was not necessary for her to have that kind of phone and her *will* to use it was the problem rather than the difficulty level. This shows that it is important to listen to the user and understand in what way one would like to use the technology. Even though the product is easy and intuitive there might not be any demand for it by the elderly oneself, even if designers and relatives can see great opportunities for the elderly person to use that product.

Similar results were conducted in a study with Kinect based interactions by Verne [24]. The users had no problem conducting the gestures, but they stated that they did not want to have a similar technology installed in their homes.

4.   Methodology

As a researcher it is easy to have ideas and imaginations of what the user thinks or needs, often before the research has even started. One essential part of social research is to elicit information by talking to and observing users. This talk will make it possible to go from the imagination about what users think to actually knowing what they think [25]. As stated by Moggridge [26] "*if you are going to create good designs, you first have to understand people – what they need, want and enjoy, as well as what how they think and behave*".

In this thesis elderly users were planned to be involved in the design process as much as possible for the scope and time available, as this is essential for creating understanding and empathy for the users, and to gather needs and thoughts the users have about the subject.

In this chapter methods for involving users in the process are presented, more specifically the methodology of human-centred and participatory design, as well as ethnographic study- and evaluation methods that were planned to be used in the project.

4.1. Qualitative research

When doing research, data can be collected in a *qualitative* or *quantitative* way. Quantitative data often presents data about how many or how much with the help of numbers and charts. It does not tell much about users' behaviour and why certain situations appear as these often are too complex to understand through numbers. Qualitative data are of better use when behaviour are of interest as the designer constructs better understanding [27].

Qualitative research can help designers understand users' behaviour, attitudes and experiences but also how a particular product or system is used in a specific context [27], and was therefore preferable to conduct in this thesis. Qualitative data can be collected in many different ways, but the most common and efficient way is through ethnographic studies including interviews and observations [28].

4.2. Human Centred Design

Design with the user in the centre of the process is commonly acknowledged for creating meaningful products. The goal with this type of process is to create a design that will meet the users' needs best possible [29]. To be able to find and understand those needs and experiences a study of user activities are required.

A range of methods are used for this study e.g. ethnographic studies including traditional data

collection methods as interviews, focus groups, observations and user tests. When collecting data, some needs and requirements are more accessible than others, as mentioned by Engelbrektsson in [29]. The *Kano model* presented in the same article suggests three different types of needs; *basic*, *performance* and *excitement* needs. The basic needs are the ones that are taken for granted by the users, while performance needs are the ones that users easy can articulate e.g. problems met daily with a product. Excitements needs are not aware by the users until a new solution is designed.

As also mentioned by Engelbrektsson [29] "*user requirements are not always articulated verbally by the users, but show themselves in the users' behaviour*", this makes it important to not only rely on interviews where the users verbally express their needs. Users often tend to say what they *think* they are doing, unaware of what they *actually* are doing. For capturing all types of user needs, a combination of data collecting methods is preferred, both question and observation based.

Depending on project and available users, a process can be more or less human-centred. In a participatory design, PD, process the users are involved to a larger extent than in a general human-centred process [30]. In this project users were planned to be involved as much as possible, hopefully in a participatory way as this would gain more empathy and understanding for the users. This is mentioned by Zhang and Wakkary [31] "*the closer designers could get to their users' lives and experiences, the more likely that their products and services could meet the users' expectations and needs*".

As a designer I planned to be open for new insights and choices detected by the users, and to not be afraid for changes in direction when more understanding was being gained. As stated by Bratteteig and Wagner [32] "*Problem understanding ideally also involves questioning if a new technology is adequate and desirable and for whom*", which was highly relevant for this project.

More about participatory design and what a designer needs to think about when working with elderly users in a PD process is presented in the section below, and how this can open up the design space.

4.3. Participatory design

Participatory design is a design methodology where users are invited to take part in the whole design process [33]. The methodology allows the end users to have their voice heard in the design process and ensure that their opinions are taken into account on how to shape the design [34]. The methodology differs from other human-centred design approaches since the users are involved as co-designers instead of just informants or testers of a finished concept [30]. The goal in a PD process is not just to understand the activity, by the use of empirical methods and design for it, but

to let the users influence the design choices made along the way, as coworkers. The methodology is based on various research methods such as ethnographic studies, with observations, interviews, and analysis of artefacts, and workshops which are used iteratively to construct the design [34].

To be able to conduct a successful PD process the designers involved need to accept the participants equal influence of the design, as Bratteteig and Wagnes [32] cites it "*designers have to learn how to use their power and how to share it*" and "*... in order to collaborate with users as co-designers the designers need to share their power with them and acknowledge their different and equally valuable expertise*".

Bratteteig [30] also talks about mutual learning as an optional phase when working with a PD process. Co-constructing a design is first about trying to learn about each other and the different expertise that are present. For the designer it is about getting to know the use context, the users activities and identifying needs, specifying requirements and test and evaluate the use. For the users it is about learning about technical possibilities so they can imagine new solutions.

Bratteteig and Wagner [35] also discuss the depth of participation in projects and to which extent the users were involved in two conducted studies. A conclusion made was that there will always be different depths of participation in different projects, depending on the role and expertise of participants and the issues it is regarding. Even though the users are able to influence the design choices in a participatory way, it is not required that the users make the decisions in all phases [36]. It is claimed that even if the design is open for influence by the users and their voices are heard, their contributions are not always visible in the end result. Although as concluded in the same book, the users contribute to widening the *design space* which provides more choices and perspectives that are very valuable for the process, and often not possible to detect without the users.

4.3.1. *PD with elderly users*

Some challenges with involving elderly users in a participatory design process are how well they can participate and get their voice heard [17]. Elderly people are often unaware of new technologies and have therefore a harder time to take part in discussions concerning this [12] [21]. Although, according Lindsay at al [12] elderly people are often delighted and engaged when talking about own experiences and requirements.

Many elderly people also have decreased functionality in different ways, as loss of vision, hearing, memory and mobility which might limit them to feel confident in participating in a design process [21]. Engaging elderly people early in the process and being flexible along the way is essential for conducting a successful PD process [12] [14]. When working with elderly users it is about adapt to their life and rhythm which e.g. can include regular meetings with health care personnel, lunch and

coffee breaks at certain times or other everyday routines [30].

Lindsay at al [12] present a method developed especially for PD with elderly users, the *OASIS* (Open architecture for Accessible Services Integration and Standardisation) approach. The method is starting with scenario work to gain sense of the design domain and to find needs, issues and challenges that the users encounter. This is followed by designers creation of potential solutions, which together with the needs and challenges found earlier are the groundwork for some creative design workshops with the users. These workshops are the start of gaining insights on the specific shape and design, and so validate if the designers are on the right track.

Zajicek [21] claims that elderly participants attention and focus is limited, which often leads to other topics and discussions irrelevant to the main subject during workshops. Suggestions are made to have smaller groups in workshops or sessions to make sure everyone is participating in the relevant discussion and so trying to prevent personal chats around the table. It is also important to have a facilitator that guides the workshop and makes sure everyone is active and engaged in the discussions. It is also a of great importance to work for a friendly atmosphere within the group as this will help the users to inspire each other [12]. To do this it is suggested to create some common ground to stand on both for the users and designers.

4.4. Ethnographic studies

Ethnographic studies are conducted to study users when doing different tasks or work practices and are widely used in design processes, especially in human-centred and participatory design. The fieldwork of ethnographic studies often include observations and interviews in the use setting e.g. when the participant uses an artefact or system [37].

4.4.1. *Interviews*

Interviewing in combination with observations is one of the most efficient methods for gathering qualitative data [28] [27] and can be used for understanding people's living situations, experiences and opinions. Interviews can be completely structured with predefined questions in a specific order, or they can be unstructured where it is more or less the interviewee who guides the discussion [29]. Many interviews fall somewhere in between and are often called *semi structured*.

The amount of users to interview in a research study depends on the scope of the project, but a basic rule is to not interview more than there is time to analyse afterwards [28]. Interviews can be conducted one-to-one, between one user and an interviewer, or in focus groups where the users together discuss a topic given by a moderator [29].

When carrying out interviews, one essential part is to gain trust by the user and create a relationship

where the user feels comfortable and free to speak [25]. As an interviewer it is important to not be afraid of silence and give the user a chance to think it through and answer the question when ready. Sometimes it can be a good idea to come back to a question later, if the user is not ready in that moment [25].

To document the interview is very important, for making further analysis easier and for having evidence on the conclusions later to be done. Taking notes is a matter of course, but to be able to recall everything the users say in notes afterwards need great practice and skills and can seem like an unreliable method [25]. A good option is to record the interview as this can simplify the analysis [38], but this needs to be done with consent from the user. Although, it should be said that transcribing records takes long time, first it takes time for listen through them and then several hours for transcribing and analysing the answers [25]. An idea is also to take photos for documenting the environment and particular artefacts [38].

Semi structured interviews were planned to be conducted with the elderly users during the project.

4.4.2. *Semi structured interviews*

Semi structured interviews are in between the structured and unstructured ones. They often have pre-defined topics or questions that the researcher wants to investigate, but the topics do not necessarily have a specific order. The interviewer can be open for exploration and has freedom for adding questions if new issues appear, as well as asking follow up questions [38]. The interviewer ensures that the predefined topics are covered sometime during the interview.

This type of interview can both have open and closed questions depending on the goal of the interview and those are often structured in an interview guide. The time for conducting this kind of interview can take from minutes to several hours, but a recommendation is to keep it between half an hour to two [38].

4.4.3. *Focus groups*

A focus group is a qualitative method where a group of users are invited to participate in a session to discuss some topics presented by a moderator. Often about five to twelve users participate in one meeting, although smaller groups are often easier to control and for the moderator to involve in the discussion [39]. Focus groups can be seen as time efficient, as those often generate useful data in a short time. Often a pre-defined guide with questions or topics to discuss is created by the researcher beforehand but the focus group can also be totally unstructured, as in one-to-one interviews [40]. The session is often located at meeting places as conference rooms or similar [39].

Important to think about when conducting focus groups is to balance the involvement of the participating users to ensure everyone takes part in the discussion, as well as trying to *not* influence them in a particular direction. The researcher should also keep in mind that peer pressure can influence the results and that users might not be honest when speaking in front of a group [39].

4.4.4. *Observations*

Interviews help designers to collect data by asking questions and get the users to explain situations and experiences while probing for more info, but those do not always solely create reliable data. Users might not express the truth during interviews due to fear of seaming stupid or incompetent if having problems with the system or artefact [27]. Observations can therefore work as a complementary method to the interviews to create a more reliable picture of the users' behaviour.

Observations can have different performance where the researcher has more or less interactivity with the user, from natural observation like the *fly on the wall* approach, where the researcher tries to be invisible to not influence the user, to more engaging approaches where the researcher is allowed to ask questions and interact with the user by *participant observations* [41].

The different approaches have different benefits and limitations; as more interaction might influence the result in certain a direction, a passive approach might reduce the possibility for creating a relationship to the user and also the ability for probing to explore *why* things appear. People also tend to change behaviour when knowing they are observed which can affect the reliability of the result [42].

The plan was to conduct observations where the users knew they are observed, and where the designer could interact with the users if necessary.

4.5. Design workshops

Design workshops are sessions where users are involved to co-design with the members in the design team. These kinds of workshops are usual in participatory design and can be held both in the early phases of the process for contributing to the ideation, or in the later stages to evaluate concepts [43]. The workshops can consist of different methods such as modelling, create collage, drawing sketches, building mock-ups or making storyboards with different material available. The structure can differ a lot but may start with a presentation of agenda, group discussions, collecting ideas on sticky notes and to be followed by modelling or building methods [43]. The plan was to conduct a couple of workshops during the project, for ideation as well as evaluation.

4.6. Personas

When data is collected around the users' experiences, living situations and requirements, the next step can be to summarise those in an understandable way that easily can be adapted and used in the design process. Creating *Personas* is a good way for doing this. Cooper [27] describe the method as *"...using our research to create a descriptive model of users in a uniquely powerful tool for interaction design"*. Personas provide easier communication of users' characteristics, behaviour and needs between different stakeholder and parties involved in the process. The narrative structure also makes those characteristics and behaviours easier to remember for the designer.

Personas are not real people, but they are archetypes that build on observations and interviews done with real people in the research study [27]. The plan was to create one or more personas of the typical users during the project for supporting the process.

4.7. Prototyping

Prototyping is a helpful tool for evaluating and discussing technical solutions with users, which makes it a good method when conducting participatory design. Prototypes can help produce ideas and possibilities and create mutual learning between designers and users [37]. The prototypes can be high-fidelity design representations or simple low-fidelity mock-ups or paper prototypes. Early low-fidelity prototypes are often used in the ideation phase and are excellent tools for testing concept ideas with users, for collecting feedback for the next iteration. High-fidelity prototypes are more refined and often have working functionalities and interactions as well as a more finished look and feel [44]. According to Mörtberg et al [37] prototypes with unfinished appearance are recommended when involving users in PD, as this makes a statement to the user that their contribution is needed.

Moggridge [26] presents the definition of a prototype as *"a representation of a design, made before the final solution exists"* and the importance of prototyping early and often is presented as the key to faster success in design. The importance of starting with low-fidelity prototypes is also mentioned, as the designers often get stuck in pixels instead of exploring the structure and basic constraints with paper and versatile materials first. Prototypes were planned to be developed at an early stage of the project for allowing early user tests.

4.8. Evaluation and usability tests

User tests are often conducted with the prototypes to find out about how to improve the usability of the interface or product [45]. The users are observed by the designers while interacting with the product or system so designers can evaluate and find out how the product is working. The users are

often supposed to conduct typical tasks or scenarios [45].

4.8.1. *Rapid Iterative Testing and Evaluation (RITE)*

As mentioned, early prototyping in the design process is recommended, but to test early and often with users is also important [26]. The RITE method builds on a test-fix-test-fix approach, to early in the process identify problems and be able to fix them in time. Low-fidelity prototypes are suggested in the early tests to make sure the biggest errors and problems are detected before a lot of time and resources are spent on high-fidelity ones [46].

4.8.2. *Think aloud*

The evaluation tests are often combined with verbalising methods such as *Think aloud w*here the user is suppose to speak out thoughts, feelings, difficulties, confusion or frustration etc. while doing a given task. The Think aloud method is the most common evaluation method used in usability tests [47]. The method can be conducted in different ways. In *Retrospective think aloud* the user is recorded on video while doing the task and is afterward asked to look it through and discuss it together with the designer [47]. The think aloud method was planned to be used during the user tests in the project.

4.9. Wizard of Oz

Wizard of Oz is used during evaluations with users, often in early stages of the design process when a working prototype not yet is implemented. Participating users believe they are interacting with a working prototype, but in reality the prototype is simulated by the designer during the test, making the interactions look real [48]. The designer steering the system should be hidden for the tester.

The method can be good to use before expensive working prototypes are implemented and makes it possible to early gain feedback from the users which will save money. It can also be suitable for products that not yet have established design patterns as e.g. augmented reality [48].

The method was planned to be used for testing the prototype that was going to be developed, because the concept would not be implemented and work technically. An alternative method for testing was therefore needed.

5.   Planning

The project was planned to be conducted from February until the middle of June. The time schedule below shows the planned four step process including a planning phase, field study, ideation and evaluation phase.

In the *planning* phase I planned for reading up on the subject and similar studies, through a literature study. This to gain more knowledge in the area. I also planned to recruit users, write and structure the interview guide and a consent form in this phase.

In the *field study* I planned to start involving elderly users by conducting interviews. This to get an understanding of their life situations and technology use, and to get answer on what kind of interaction and technical products that suit them best.

During the *ideation* I planned to conduct one or two workshops with elderly users for giving them a chance to influence the design. The performance of the workshops was depending on the availability of users that could participate. Sketching and early prototyping was also a part of the plan in this phase. The hope was to get help shaping the prototype by users.

In the last, evaluation phase, I planned to perform *user tests* to evaluate the prototype that was developed during the ideation. A hope was to include the same users that already were involved in the field study and workshops.
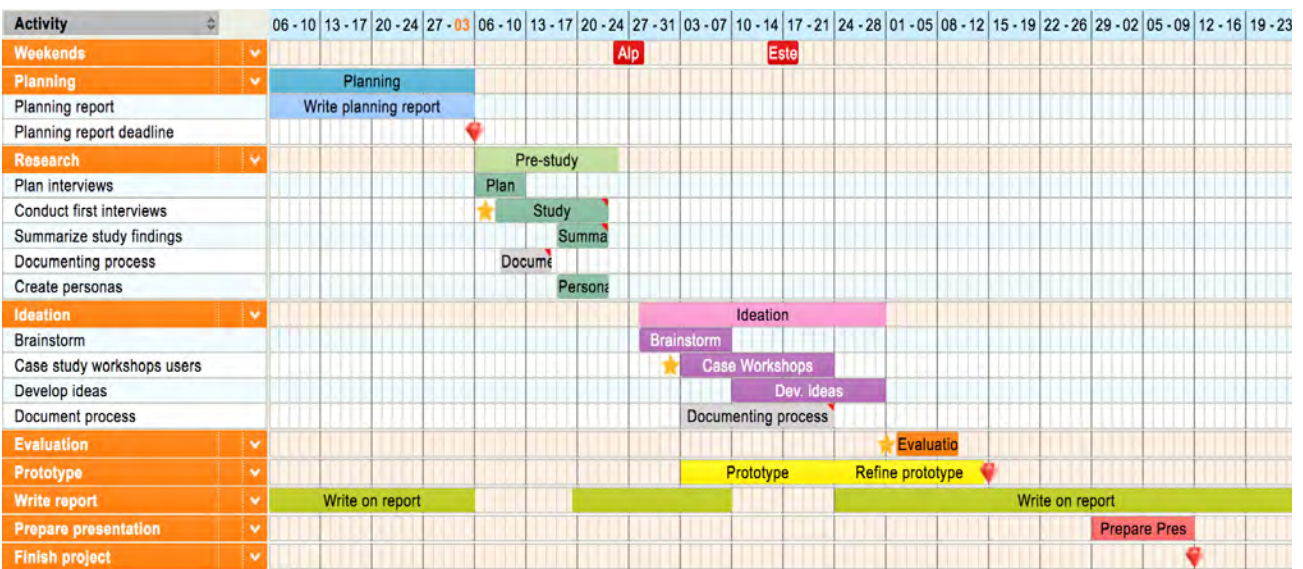
Figure 1; Time plan

6.   Research process

In this chapter, the actual performance of the research process is presented as well as findings and partly results from field studies.

In the first phase of the process a literature study was conducted to frame the project and gain knowledge from previous studies and research. This was followed by a first field study that included interviews with elderly users. The findings were summarised and two typical users were formed into two personas. The ideation then started and a first prototype was built to enable early user tests. At the same time a second field study was conducted where participative observations were performed in technology classes for elderly people at three occasions. User tests of the first prototype were conducted and the concept was developed further. A round of final user tests were held before the prototype was finalised. **Figure 2** shows the process.
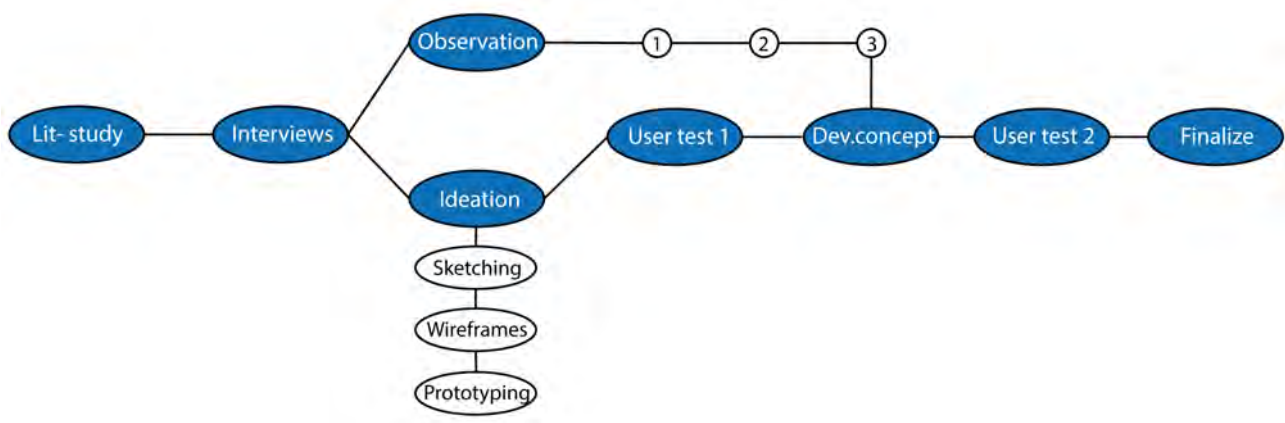
Figure 2; The research process

6.1. Planning phase and literature study

The literature study included investigation around the broad concept of welfare technology and elderly people as users of this technology. It also investigated similar video communication systems and other research studies done with elderly users interacting with technology and interfaces. The aim with the literature study was to frame the project and gain more knowledge.

By the use of Chalmers digital Library and the search engine *Summon,* articles and literature were found. Often one article's references lead to another interesting paper. A few articles were also obtained through the supervisor at UiO, Guri Verne, who has much knowledge in the area and has written several articles herself, and together with colleagues. See background and theoretical

framework for literature study results.

The planning phase also included investigating of how the collected data would be managed according to NSD[7], Norwegian centre for research data. The data collection was reported to the organisation under the BRIS application form. Much of this was done in collaboration with the supervisor at UiO, Guri Verne.

6.2. Recruiting users

The users were recruited through personal contacts and with help from the supervisor, Guri Verne at UiO. The first established contact was a woman, **Interviewee 1**, who was member in a council for elderly people outside of Oslo, Norway. As she was the chairperson in the organisation she had a the opportunity for spreading the word of the study to other members in the group. Two more users were recruited with her help. Most of the interviewees were recruited this way, one contact led to another and opened doors to other organisations.

SeniorNett[8] is an organisation for elderly people that need help with technology related tasks and use. The organisation offers classes in different areas of use, as sending emails, using mobile or smart phones, internet use, net banking and similar. The classes are organised voluntary by elderly people. **Interviewee 1** gave advice to contact SeniorNett for finding more users. Doing so lead to another established contact with an elderly supervisor in the organisation and later to several participating users that were invited to both interviews and user tests. The organisation had weekly technology classes which also created great opportunities for conducting observations. Good relations were established with many elderly people at the centre thanks to the weekly classes.

Early in the process, users were also recruited through personal contacts in the area of Falun, Sweden. A small focus group was conducted with a family member and his old friend. Two more users were then recruited from other contacts in the area and interviews were held with them.

The users had a wide geographic spread as people both from Norway and Sweden participated, and the ages and experiences of technology differed a lot among them. The youngest user was 63 years old and the oldest was 89.

6.3. First field study – interviews

The aim with the first field study was to gain knowledge about the user group's life situations and

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[7]   http://www.nsd.uib.no/
[8]   www.seniornett.no/

experiences with technology as well as finding out about elderly people's opinions and ideas regarding video communication. Seven elderly users between the ages of 67-87 participated in personal, semi structured interviews, and two in a focus group. **Figure 3** shows an overview of the users with geographic area and balance of gender.
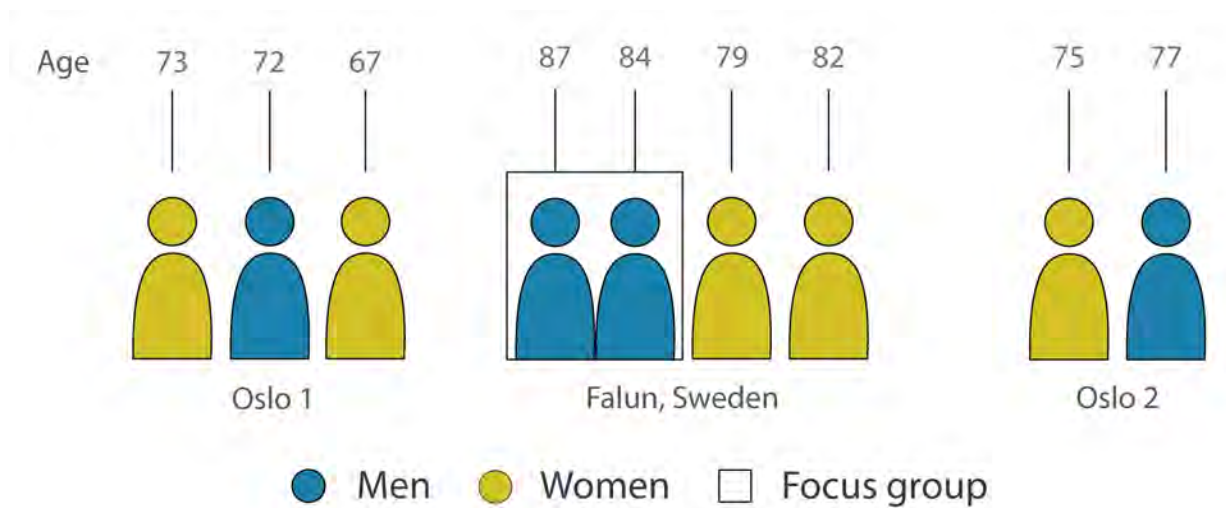

Figure 3; Overview of users first field study

6.3.1. *Consent from users*

Before the interviews were held the users got to read and fill out a consent form to approve their participation in the study. The form made it clear that the gathered information from the interviews could be used in the study and that the user was anonymous and could any time drop off. The users also signed to approve being audio recorded during the interviews, and were informed that all the audio files will be deleted when the study is finished.

The consent form followed an already defined structure used in earlier studies in the BRIS project with some changes to fit this project's content.

The consent form is presented in more detail in Appendix 1.

6.3.2. *Semi structured interviews*

A semi structured interview guide was prepared before the study started. The interview guide included three areas of concern, social life and technology use and video communication. In the first area, topics regarding the users' social situation were covered to gain understanding of how

elderly people live and feel about their everyday life. The second part of the interview-guide covered technology use and what products or systems the users experience as easy or difficult. At first the interview guide was divided after area but was later mixed together after feedback. Questions regarding use of video communication was also included in the guide and covered what the users thought about the concept and of having it installed at home. A pair of questions were scenario based and placed the interviewee in another elderly persons situation.

This guide was used in the first three interviews but was then modified to a shorter version with more focus on technology use and video communication and less on the social situation, as it was discovered to be quite sensitive for the users to talk about their social situation and their own personal feelings. Scenario questions regarding other elderly persons social life seemed much easier for the users to talk about and were therefore kept and focused more on.

During the interviews the users were audio recorded to simplify the later analysis. Notes were also taken but in a unstructured way without any defined form. It was assumed that the order of the questions would vary between the interviews as small talk would lead in to the different subjects and that some users would talk a lot about some questions and less about others. A semi structured interview guide was therefore a good choice, with predefined questions but no particular order. The assumption seemed to be good as all the interviews varied a lot and small talk changed the direction and order of the questions constantly.

A full interview guide is presented in Appendix 2.

6.3.3. *Results interviews*

Technology use

Most of the younger seniors, 67-75 years old, were frequent users of touch devices as smartphones and tablets. The amount of functions used differed in the group, but most of the users had apps for writing emails, reading newspapers and conducting bank services beyond the regular call and sms functions. Some of the users used other functions such as social media applications, camera, gallery, health applications, GPS, maps and google search.

> *"I want to be as good as the younger generation on technology!"* - **Interviewee 1**

All users were active on TV, but only one saw the benefits with using a smart TV. Most users had a smart TV installed at home but did not use the smart functions, instead they used it the way they always had with fixed times for programs. Only the youngest user at 67 years old, **Interviewee 3**, was using the smart TV functions once in a while when she wanted to see a program at a specific

time outside the regular TV schedule. Another user expressed that she did not know what she could do with her smart TV.

The older part of the user group were not using technology at the same level, especially two of the users over 80. **Interviewee 4** had a smart TV installed but only used it the regular way. He also had an old mobile phone with tangible buttons for calling once in a while and a computer that he used for paying the bills only. **Interviewee 7** was in a similar use situation. She used a regular TV with four channels, a Doro[9] mobile phone only for answering when she was outside or calling if she needed help, and a computer for paying the bills. She also used an iPad, but not as much as the younger seniors above. She used it for saving contact information to family, playing bridge and for listening to audio books and she managed those functions well even with her limited experience of technology.

Video communication

Almost all users had tried video communication at least one time, except one user, **interviewee 7,** which was both the oldest woman participating and one of the users with least experience of technology. Only one user, **interviewee 5**, used video communication regularly. He was 84 years old and used FaceTime for calling to family members living far away from him. He expressed a very positive experience with the system saying *"If everything was as easy as FaceTime, then I think every old person could learn to use it"*.

Many of the users in the group were skeptical to the concept of calling with video, but they expressed that it could be a good option in the future or for other elderly people in another living situations than themselves, e.g. people with a sickness or disability. They answered it could be a good supportive technology for the persons in the scenario questions.

Interviewee 1 expressed that she was afraid for a future with video communication as it might reduce the times her grand children will come to visit. She feared that they would replace the physical visits with video instead. The same user thought it was confusing when she tried video communication in a group setting, and said that everyone talked at the same time which made it hard to follow the conversation. This made her feel unengaged in the conversation.

Interviewee 7 that never had tried video communication was also very skeptical to the concept, and she expressed that she didn't need it. But after thinking for a while she started to accept the thought of it, saying *"I have a relative in America I use to call by phone once in a while, I have not seen her in many years as we are too old for traveling so far, so it had of course been lovely to see her... but I don't know, video communication feels so strange and new"*.

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[9] https://www.doro.se/

When asking about the appearance of the system the users had many suggestions. Almost all said that the system must be as easy as possible with few buttons and alternatives, as well as making use of easy colour coding. Some users also suggested that the system would fit best on larger screens as a computer or TV, and not on a smartphone.

Interviewee 6 thought that video communication was best suited to have on a computer, but when she got the idea of having it on a TV she liked it and expressed that *"then you don't get connected to everything else as on a computer, but you are connected to only the thing you want to"*.

Interviewee 2 had many ideas, in example he presented a function for zooming in and out at the picture to be able to see more of the surroundings where the receiver was positioned or for seeing the face more close. If there were more people in the call he also suggested that a good idea could be to be zoom in on different faces.

Interviewee 3 pointed out the importance of knowing when the system is On or Off, as elderly people otherwise might feel unsafe, believing someone is watching them. The same user also talked about increasing volume individually on the persons in the call because some people talk very quietly.

Interviewee 1 expressed the importance of having a help desk with physical persons that you can call for help. The user talked more generally at first, and then exemplified it with her net bank service where she appreciated to be able to call a supervisor when she wanted to. The user said that she felt more safe when she knew she could get help from a physical person.

Difficulties with technologies

The users expressed many difficulties with the technologies used. Several users expressed that they were afraid for pressing the wrong button and therefore they did not try at all. As **interviewee 1** said *"My grandchildren tell me to just press a try, but I am afraid of doing it as I will get lost and not find the way back to where I was"*. Some users mentioned similar challenges, as using only a small amount of buttons on their TV remote control because they were afraid of pressing the wrong one so settings might be done that they cannot reset.

Several users also mentioned trouble with the use of login information and passwords for different applications and websites. **Interviewee 1** said ;*"All the passwords you need to learn for different applications are so hard, I never remember, there should be a better system for it."*

Interviewee 4 expressed a hard time writing sms on his old mobile phone with tangible buttons. He said the buttons were too small and not adapted for older people's hands. He also expressed the function of pressing three times on each button for generating each letter as hard and ineffective.

The same user expressed that it was too much information presented on computers, saying *"I could never learn a new computer like that (pointing at a MacBook), my brain is too tired for adapting that much information"*.

Several users expressed that they felt unsure of what of their private information on their computer or tablet other people could read on the internet, what was published or not and when different applications were activated or not.

Most of the users expressed that touch on tablets and smartphones worked fine, but that the touch pads on laptops were hard to use. **Interviewee 1** saying; *"Sometimes it zooms in and sometimes out, it is so hard to use"*.

Learn new technology

Several users mentioned the importance of presenting one step at the time for making a system easy to learn. **Interviewee 8** said; *"If you teach an old person one step at the time, I think everyone can learn to use a tablet"*. The same user also said; *"Touch is the easiest way for older people to interact as they just need to point at the function they want to use"*. **Interviewee 1** expressed; *"I think elderly people are very prejudiced against technologies, I think it is important to motivate them to learn and take one step at the time"*.

6.4. User requirements for the video system

From the results of the literature- and first field study a list of the most important findings was created as requirements. The list worked as a support in the design process to remember all the findings. The requirements are not very specific or technical, but summarised what the users mentioned in the interviews in points. See the full list of requirements in Appendix 3.

6.5. Personas

Personas were constructed from the users' behaviour and technology use that were noticed in the first field study, to make those easier to remember during the design process. Two different personalities were shaped and as much findings as possible were included in the descriptions in a narrative way. The two personas have different experiences of technology, one represents a non experienced user and the other a very experienced one. This for remembering the diversity in the user group even though the non experienced user was under-represented in the first field study. See personas in Appendix 4.

Harald Haugen

AGE: Retired, 83 years old

PREVIOUS PROFESSION: Engineer

INTERESTS AND ACTIVITIES: Once a week he participates in a group on a senior center in town. The group consists of seven other retired men with similar interests, namely to play cards and Schack. Harald also have great interest of nature and so he loves to walk in the forest and picking mushrooms or berries.

TECHNOLOGY USE: He uses a smart TV and a mobile phone with tangible buttons daily, he also owns a computer but it's used only for the most important tasks, namely for paying bills.

HEALTH CONDITION: Harald is mobile and still going strong but he has really bad hearing from many years back. Even though he wears a hearing aid daily he still experiences difficulties when people talk fast or unclearly.

"I DON'T HAVE THE ENERGY TO LEARN A NEW SYSTEM OR COMPUTER, MY BRAIN IS TIRED THESE OLD DAYS. BUT IT'S OK TO USE THE ONES I ALREADY KNOW"

DESCRIPTION: Harald is living with his wife that is a few years younger than himself. She was active on technology and was the one steering the computer at home, until some year ago when she got sick and could not longer use her hands properly. Harald have since then taken over some tasks as paying the bills on the computer, but he doesn't see any need for using it for other tasks. If he can do the tasks other ways than through a computer, he prefers that. It takes too much time to learn new systems on the computer, he means he's too old for that.

Harald watches the news on the TV every evening. After that he often watches documentary series that are sent on a regular times. He likes to have fixed times for TV programmes and does not see any benefit with using the smart TV functions installed. His hearing problems makes him add subtitles whenever possible, but on the news it's sometimes not possible which leads to misinterpretations of content in some cases. He is lucky to have his wife those times.

Harald uses his mobile phone for making calls to children or friends. He thinks it's pretty easy to make calls, but sending sms he experiences as very clumsy and unintuitive, as he needs to press three times on each button to write a letter. The buttons are also very small and he feels they are not at all customized for his old stiff hands.

Grete Hansen

AGE: Retired, 76 years old

PREVIOUS PROFESSION: Teacher

INTERESTS AND ACTIVITIES: Meet her old ladies for coffee and bakery, walk her little dog in the park, meet the knitting group for sharing the latest work, visiting grandchildren.

TECHNOLOGY USE: Smartphone for calls, sms, bank, social media and sending email. Tablet for playing bridge, listen to sound books and reading newspapers. Smart TV installed, but often doesn't use much more than the regular channels.

HEALTH CONDITION: She is active and mobile. Her hearing is still okey but her sight really starts to impair her. She needs to use strong glasses and zoom in on screens to be able to ready properly. Her cognition is still good thanks to her active kind, but she forgets more and more as the years passes.

"I'M AFRAID TO PRESS THE WRONG BUTTON AND NOT BE ABLE TO FIND THE WAY BACK TO WHERE I WAS"

DESCRIPTION: Grete is a retired teacher and widow with a lot of energy and will to learn new tings. Her husband past away a few years ago so to not get isolated she tries to be active, engaged and meet people. She also tries to be updated on technology and string along with all the new products that constantly are produced, because she thinks it helps her to feel more participation in society. Even though her curiosity and will are excellent, she experiences difficulties in learning new technologies and new functions on her existing ones. She's afraid of pressing the wrong buttons so she gets lost in the interface and won't be able to come back to where she was.

She often feels tired and confused when too much information are presented at the same time and to not mention all the password she needs to remember to websites and applications, this is a great problem for her. Also when she is not sure if the product or system is activated or not she can feel unsafe and afraid that someone might infringe on her privacy by monitoring her or similar.

When something goes wrong with her technical products she calls her grandchildren to come and help her, and if they're not in town she calls the helpdesk (if there is one avaliable). She feels safe when there is a physical person helping her and she is not happy at all with self-helping systems or vocie-mails.

Figure 4; *Persona 1 – Less experienced user*   *Figure 5*; *Persona 2 – Experienced user*

6.6. Second field study – observations

A good opportunity for performing observations was offered at SeniorNett at their weekly technology classes at a Senior centre in Oslo. The classes were held by three to five elderly supervisors and were aimed at elderly people that had different technology problems. The participants could either book a meeting with one of the supervisors beforehand or just show up spontaneously with their problem. By participating in the classes as an extra supervisor and participative observer a lot of valuable information could be collected, e.g. about the typical problems that occur with technologies among elderly people. The observations were conducted during three occasions in parallel with the ideation phase and influenced the design with new insights every week. Four users were observed and among them one person was observed several times over the three occasions – an old man in beginner iPad class. **Figure 6** shows an overview of the users and activities observed.
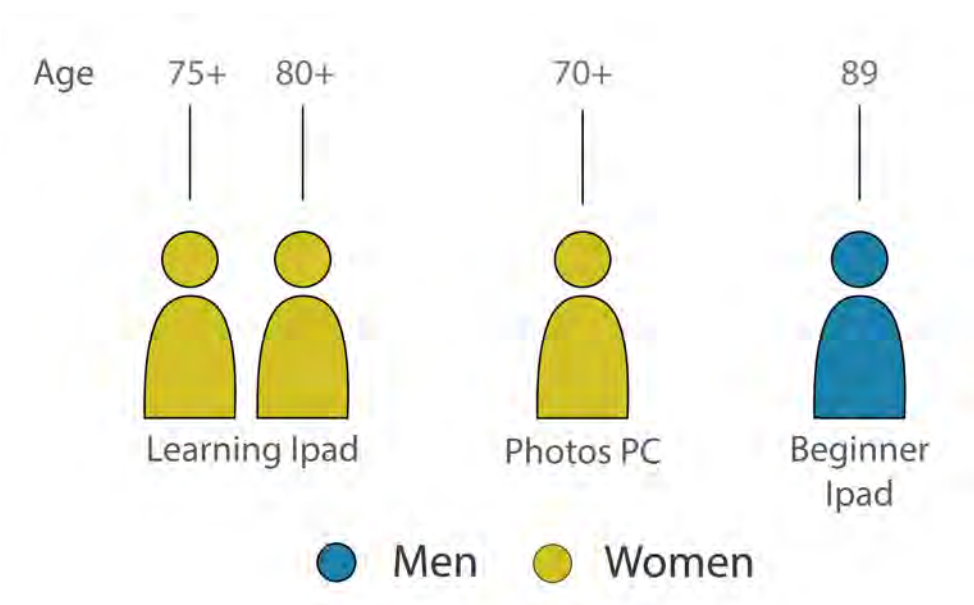
Figure 6; Overview of users second field study - observations.

6.6.1. *Woman learning how to use the iPad calendar*

At the first class it was observed a pair of elderly women, one teaching the other on how to create activities in the iPad calendar. The women were informed of the master project and knew they were observed. The observation was participative for creating a good relationship with the women and for making them more comfortable with my presence. The interaction with them occurred mostly when the elderly supervisor had problems she could not solve herself and asked me for help. Otherwise the observation was kept as natural as possible during the class.

A good relation was established with the women which lead to another recruited user to observe - one of the women's husband. He was in need of a beginner class in iPad use and the woman wanted to book me for supervision in his favour. The meeting with the man took place the week after and was later established to a fixed once in a week class.

Figure 7; One woman learning the other on how to use iPad.

6.6.2. *Organising photos on PC laptop*

At the same week another woman got help by a supervisor to arrange her photos on her PC laptop. Natural observation was conducted as the woman only wanted help from the elderly supervisor. It was too much for her with two persons helping at the same time, which she expressed clearly. The observation took about ten minutes, the woman then asked me to leave as she thought it was disturbing being observed while learning.

6.6.3. *Man in beginner iPad class*

The meetings with the man were held in a small conference room at the Senior centre. He was 89 years old and had never used an iPad before. The meetings took about one hour each time and gave a lot of insights on how it is to learn a new technology as an elderly person. During the meetings the man got instructions for tasks he then tried out himself, e.g. how to use google, how to read the news paper in the web browser and in the application for the Norwegian newspaper Aftenposten, as

well as how to add contacts and numbers. The man also tried to use the map application and learned how to zoom in and out on the screen.

6.6.4. *Results second field study*

Woman learning iPad calendar

For some elderly users it can be hard to distinguish between similar touch gestures. This was discovered in the first iPad class with the two women, e.g. long or short press touch interactions that trigger different actions. The woman in the iPad class wanted to edit one already created event in the calendar and therefore tried to press on it. The two first actions were to weak so the system did not answer. She then tried to press and hold on the activity which marked it but it did not show the menu as she wanted. Both women expressed confusion and did not understand why they couldn't press and edit the activity. The same happened for other functions where the system answered on something else that they wanted to.

Remembering the steps of a task was discovered to be a challenge. Several times the woman tried to press directly on the time slot for creating a new activity in the calendar, instead of going to the plus sign at the top right corner. She had difficulties remembering the steps on how to create a new activity, even though she just a minute before did exactly the same. However, to remember the later steps when the menu had appeared was easier for her.

Next, the woman wanted to create events for her husband in the same calendar. Some of the events appeared on the same time interval as her own activities. She expressed: *"it is very hard to distinguish between mine and his activities when they lie upon each other like that, and when they have the same colour".*

Arranging photos on PC

The supervisor showed the woman how to create new folders, drag and drop files and changing names on the folders. It was obvious that the lady had a hard time to understand the hierarchy of folders. She did not understand which was the main or sub folder and every time she had to ask how it was done to create a new one.

When she tried to move a bunch of photos, she pressed the wrong button in the menu and instead deleted the photos. She got frustrated and had to ask for help to get them back.

Man in beginner iPad class

When observing the man adding contacts on his iPad similar difficulties appeared as with the women with iPad earlier. For every round of adding a new contact it was hard for the man to

remember the first command, to press the plus sign in the top right corner. The man was also a bit shaky on his hands which lead to selections of buttons adjacent to the one he wanted to press. This made it difficult for him, especially when writing on the touch keyboard were the buttons are placed close to each other. When a misspelling was made he tried to delete the wrong letter, but several times he mixed the delete- and enter button which made the text cursor move to the next row which he did not notice. This also caused problems for the man.

When adding a number to a contact on the iPad it is possible to choose what type of number it is, e.g. mobile, work, home etc. and for choosing what kind, the user has to press on the blue text that appears. This was hard for the man, as he did not understand that he could press the text. Instead he wanted to press the red minus button or the green plus button because those were more distinct and looked like buttons. Pressing the red button suggested deleting the row with the number he just added and I had to help him come out of it. For every round I had to remind the man to press the text for changing the kind of number and not the red or green minus or plus button.

The system did several times not respond on the mans interaction, probably because of his dry hands or too weak pressure. This made the man try to press and hold to get response, but this only asked him to delete the field he just had filled out. As already noted in earlier observations with the women, different commands for different pressure or hold are not successful when designing for elderly users, and this was again confirmed.

6.7. The ideation

The field studies gave a lot of great insights about elderly people's technology use and life situations as well as common problems around technology use. The ideation phase started with investigating what kind of interaction and platform to design for. This was done with the help of insights gained from the interview study and the personas and requirements in mind. However, some ideas came up before the ideation and interview study, including the idea of creating an application for smart TV's. This idea derived from the BRIS project's interests of having TV as included technology as well as the wide extent of TV use among elderly people. The idea was discussed further in the ideation phase and different kinds of interaction were considered for the idea and discussed with findings from the interviews. Some examples were to use a remote control or touch interaction on a smartphone. However, the idea with a smart TV application did not seem to be the best solution for the user group after insights were gained from the interviews. Only a few elderly users knew how to use the smart TV functions and most did not use it at all. As almost all the users in the interview study used tablets and had positive thoughts regarding touch, this platform was instead considered for the design. In the interviews users also explained their use of other interactive products such as

remote controls, buttons on mobile phones as well as computer touch pads, and their thoughts around those were less positive than with the touch interaction on tablets. When touch also showed to be widely used in products for elderly people in the literature a decision was made to design for the platform. The users also mentioned that learning new technologies often was a challenge but that tablets felt easiest to learn. This strengthened the decision.

A suggestion from users was to implement the system on a large screen and not on a smartphone. A tablet seemed therefore to be a bit small. A function for connecting the tablet to another larger screen as a TV was therefore considered.

The ideation process was an iterative process of sketching, observing and creating digital wireframes as more insight was gained. Some paper sketches of ideas that appeared are presented below as well as some thoughts regarding those. Further down some of the first digital wireframes are presented.

6.7.1. *Paper sketches of the tablet application*

The first wireframes were created by simple pen and paper sketches created in an iterative process. The navigation in the system was important to solve at this stage and different ideas were discussed. The users had also suggested several functions for the system already in the interviews and those were considered and sketched on as well.

Sketches on the contact view were created and resulted in a grid with large images of contacts in alphabetic order, for easy visibility and interaction. An idea of what can happen when selecting a contact for reaching detailed information is presented in **Figure 8**. This idea builds on expanding the contact in the same view with the rest of the contacts still available under and when scrolling down. This ideas was not taken further as insights were gained regarding the
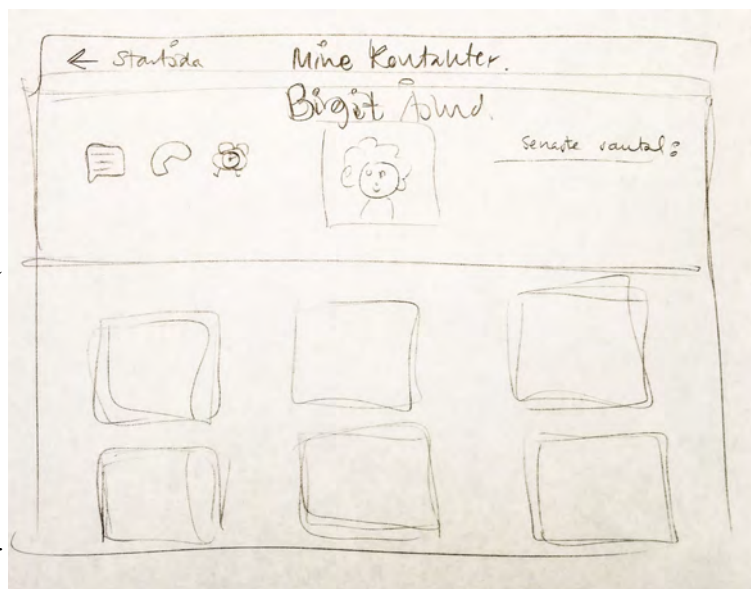
***Figure 8**; Sketch of contact view*

amount of information to be presented at the same time, especially when designing for people with cognitive impairments. The idea presents many elements at the same time which can increase the complexity for the elderly user. A better option was to open the contact in a new view which was the idea taken further.

An idea on how to solve the navigation in *My contacts* is presented in **Figure 9**. A common hamburger menu is placed in the top right corner where the user can reach functions as *help* or *add new contact*. This idea was later abandoned as insights were gained about being careful using menus in systems for elderly users. A one level navigation was instead created in that view.
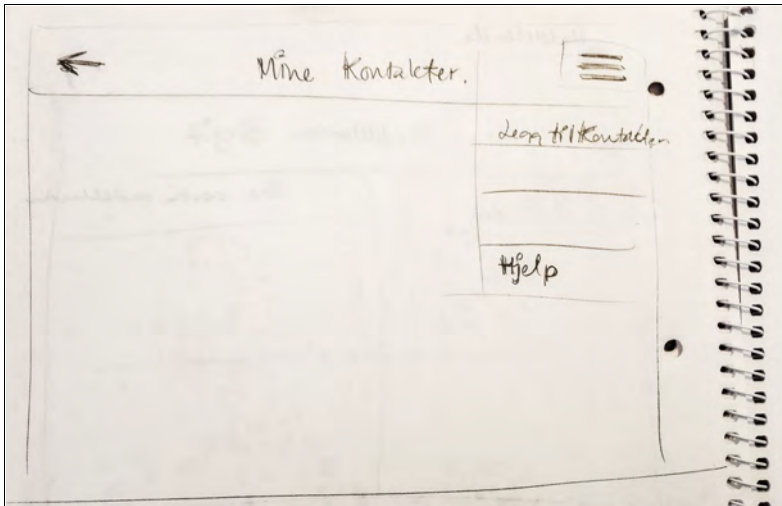
Figure 9; Sketch of hambuger menu in contact view

Ideas also came up regarding a menu bar in the call view and a discussion was held about having a menu bar at the side or in the bottom of the screen and what to include in it. **Figure 10** presents the call view with the menu at the right side including volume settings, add more people to the call and writing a message. Later this idea was abandoned as an insight was gained about having the menu in the bottom for preventing covering parts of the screen while interacting. **Figure 11** shows the idea with the menu in the bottom, which was taken further.
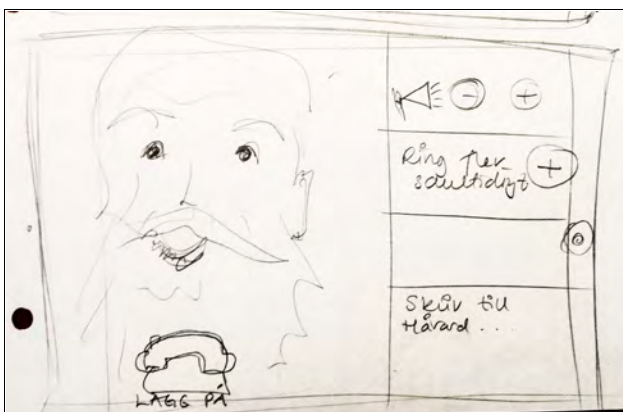
Figure 10; Sketch of navigation in call view
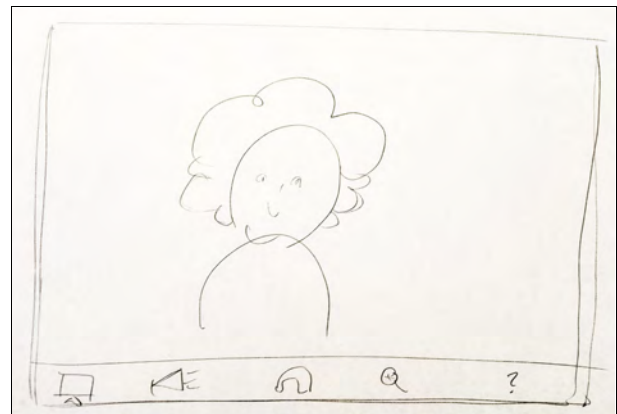
Figure 11; Sketch of navigation in call view

Functions as adjusting *volume*, *zoom* and *help* were suggested by users. The functions were sketched on and included in the design. Another function suggested by a user was the ability to send documents. The function was considered but was after some discussion left out as more functions also bring more complexity.

6.7.2. *Wireframes and early prototype*

When the sketches started to take form, digital wireframes were developed in Adobe Experience[10] and a clickable prototype was created with these for allowing early users tests. As mentioned by Moggridge [26], prototyping early and often is important for creating meaningful products. Paper sketches and digital wireframes were created iteratively when more insights were gained and tried out with users. The first prototype included wireframes of contacts, group calls, detailed view of a contact, the call view on the tablet, the remote control with zoom and volume settings. The pictures below show some of the first digital wireframes included in the first prototype.
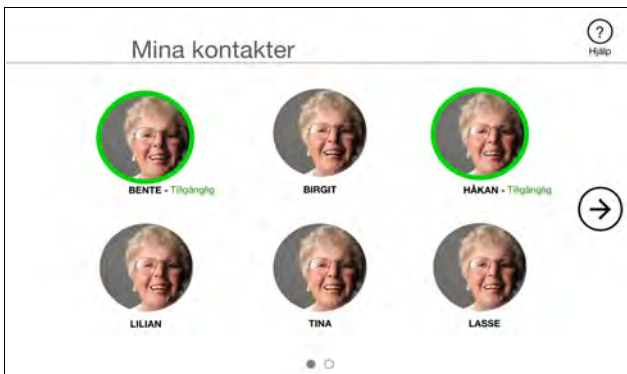
Figure 12; View of contacts
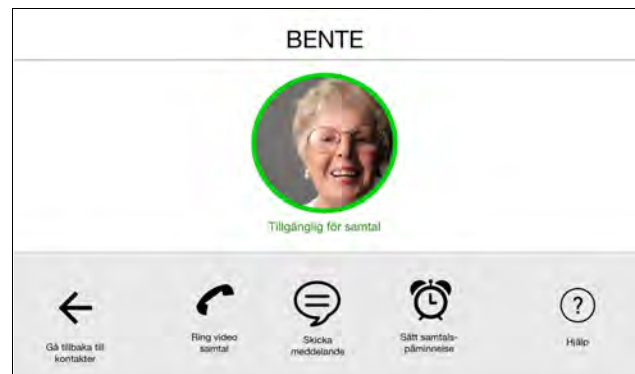
Figure 13; View of detailed contact
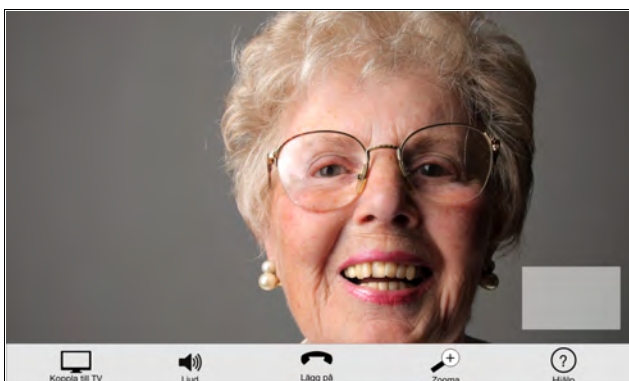
Figure 14; Call view - one person
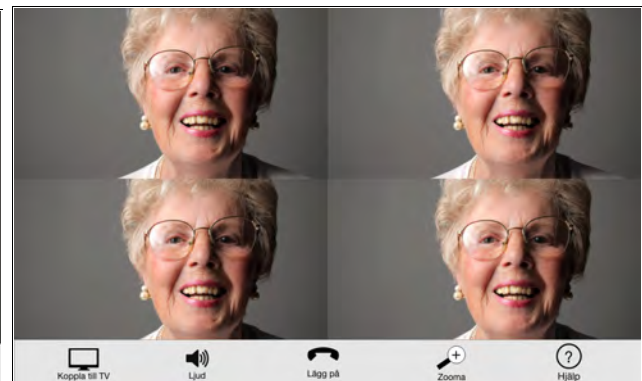
Figure 15; Call view - group

Figure 16; Connect to TV view

Figure 17; Remote control view

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10   http://www.adobe.com/no/products/experience-design.html

6.8. First round user tests

Both at, and in between, the observations at the Senior centre, contact with several elderly users was established. Some of them were willing to participate in user tests of the first prototype. After the first week's technology class the early prototype was tested with three elderly users in the ages of 63 to 80 years old that all had previous experience with iPad, but on different levels.

The tests were conducted by using the *Wizard of Oz* method, as the system didn't work in real. The system was simulated to work and the users had to imagine that some functions worked.

6.8.1. *Set up*

The function for connecting the system to the TV as well as the video call was not implemented, and therefore had to be simulated in the test. The set up of the user tests consisted of a tablet connected to a laptop which made it possible to show the prototype on the screen. The tablet was then placed in a stand to make it more realistic with the camera pointing at the user. The users had to imagine that the laptop screen was their TV at home, and that the connection to the TV was wireless. The laptop was at the tests made dark until the users imagined to *turn* on the TV and connected the system to it, then the laptop was manipulated by the test leader and turned on which showed the picture on the laptop. When the users were supposed to zoom on the TV by using the remote control on the tablet, the picture on the laptop was changed by the test leader using the scroll on a mouse connected to the laptop, which made the interaction look like it worked.

The tests were individual and started with an introduction to the project and how the system was supposed to work and be used. The users were then introduced to the method *Think aloud,* and got instructions to say what they were thinking and doing while testing the system. They then got a consent form with information of the test and what it meant to participate. For example that they were going to be audio recorded during the test, that it was anonymous and that they could jump off at any time. They signed the paper and the test could start.

During the tests the users got a few tasks to perform. The first task was to choose a friend, make a call and try to connect it to the TV (laptop). In the TV view the users had to try the remote control appearing on the tablet screen by zooming in on the person and change the volume.

Second task was to call a predefined group of friends and once again connect the call to the TV. The users again had to try the remote control appearing on the tablet, by zooming in and changing volume. The users then had to disconnect the TV and try some settings in the tablet screen, as zooming in, volume and end call. If the users didn't understand they got instructions from the test leader. They also got follow up questions regarding the challenges that appeared and how the design could be improved to avoid those.

After the tests, the users also got questions regarding what they thought of the system and if they had any ideas on how to develop it further or make it better.

6.8.2. *Results - Tester 1*

The user was a man, about 80 years old, with much experience with iPad, MacBook and smartphone. In the introducing talk he expressed that he wanted to have more contact with people and friends to talk and discuss different topics with. The concept therefore seemed to suit him well. The *Think Aloud* method worked fine for the man as he described the different steps he went through and what he saw on the screen. The results from the test are presented below.

My contacts

The user was a bit confused over the view called *My contacts* as it worked as a start page in the current prototype. The man asked how he came in there and how the start page looked like. The start page was at this time not designed. In the contact view the man requested a way to add a new contact as he could not find how to do it. He also asked how he could create a new group and delete a member in a group if one did not want to participate any more.

Connection to TV

The user expressed positive thoughts on having the system connected to the TV. He meant that the larger screen would make the call much more real as the size of the person gets more realistic, he said*: "It is good with a large picture on the TV, then it feels more like you are in the same room"*. He also discussed how it could work to connect the tablet wireless to the TV and said: *" I'm using apple TV at home so I guess this will work the same way"*.

Call

The user started to talk about the picture in the corner of the call view and he understood it was supposed to represent him. He expressed that he did not think it was necessary to have it there, and he suggested to have a function for minimising it.

Group call

The user was very positive to the function of being able to call a group of people. He said he was interested in using it for discussing different topics with friends. Although he had some concerns about how the group call was controlled so not everyone were talking at the same time. He suggested that it could be a text coming up on the person that talked at the moment, and the sound on the other persons could maybe be muted. After thinking for a while he said it just was needed some discipline among the participants.

The user gave positive feedback regarding the message function and said: *"Then you might be able to send a document that can be discussed on the meeting"*. The user asked questions during the test and said: *"What if one in the group is not available, what happens then? I can still call the other three right?"*. He discussed what to do for making the other person available and said you maybe could send a message, but he then got unsure if the person actually could see the message if not available.

Figure 18; *Man sketching during a user test*

Logo

In the end of the test the users started to discuss what a logo symbol could look like for the application as the man was concerned about how he could enter the system and how the start page looked like. The user got a sheet of paper to draw on and said he wanted to have a group of people and a TV in the logo, while he tried to draw it on the paper.

6.8.3. *Results – Tester 2*

This user was a 63 year old woman with little experience of iPad. She had used it earlier during work in the health care service but expressed it as a bit problematic to use in that setting, because the battery always went out and the internet connection was sometimes bad. She was unsure if she wanted to use it at home.

The user had no problem in understanding the system with the icons, text and functions. She had no problem imagining that the computer was a TV and she could easily understand how it was supposed to be used.

In the call view she did not understand the picture of the man in the right corner, but when I explained that it was supposed to be her she directly understood.

She explained all the different functions on the screen. Zoom, sound settings and help were all easy to recognised. She said it was good to have a help icon and explained that it could be a real person appearing so you could ask questions, a sort of help desk. When asking her if the help function could be a text based guide with pictures she agreed and said that it also could work.

She had no problem understanding the group call and could easily zoom in and out and change the settings from the iPad remote control.

Afterwards she got the questions if she wanted to use the system at home, she answered no but said that it could be a good option for someone else.

6.8.4. *Results – Tester 3*

This tester was a woman, about 75 years old, with some experience of Mac and she had just started to use iPad. She used it as a photo gallery, for saving pictures of her family. The woman had a strong visual impairment and had to use strong glasses and a magnifier for reading on the screen.

On the test day the woman had forgotten to bring her magnifier which made it hard for her to read, but we decided to proceed with the test anyway.

Text size and symbols

When the woman started the test she could easily read the header of the views, *My contacts, Group calling* etc. Although, she had a hard time to read the smaller texts, but managed to read the names of the contacts after looking very close. She did not have a chance to see the text under each icon and therefore had to fully rely on the symbols. In the detail view for contacts she understood phone for calling, clock as some sort of reminder or calendar and the question mark for help. It was harder for her to understand the message symbol but after explaining what it meant she understood.

When she entered the call view she tried to explain all the icons in the bottom menu. Sound and help was very clear, but it was harder for her to recognise the zoom icon and to my surprise also the hang up icon. She thought the phone was a pair of headphones. When I told her it was supposed to be a phone for hanging up, she laughed and said *"yes, now I see it".*

When connecting to the TV and the remote control appeared on the tablet screen she said that the

icons were easier to understand as they had a circle around, although, the text were still a bit small. When asking about the symbol for disconnecting the TV, she thought it meant to disconnect the video and make it a regular voice call. She suggested to use another symbol for that or to have a more clear description under.

Group call

When calling a group I asked her if this was something she could imagine using at home. She answered that it could be a good function, and that she could use it for calling her neighbours at the allotment to talk about farming and share farming experiences. She explained they rarely met at the allotment so it could been a good function to use for arranging a meeting with the whole group.

6.9. Develop concept

After the first user tests had been conducted the prototype was developed further to better meet the users' needs and requirements as well as taking into account the feedback that was given. Text and menus were made larger and a function for adjusting text and icon sizes was added in a settings menu. Icons were developed to more distinct and clear and more functions were designed, e.g. the message function, add contact/group, a start page and a red dot marking *new message* or *missed call* was introduced. The prototype was also made more refined with more colour use. Realistic photos were downloaded from Adobe stock and added in contacts. The prototype was also designed in a colour blind perspective by using not only colours for different states but different icons and text so the user has more than colour to rely on.

6.10. Second round user tests

The developed prototype was then tested again with new users for getting feedback and insights about further developments. Five users were involved this time, and all of them through contacts at the Senior centre in Oslo. Two of them had participated in interviews and observations. The set up was the same as in the first user tests. The picture below shows an overview of the participated users. The results from the test are presented below.
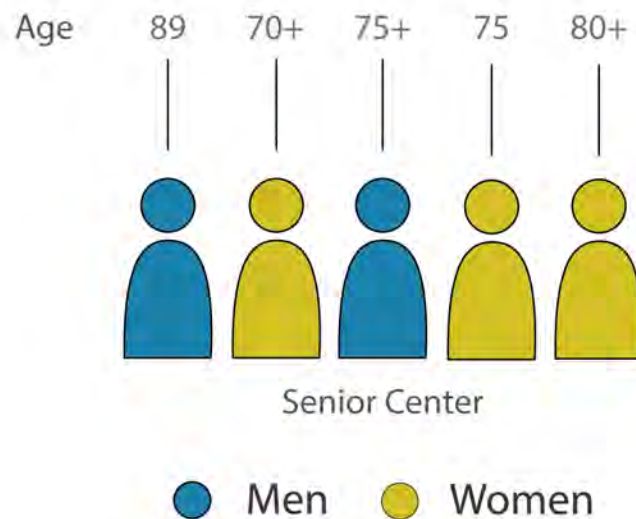
Figure 19; Overview of users in the second round user tests

6.10.1. *Results – Tester 4*

This was the same man that participated in the beginner iPad class, without any experience of touch interfaces from before. The test was conducted after one of the fixed meetings on Mondays, therefore the meeting started after an hour and the man was a bit tired.

The man listened to my instructions but was not so interested in trying it out himself, even though he wanted to the week before. I tried to make him test and he did for a short time but had hard time to keep focused. Instead he started to talk about his cabin in the mountains and asked me questions of my family and hometown.

In the call view the man asked about the picture that was supposes to be him, and wondered why it covered a bit of the woman behind. He thought the picture was in the way and wanted to move it or take it away.

The test was cancelled after a short time.

6.10.2. *Results – Tester 5*

This tester was a woman, about 70 year old, that used iPad daily. As her old profession was being a teacher she had a lot of valuable opinions from a pedagogical perspective.

Notification

The first question that appeared was regarding the red dot notification that appears on a contact when getting a message or missed call. At first the woman did not understand what it meant and she

guessed that it could mean that someone is before her in line, i.e. that the contact was occupied. When I explained for her that it meant *new message* or *missed call*, she directly understood and said; *"Of course, now I get it. I have seen it in other systems too, in my iPhone it is the same".* She discussed how to make it easier. She suggested to instead of the red dot have a mail icon for indicating a new message, but after a while she changed her mind and said it probably is better to use the same design as in other systems, as you then are introduced to a larger system.

Call view

When entering the call window the woman explained that she had a friend in England that used to call her by video. She expressed that she felt very uncomfortable when getting the video call unprepared, because she felt she did not look okay for being filmed. This lead to a discussion of having a function for turning off the camera and she thought it was a good idea.

When trying out the volume slider I asked her what she thought elderly people would think of this type of interaction. She answered that she thought that most elderly people would understand it, but that it can be hard to interact with as it needs some precision. She suggested it could be plus and minus buttons to press for making it easier.

Message

When we talked about the message function she pointed out the difficulty many elderly people have when writing on touch keyboards. She suggested to use voice control and explained that she sometimes used it on google search instead of writing.

The woman also discussed the colours on the message bobbles, which at that time were blue and yellow in the prototype for supporting colour blind people. She said she recognised the blue colour from her iMessage function in her iPhone but that she never had seen the yellow before. She thought it worked fine with the colours but that she preferred to have the yellow bobble white as it is in other systems.

6.10.3. *Results – Tester 6*

This man was asked early in the project to participate in a user test, but he expressed clearly that he was not interested in participating and that he did not want to use that video communication. The man was at the Senior centre often so I met him almost every time I went there. This lead to many small talks. During one week's technology class I also helped him deleting an app on his smartphone. Several times he saw me testing the system with other elderly people at the centre and he suddenly started to get curious. One time he stood behind me and the testing user watching how it was done. When I asked him again if he wanted to try, he was a bit skeptical but finally accepted

trying it. He said that he could do it for me because I had helped him with some things earlier.

The man had not much experience with tablets but used a smartphone for elderly people from Doro daily.

He started to try the system and he had no bigger problems understanding it, although he had some difficulties to get the system to respond on his touch interaction. He said it used to be like that and showed me his dry hands. On the man's Doro smartphone he used a pen for interacting, which seemed to work pretty good for him.

When the man had tried the call function for both one contact and a group he seemed positive about the concept and said he could use it for making calls to his grandchildren. The man did not have too much patience so the test did not last long.

6.10.4. *Results – Tester 7*

This user also participated in the first field study in an interview. She was 75 years old and had much experience of computers and tablets. She worked as a supervisor in the technology classes at the Senior centre and had much insights on how elderly people experience technology. She was very interested in welfare technology and asked if she could test the system.

The woman understood most of the functions and expressed that the system was easy and intuitive to use. She also thought the system would work good for elderly people with less experience than her.

Volume

When trying the volume function in the call view, she said the slider could be difficult to use for some elderly users. We discussed what it could look like and she thought a plus and minus button could helped a lot.

Functions

When talking about how to broaden the system and include more functions, as sending a document or sharing pictures she said she did not think it not was necessary. She argued that if you are so up and going that you want to send documents you probably can use a regular email for doing that instead of including it in the video system. The lady pointed out that the system should not include too much functions as that will complicate and bring difficulties for the users that do not need it.

6.10.5. *Results – Tester 8*

This user was a woman over 80 with much experience of iPad use and had some experience of using Facebook. When I explained the concept for her she seemed very positive and told me she had a family group on Facebook messenger where she could write to her children and grandchildren all at the same time. She was very positive to the messenger group and said it would be fun to call them by video where she could see them.

The woman tested the system and had in the beginning no bigger problems understanding it.

Notification

At first she did not understand what the red dot notification meant, but when she clicked in to the contact she understood that it meant message and missed call. She discussed it a bit and suggested to also have a text somewhere saying you got a missed call.

Group call

The woman tried to call one of the predefined groups, and pressed the volume button in the call view. It was a bit hard for her to understand that this was going to be used for increasing volume on the different persons in the call, but after I explained it to her she understood.

Message

The message function was understood directly by the woman, probably because she was used to the Facebook messenger chat. Although she anyway expressed that it was a bit too much information at the same time, this could be a problem especially for elderly users that not are used to systems like Facebook. After discussing it together she said it could be easier to show only one message at the time or designing it more as an email system.

7.   Main results

The aim with this study was to gain knowledge of what kind of interaction that is suitable to use in video communication systems designed for elderly users. The aim was also to investigate what a designer need to think about when designing a graphical user interfaces for elderly people. In this chapter the results of the investigations are presented through design recommendations derived from the conducted literature- and field studies.

7.1. Device for interaction

The first field study gave useful insights about elderly people's technology use, their thoughts around video communication as well as what difficulties they face while using different technologies. The collected information was summarised, and together with the insights from the literature it lead to a decision of what kind of interaction to suggest and go further with for the video communication system.

7.1.1. *Touch interactions are intuitive for elderly users*

In the first field study, the majority of participants were frequent users of touch interface products, especially tablets. Only one user in the study did not use a tablet and he was the oldest one participating, 87 years old, with very little experience with technology.

When touch interaction was discussed with the elderly participants several users expressed it as easy and intuitive to use. One user said; *"Touch is the easiest way for older people to interact as they just need to point at the function they want to use"* as well as *"If you teach an old person one step at the time, I think everyone can learn to use a tablet"*. Another user said *"If everything was as easy as FaceTime, then I think every old person could learn to use it"*. FaceTime was used on a smartphone by this man.

The literature study showed that touch interfaces are widely used in products for elderly people, due to this intuitiveness and ease of operation [17][22]. In these two articles, studies were done on elderly people's interaction on touch interfaces, and both articles mention that it is critical to adapt touch interfaces for elderly users to ensure ease of operation.

The collected information gave a lot of understanding about elderly people's abilities for interacting with touch, but to be able to give a general recommendation for it in video systems for elderly people, more studies and investigations are needed. For this thesis, a decision was made to go further with touch as interaction, as the findings in the literature- and field studies showed promising potential for this.

7.2. Tablet and TV as combined platform

A lot of insights were gained already in the literature study, and ideas came up on what platform to design for. One was to create an application for smart TV's, as TV was a technology of interest by the BRIS project. However, after the conducted studies it took another turn.

Through the interviews it was discovered that most users had a smart TV installed at home, but only one user used it's functions daily. Most elderly users were more than satisfied with the regular TV functions and were not interested in using smart TV applications for streaming movies or seeing programs outside the TV schedule. One user also expressed that she didn't now what she could do with her smart TV. The gained insight about the low smart TV use among elderly people had a strong influence on the choice of platform for the video concept. TV technology was a part of the BRIS project interests, and was therefore planned to be the main component in the system. However, the field study results influenced the design to take another direction.

Touch seemed to be a good choice for interaction, but a decision on what platform the system was going to be designed for was needed. One idea was to use a touch remote control for steering an application on a smart TV. However, *smart* TV did not seem like a successful platform to base the application on, as few elderly people used the smart functions. Tablets though, were used by almost all participants in the study and therefore seemed to be a better choice.

In the first field study a couple of users suggested to have the video call on a large screen for better visibility. A tablet seemed to be a bit small for this suggestion, and solutions for how to solve it were discussed. To offer a function for connecting the tablet to another screen came up as an idea. Almost all elderly people had a smart TV at home which could be used for sharing the screen from the tablet.

The final concept resulted in a tablet application that can be connected to the TV for better visibility. The connection can be done by e.g. Chrome cast or Apple TV which are widely used systems for sharing screens to the TV.

Illustrations of the concept and more details of how it works are presented below.

7.2.1. *The final concept*
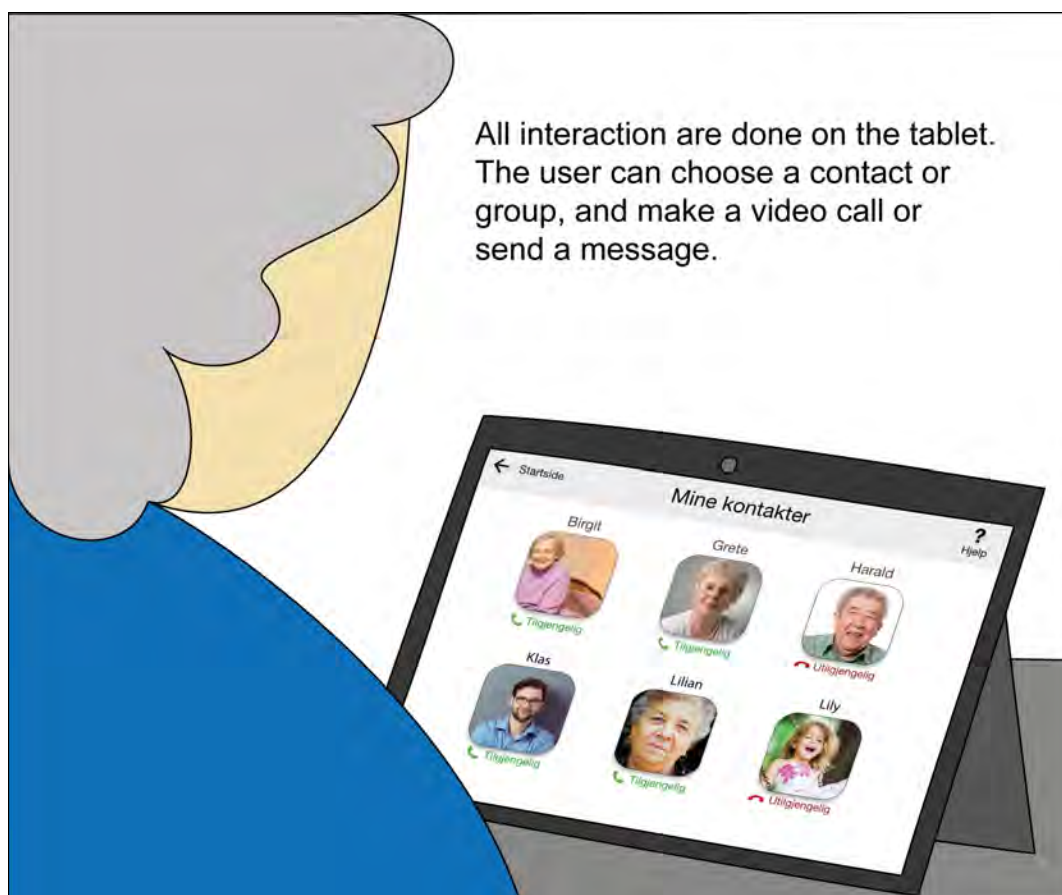
Figure 20; Concept picture 1
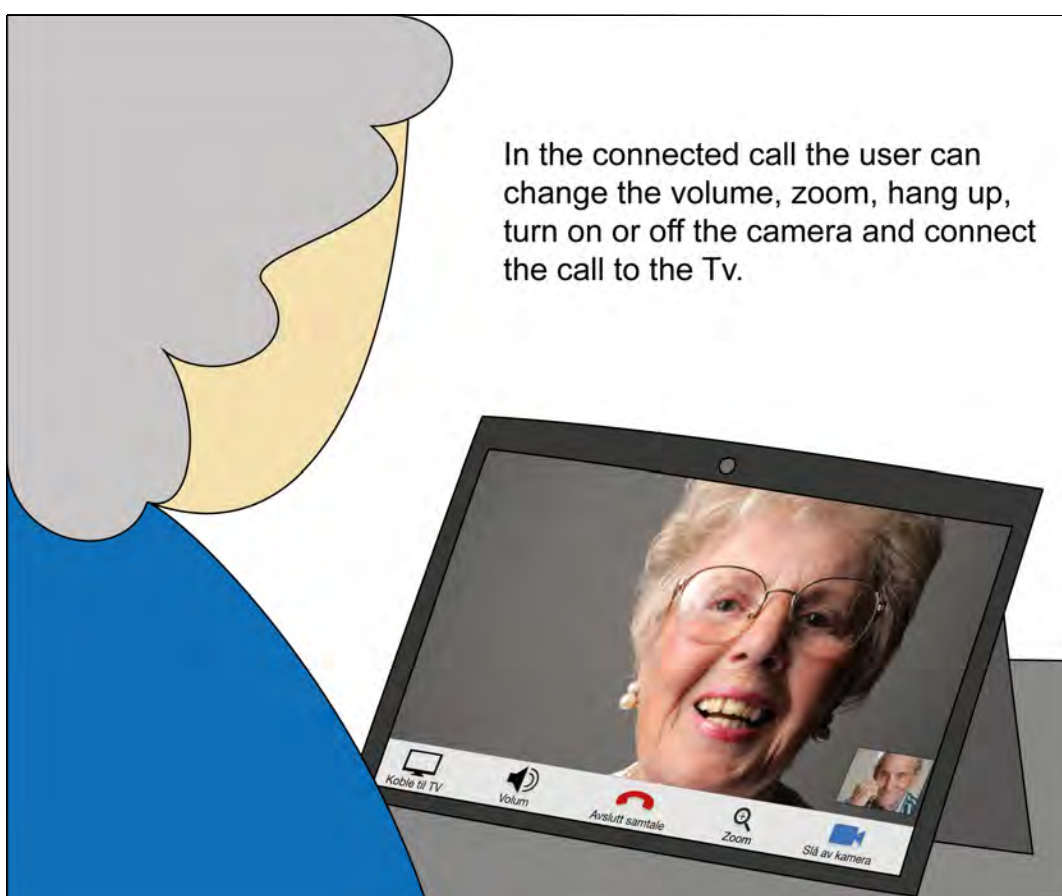
Figure 21; Concept picture 2
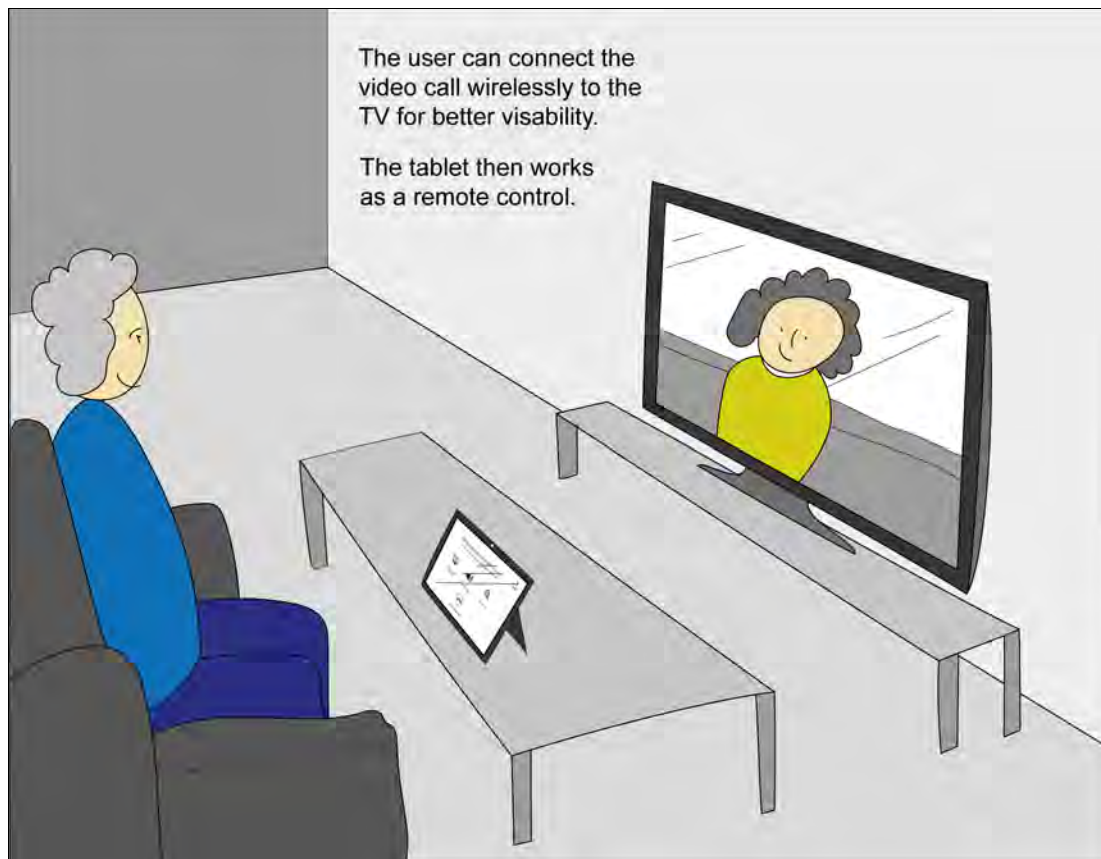
Figure 22; Concept picture 3
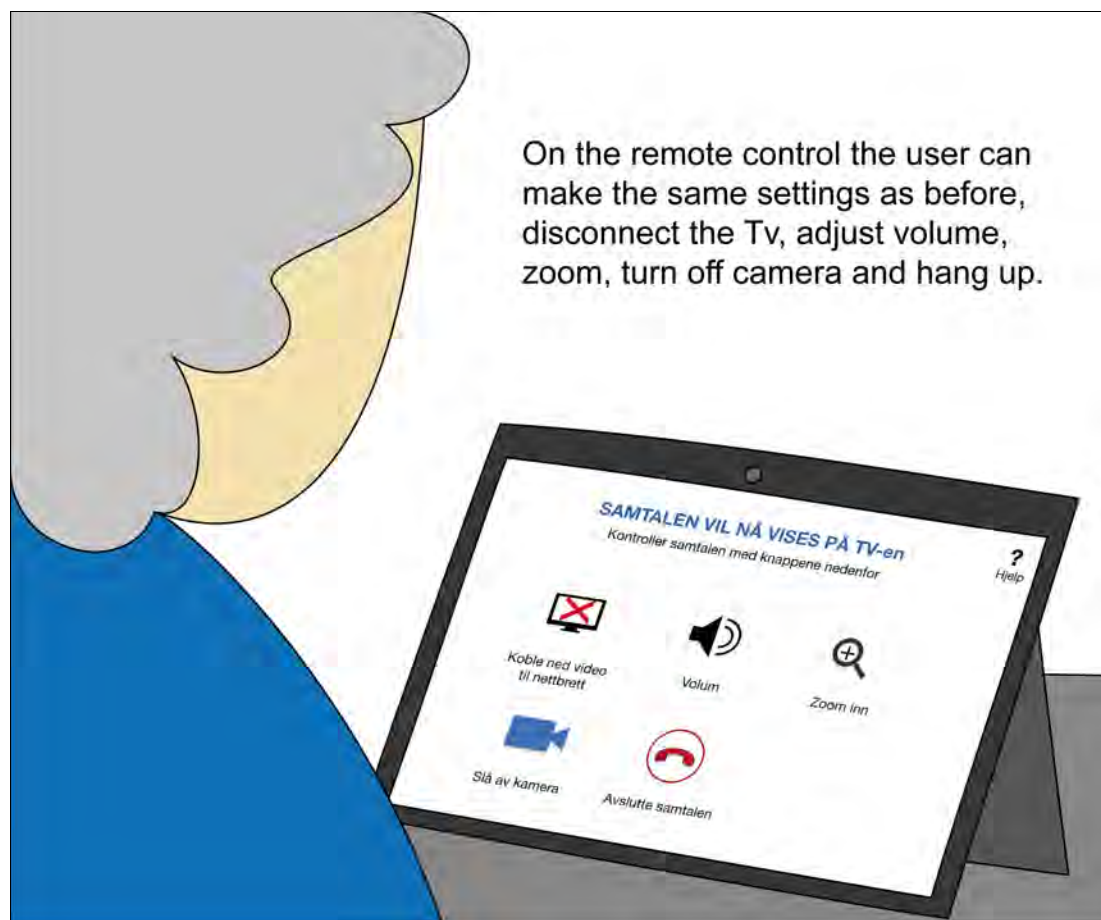
Figure 23; Concept picture 4

7.3. Recommendation for the GUI

When the decision was made to design for a tablet and touch interaction the shape of the touch interface could be considered. The interviews in the first field study did not only examine technology use but investigated users' opinions regarding video communication as well as their ideas about the design. User tests and observations gave more understanding of the user group which also influenced the design, and the literature study gained insights on what to think about when designing touch interfaces for elderly people.

The insights about interface design with elderly people, from both the literature, field studies and users test were formulated into design recommendations. Some of them confirm the already existing guidelines found in literature, while others can be used as a complement to those. General recommendations to use when designing touch interactions for elderly people are presented first. Further, more specific recommendations for functions to include in video applications for elderly people are presented.

7.3.1. *General recommendations for touch interfaces*

Design for cognitive impairments

Clarkson et al [16] suggest to not present too much information at the same time, and avoiding tasks requiring high memory load. My recommendation is to always have a discussion when adding more functions to a system for elderly people, as the complexity level might increase and more memory is needed by the elderly user.

In the first field study several users expressed the importance of presenting information in steps in systems for making it easy to use, which confirms the suggestion by Clarkson et al.

Design adaptable interfaces

Elderly people are a highly diverse user group [12] [13] [14] as mentioned earlier in the thesis. In a diverse user group there are many different abilities, needs and impairments represented. Elderly people also have *changing* needs to a larger extent than younger people [14]. Diversity and changing needs create a challenge when designing interfaces. A recommendation is to design adaptable interfaces that can be customised for the specific users to make sure many people can use it. Adaptations to include can e.g. be sizes, functions available or colours.

In the field studies, this diversity was confirmed as there were major differences between users. Both visibility, hearing and cognition seem to vary a lot between them.

Colour, contrast and lightning on screens should be increased

Several users in the first field study suggested to use colour coding for easier recognition. The literature also suggests to use increased contrast, lightning and colour contrast when designing for elderly users [16].

Large or adjustable text and icons sizes

Elderly people's visual ability is often decreased which requires larger text and buttons in systems, for good performance [16]. In the first user tests, a visually impaired woman participated. Even though the woman had strong glasses, she could hardly see any text and had to rely on the icons only. After the test, the text in the prototype was made larger. A function for adjusting the size of text and icons was also added for allowing personal customisation. This for meeting more users' needs and be able to offer a good experience for the visual impaired woman.

As presented in the theoretical background, Jin et al suggest to use button sizes at 16-19 mm for best performance among elderly people [22].

Avoid different commands for similar touch actions

During the observations where users interacted with tablets it was discovered that many had a hard time to understand that some similar touch actions resulted in different commands, e.g. between press and press+hold which often generate different commands in regular systems.

A recommendation is therefore to keep touch actions as simple as possible in systems for elderly users, and avoid to have different commands for similar actions, as press and press+hold.

Place the menu in the bottom of the screen

Lorenz and Oppermann [13] suggest to arrange buttons in the bottom of the screen to prevent the users from covering parts of the screen while interacting. This was taken into account in most of the design and seemed to work well for the testing users. The arrangement also seemed to produce few error selections in the user tests and is therefore recommended.

Do not use more than two level menus

When observing a user learning how to arrange photos on her PC it was clear that she did not understand hierarchy of folders, and menus were also a challenge. Lorenz and Oppermann [13] suggest to avoid menu structures and use one level navigation, as this provides better performance among elderly users. However, Stojmenova et al [20] suggest to use not more than two levels in menus for elderly people.

Summarised, my recommendation is to use one level navigation when possible, but when a menu is needed it should be designed simple with the elderly user in mind and with not more than two levels.

Be consistent with other widely used systems

To make it easier for elderly to create understanding between platforms and systems, a good option is to follow widely used design patterns e.g. using the same symbols, notifications and colours as in other systems. This will introduce the elderly users to a wider system and work as help for users that have experience of other systems from before. This was pointed out by an experienced tablet user with pedagogical background during a user test. Other users also recognised the used notifications, as well as the messages view, from other systems on their phones or tablets.

Use metaphors proper for the age generation

Bratteteig and Verne [18] suggest to base the design for elderly users on things they are familiar with, to decrease the difficulty level. During the user tests this also showed to be important. One user did not understand the first icon for messages, even though the icon was a widely used speech bobble with lines inside. For this user it was more intuitive to use an envelope icon as she was more familiar with sending letters than messages online. Metaphors differ among generations and a recommendation is therefore to give it an extra thought when designing symbols and icons for an elderly user group.

7.3.2.   *Recommended functions to include in video communication systems*

Adjustable volume

One user that had tried video communication earlier pointed out the importance of being able to adjust the volume in the call. For an elderly user it can be hard to understand and hear a person that speaks quietly or unclear, especially when having a hearing loss she mentioned. The user expanded the idea and suggested to be able to adjust the volume individually on persons in a group call, if that was possible technically.

Elderly people's hearing abilities are often decreased [13], especially for high frequency sounds [16]. This also confirms that adjustable volume is a good suggestion for the system.

Zoom in on users

A user in the first field study presented an idea for zooming in and out at the person in the call to be able to see the face closer, or more of the surroundings.

Elderly people's visual ability are often decreased [13] [16], but we should not forget that they are a

highly diverse group with great variations. Functions that can be customised for individuals with different visual ability are needed. A zoom function is therefore recommended in the call view, to create a view that can be used by many people.

Voice control as an alternative to writing

When I observed the elderly users interacting with their tablets, it was noticed that touch keyboards were a challenge. A touch-keyboard contains many small buttons placed close to each other, which creates many error selections among elderly users. A woman in a user test tested out the message-function in the prototype. She suggested to add *voice control* or *voice to text* for writing messages, as this could simplify the use significantly for elderly users. She explained that she often used it for google search and was very positive to the function.

Clarkson et al [16] also suggest to have both audio and visual feedback in systems for elderly users as those create availability for more users. Auditive feedback is not implemented in the current prototype but is a recommendation for future work, as well as voice control for writing messages that normally requires use of touch-keyboards.

Add contacts and create new groups

During the first round user tests a man requested a function for adding new contacts and groups. At that time the prototype was not fully developed and the function was not implemented. It was discussed whether having this function visible or not, as elderly people with no experience probably would get help adding contacts, and the function would then only add more complexity. The function was implemented and tested in the second user tests and showed good results. The users understood and managed to use the function well and the complexity level seemed to be moderate. I recommend to offer this type of function as long as it is designed simple and in steps, for the users with no or little experience.

Help function

In the first field study a user expressed the importance of providing help functions in computer systems and services for elderly people. The user talked more generally at first, and then exemplified it with her net bank where she appreciated to have a help desk with physical persons available on the phone. She said this made her more confident and safe. Another user in a test suggested to have a chat function that could be used for contacting help when needed. The same user also suggested to have a simple help guide with a list or similar.

Ideas on a help function were sketched on in the later stages of the process, and were therefore not tested out with users. To add a help function is however recommended for creating more confidence among the elderly users, but the appearance of the function is left for future work.

Function for turning off the camera

In the second round user tests a woman expressed that she felt very uncomfortable when she got a video call unprepared, because she felt she did not look okay for being filmed. The discussion with the woman resulted in a function for turning on and off the camera. The woman liked calling with video other times, when she was prepared for it, but requested an function for turning off the camera when she wanted.

Again, a discussion was held before adding the function, as more functions adds more complexity to the system. It was decided to compromise, by implementing the on/off camera function and to take away the help function in the call view. This to keep the functions few and only keep the most important ones. The help function seemed to be unnecessary in that view as most users had managed it well during the tests, but more user tests are needed for getting more reliable answers regarding the complexity. A way to turn of the camera is however a recommendation for the system.

8.   OldPhone

In this chapter, a design suggestion for a video communication system is presented, derived from the design recommendations presented above. The system is called OldPhone and the final digital wireframes of the GUI are presented as well as descriptions of the included functions. For more pictures of the concept and included functions see Appendix 5.

8.1. Start page

The start page is reached from the tablet desktop and offers three main activities, *My contacts*, *My group calls* and *Settings*. The user can cancel the application by pressing the exit button.

Figure 24; *Start page*

8.2. My contacts

The user meets a view of all contacts ordered alphabetically. The contact's availability is indicated under each picture by the use of an icon, text and colour. This to ensure that colour blind people also can notice the difference of states.

In the end of the contact list the user can *Add a new contact* by pressing the empty picture. In the upper right corner a help icon is available for users that need guidance. By pressing the arrow in the upper left corner the user is sent back to the S*tart page*. The navigation is placed in a position familiar to many other applications, which hopefully will create recognition.
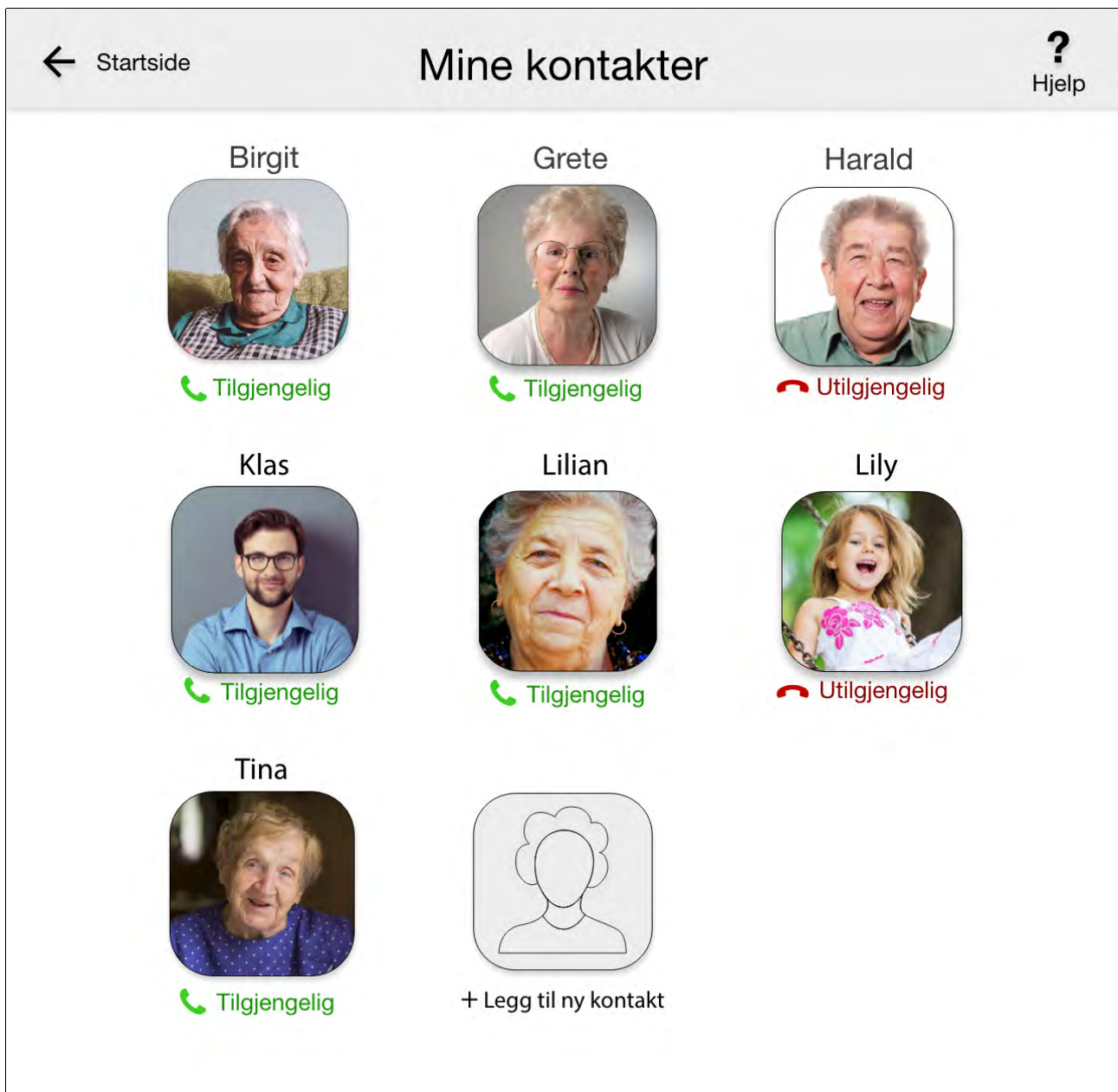
Figure 25; My contacts view

8.3. Notifications

If someone has tried to reach the user or sent a message a red dot will be visible on the contact picture and a message is presented in the top. By pressing the message in the top the user is sent to the relevant contact's detail view.
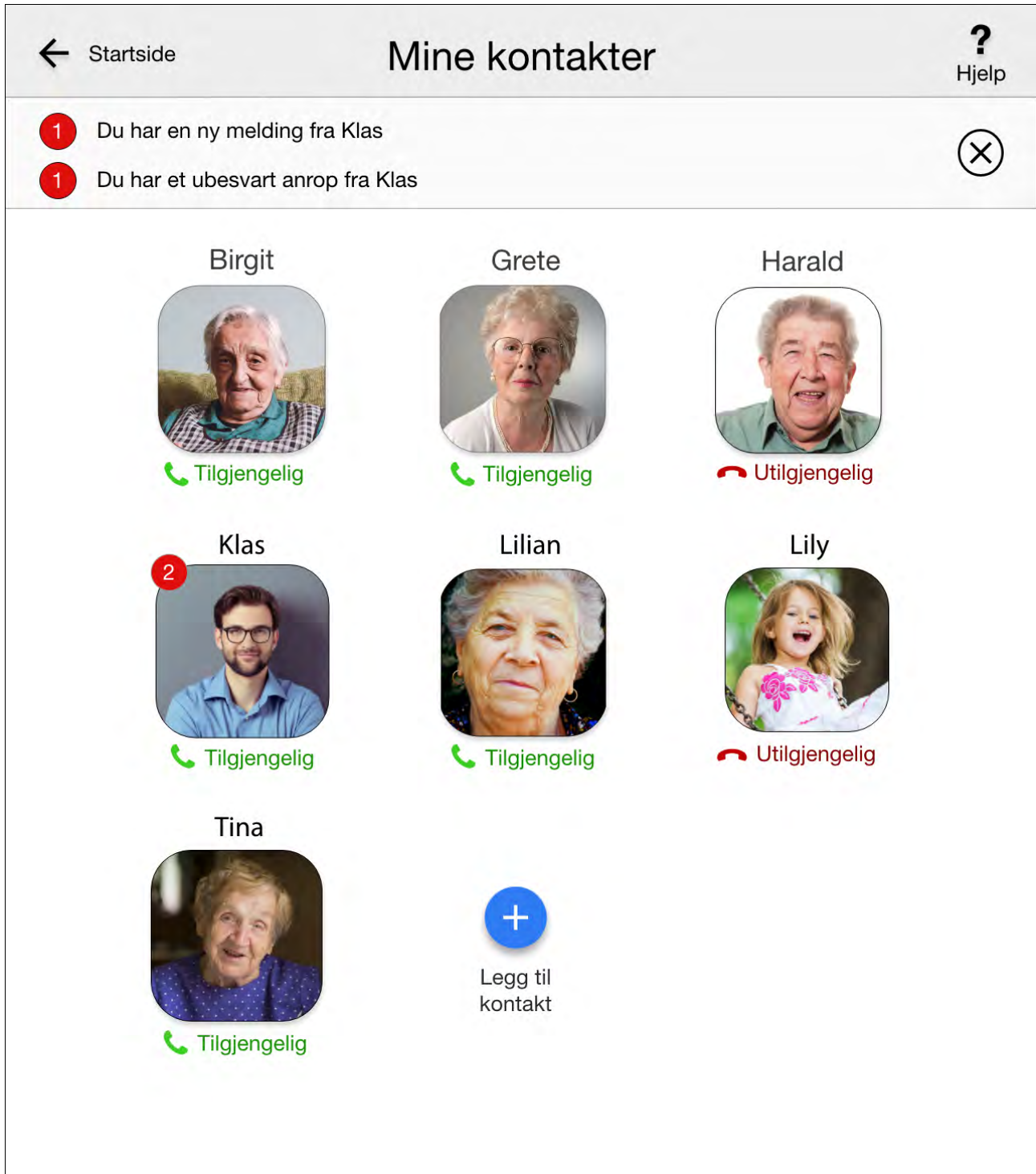
Figure 26; *My contacts with notifications*

8.4. Detailed contact view

By pressing a picture of a person in *My contacts,* a detailed view of the contact is shown. In the detailed view the user can choose to *Call* the contact or select *Messages*. The back navigation is consistently placed in the upper left corner and sends the user back to *My contacts*. If the contact has tried to call or sent a message the red notification dot is visible on the icon.
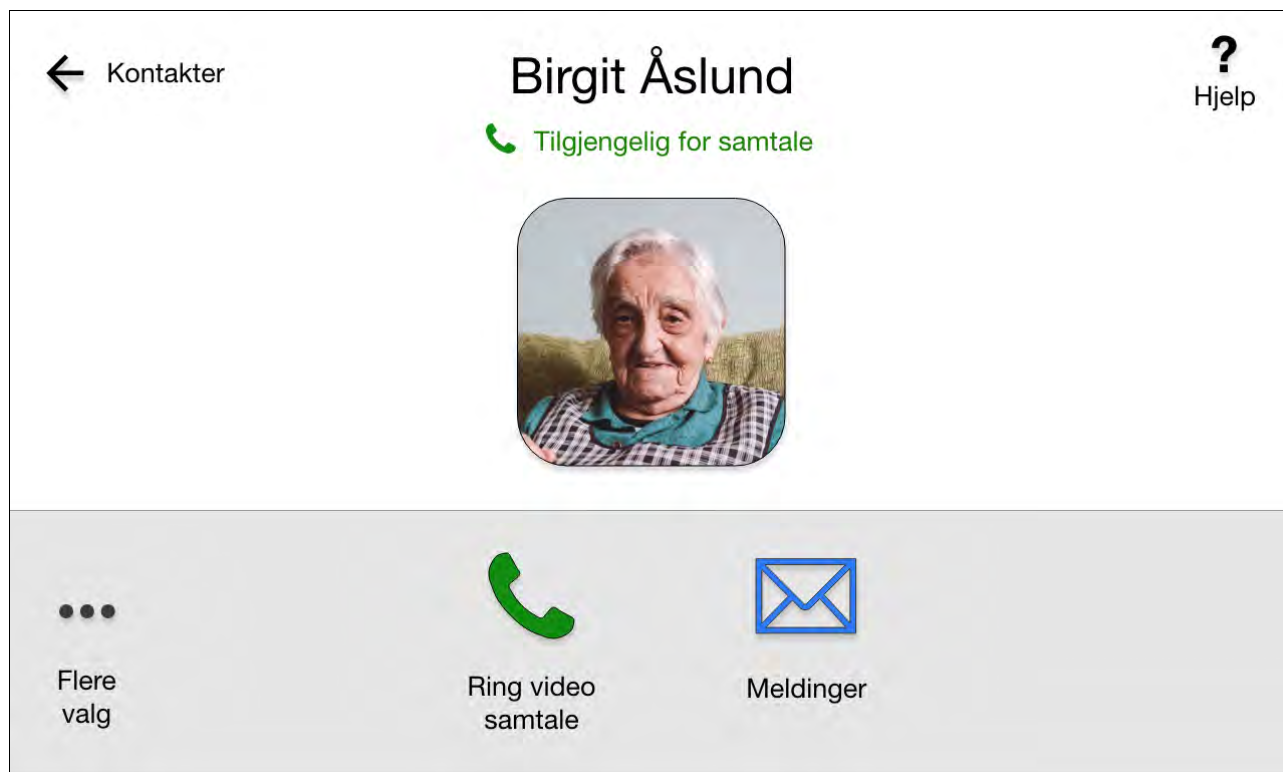
Figure 27; Detailed view of contact
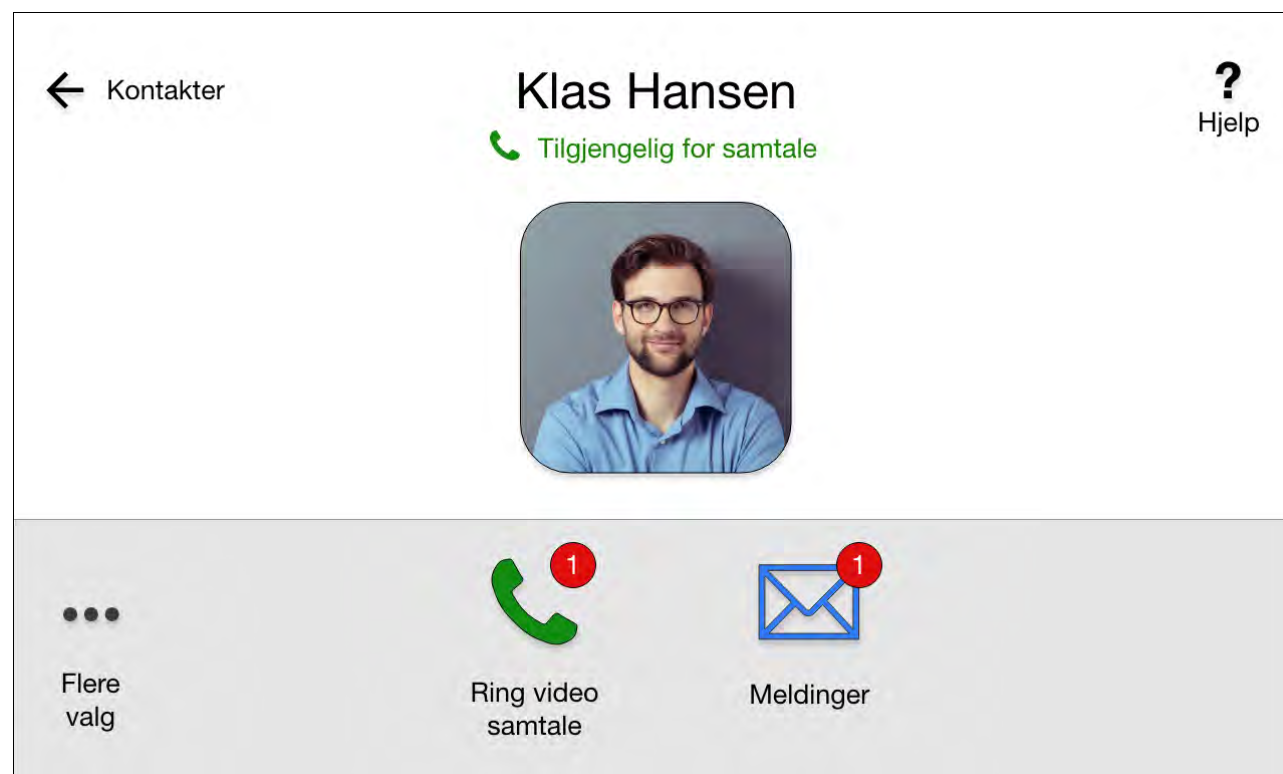
Figure 28; Detailed view with notifications

8.5. Call view

In the call view a menu bar is placed in the bottom of the screen to prevent the user from covering the screen while interacting as well as preventing error selections caused by this. The menu bar has five different choices, *Connect to TV, Volume, Hang up, Zoom* and *Turn of camera.* In the lower right corner the user can see the video record of oneself, which can be turned off by pressing the camera.
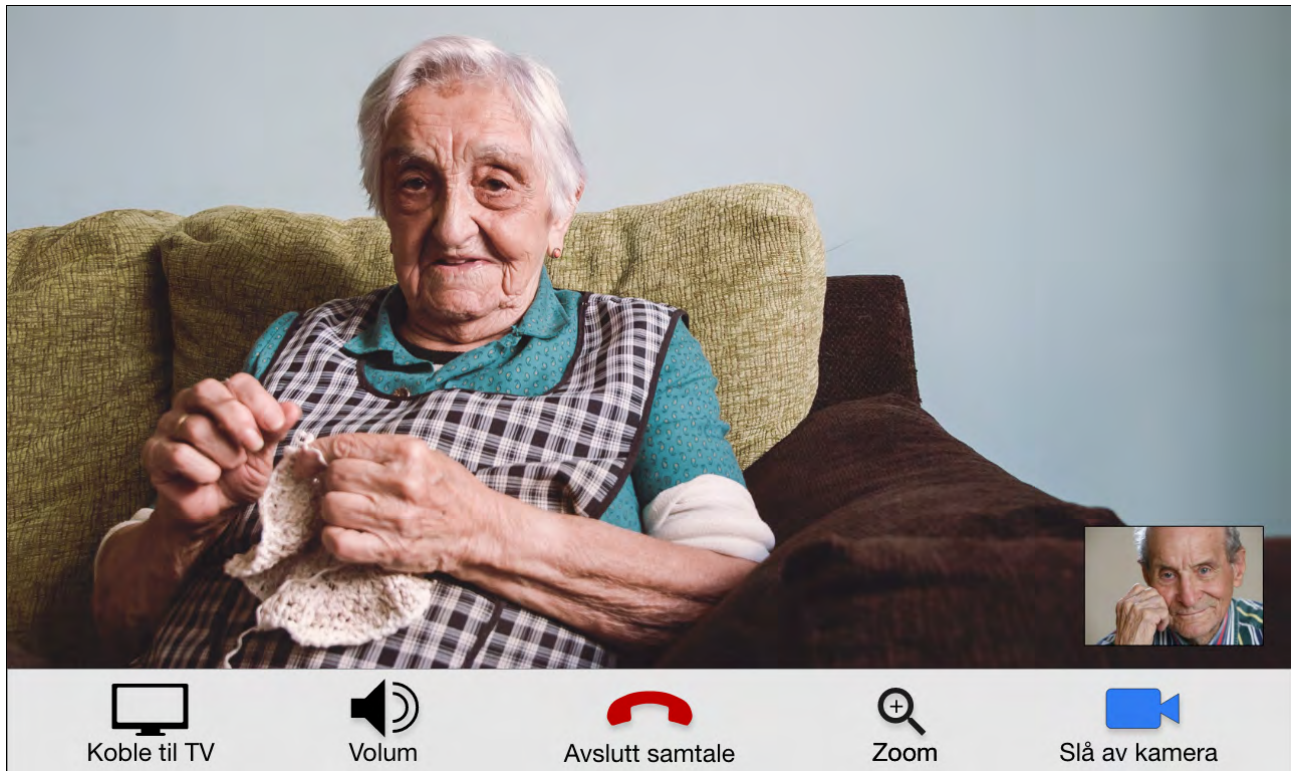
Figure 29; *Call view*
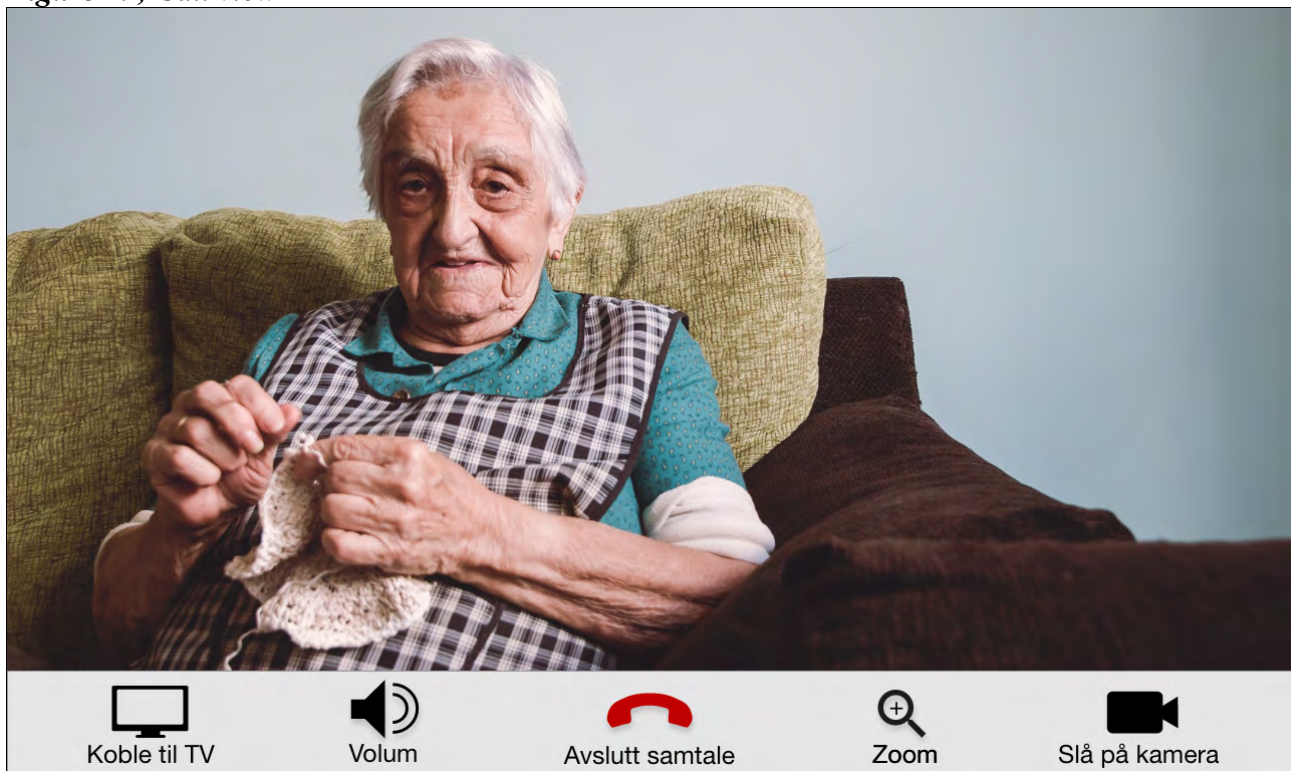
Figure 30; *Call view – camera turned of*

8.6. Call view adjustments

The user can adjust the volume of the person in the call by using the slider or pressing the plus or minus icon. The user can also zoom in if desired by pressing the magnifier.
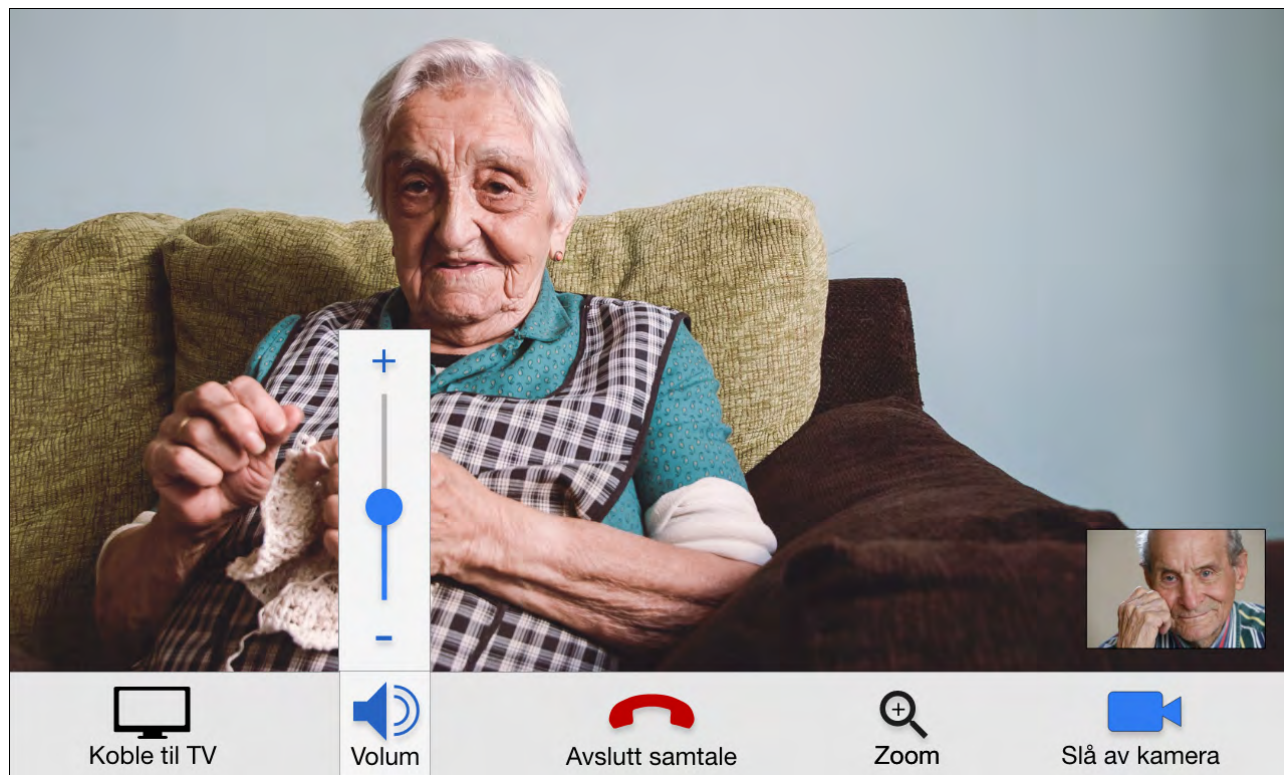
Figure 31; *Call view – volume adjustment*

8.7. Connect to TV view

When pressing *Connect to TV* in the call view, the user gets a message saying *"Turn on your TV by using your remote control, then press OK"*. By pressing OK the tablet will share the call view to the TV through a wireless connection and a remote control will appear on the tablet screen with the same options as in the call view.

Figure 32; *Connect to TV*

Figure 33; *Remote control when connected to TV*

8.8.   My group calls

By pressing on *My group calls* at the *Start page* the user can see one's created groups or create a new by pressing the empty box. In this view two groups are presented, the *Knitting club* and *Training group.* The navigation arrow on top takes the user back to the *Start page.*
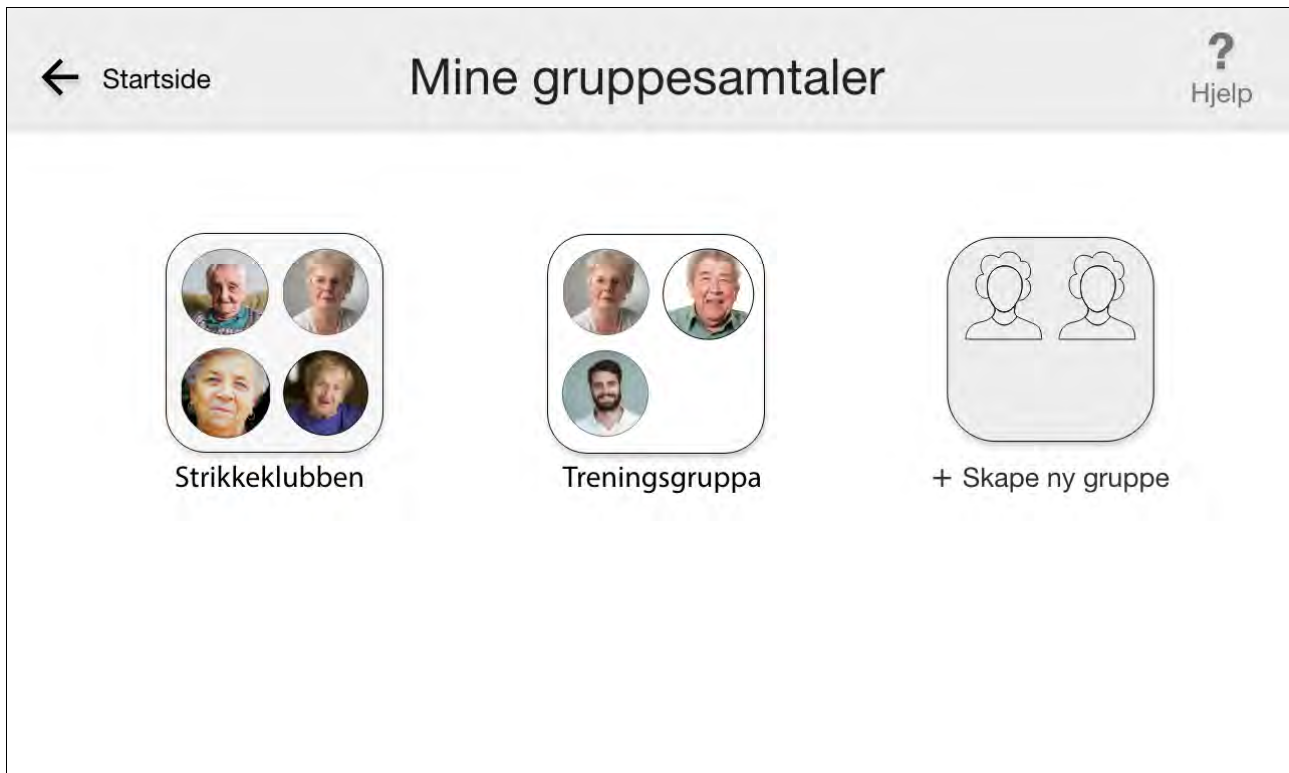
Figure 34; My group calls

The detail view of a group is presented the same way as the detailed contact view. The user can see the included contacts and choose *Call* or *Messages.* When calling the group the user meets a screen divided by the number of users, in this case four rectangles. The same menu bar as before is presented in the bottom offering the same functions.
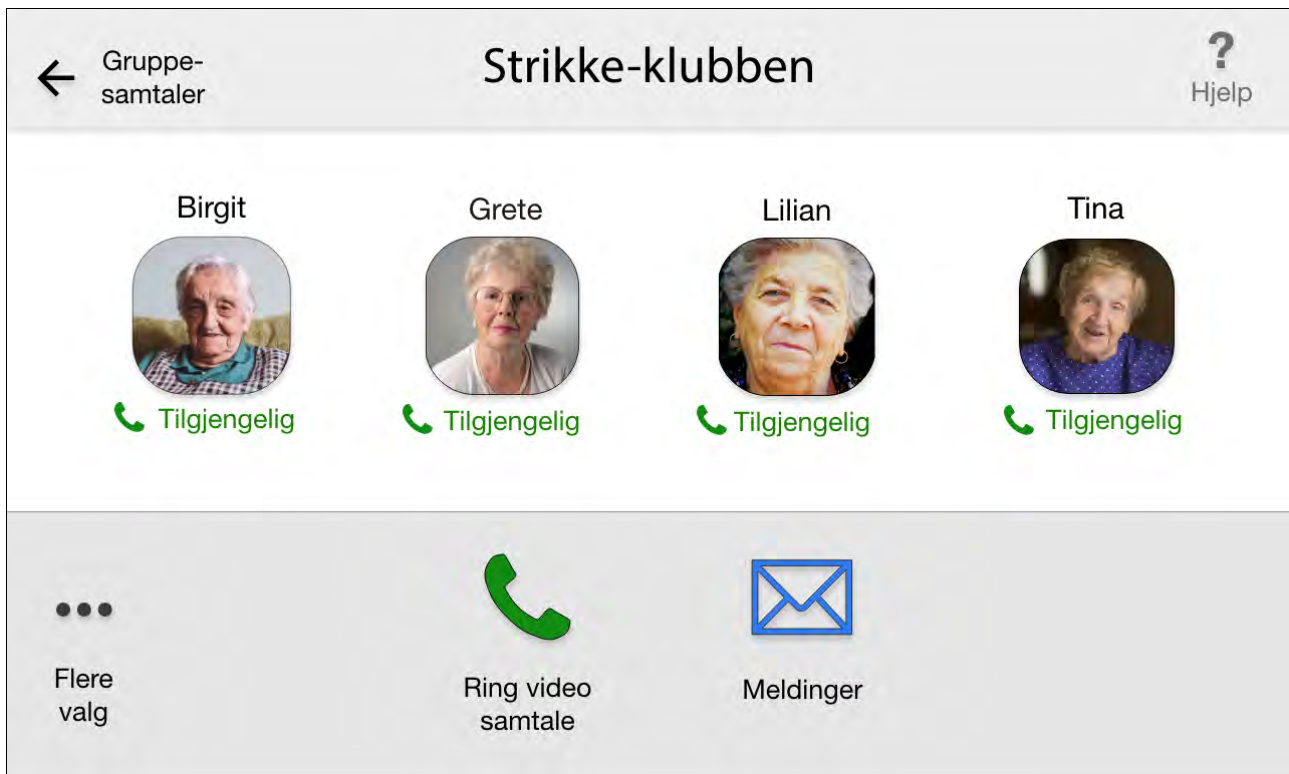
Figure 35; *Detailed view group call*
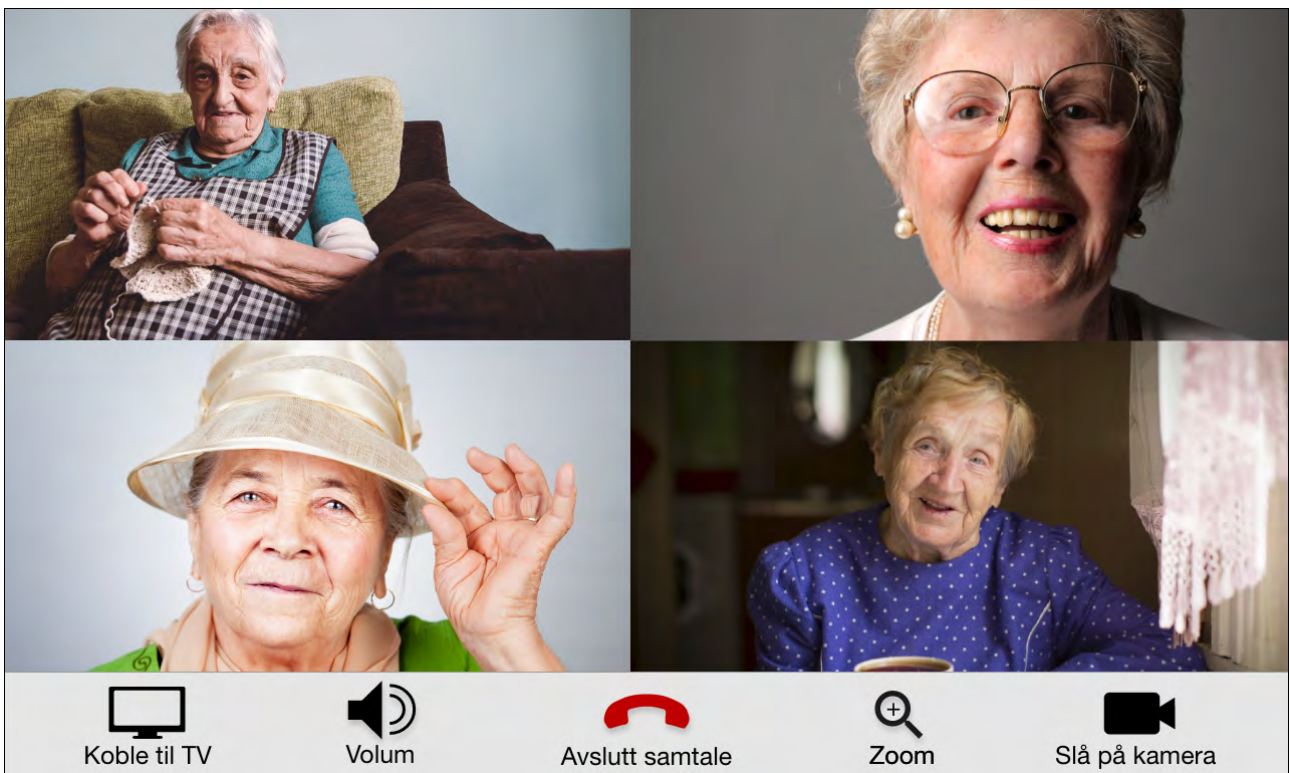
Figure 36; *Connected group call*

8.9. Group call adjustments

The user can adjust the volume for each person in the call by using the sliders or plus/minus buttons. By pressing the zoom button an icon will appear in every contact's square which can be used for zooming in individually on the contact. In **figure 38** the woman in the upper left corner is being zoomed.
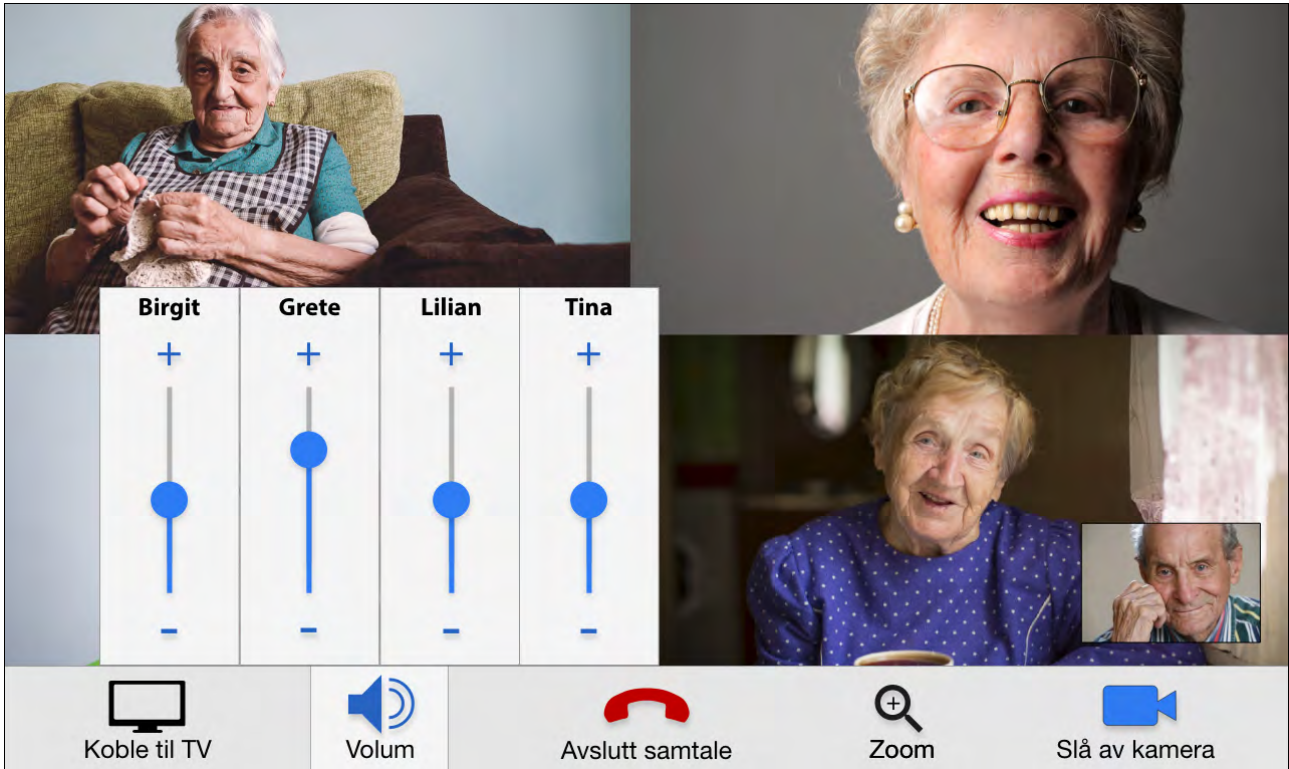
Figure 37; *Volume adjustment group call*
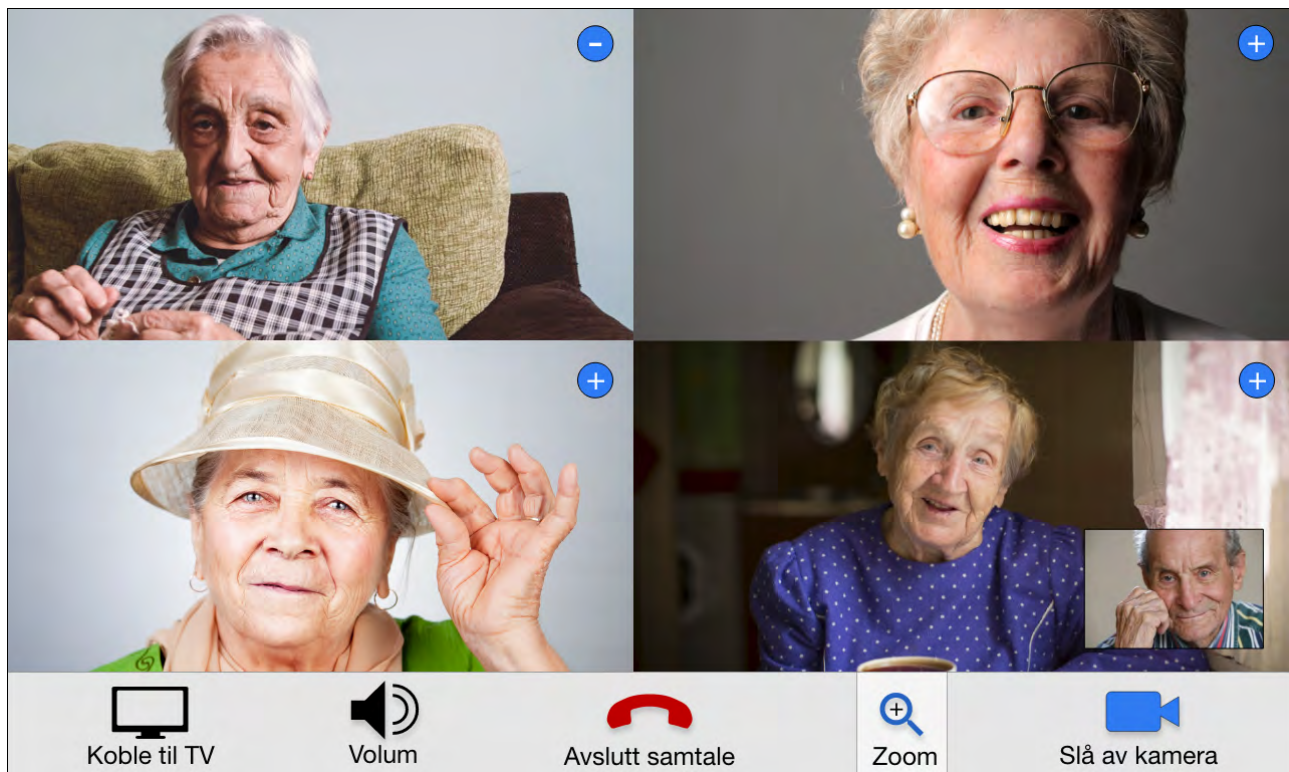
Figure 38; *Zooming group call*

8.10.   Change and delete a contact

In the detail view for contacts the users who wants to edit a contact can choose the icon *More choices* in the lower left corner. By pressing it a menu appears allowing the user to delete the contact or pressing the edit button for changing name etc. The background is blurred out when the menu appears to limit the presented information and focus on the menu.
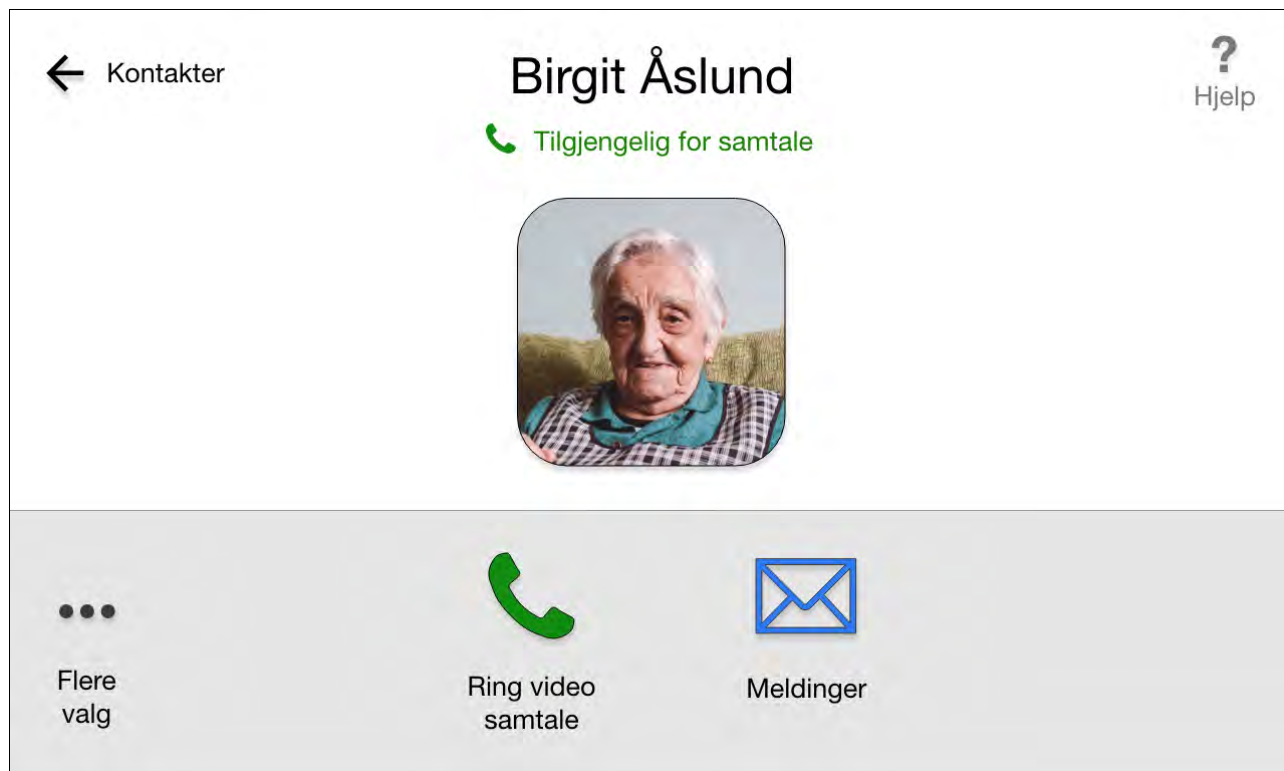
Figure 39; *Change and delete a contact*
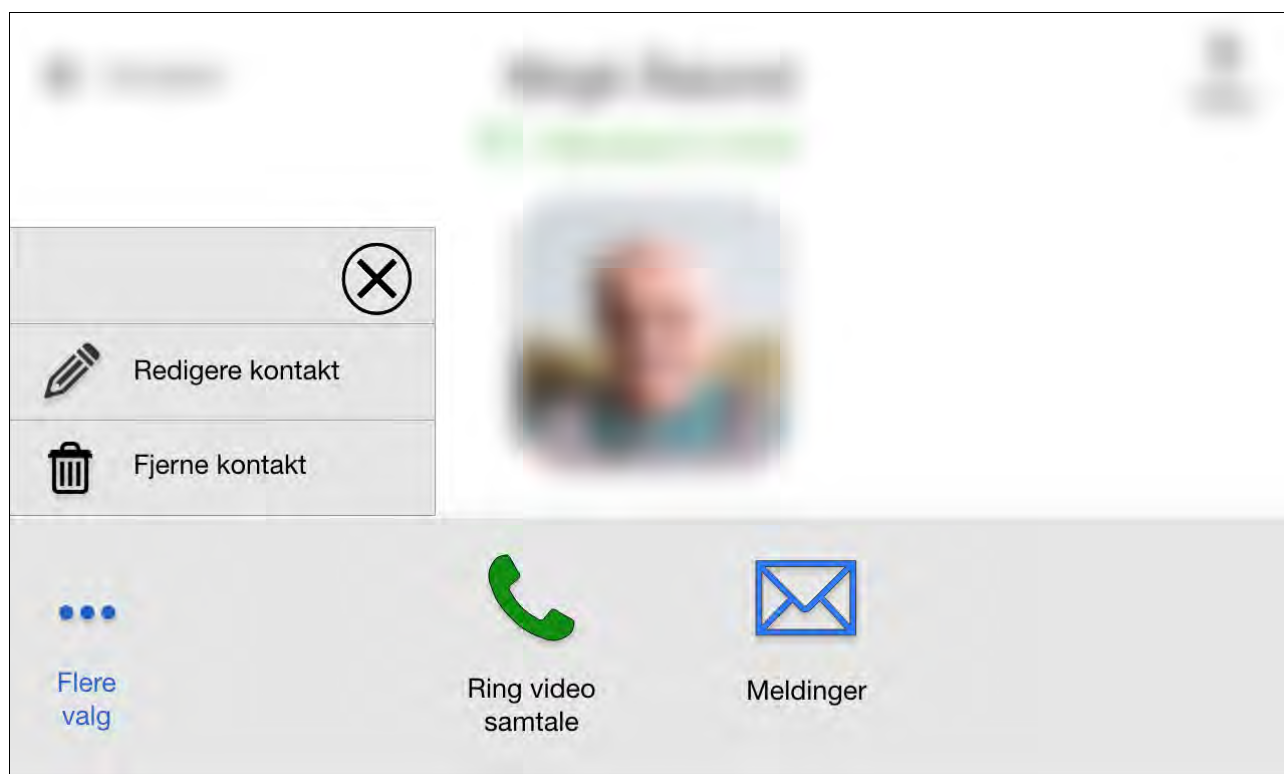
Figure 40; *Menu more choices*

8.11. Settings for adjustability

At the *Start page* the user has a choice called *Settings*. In this menu the user can reach a page for adjusting the size of text and icons to customise it for one's own abilities.
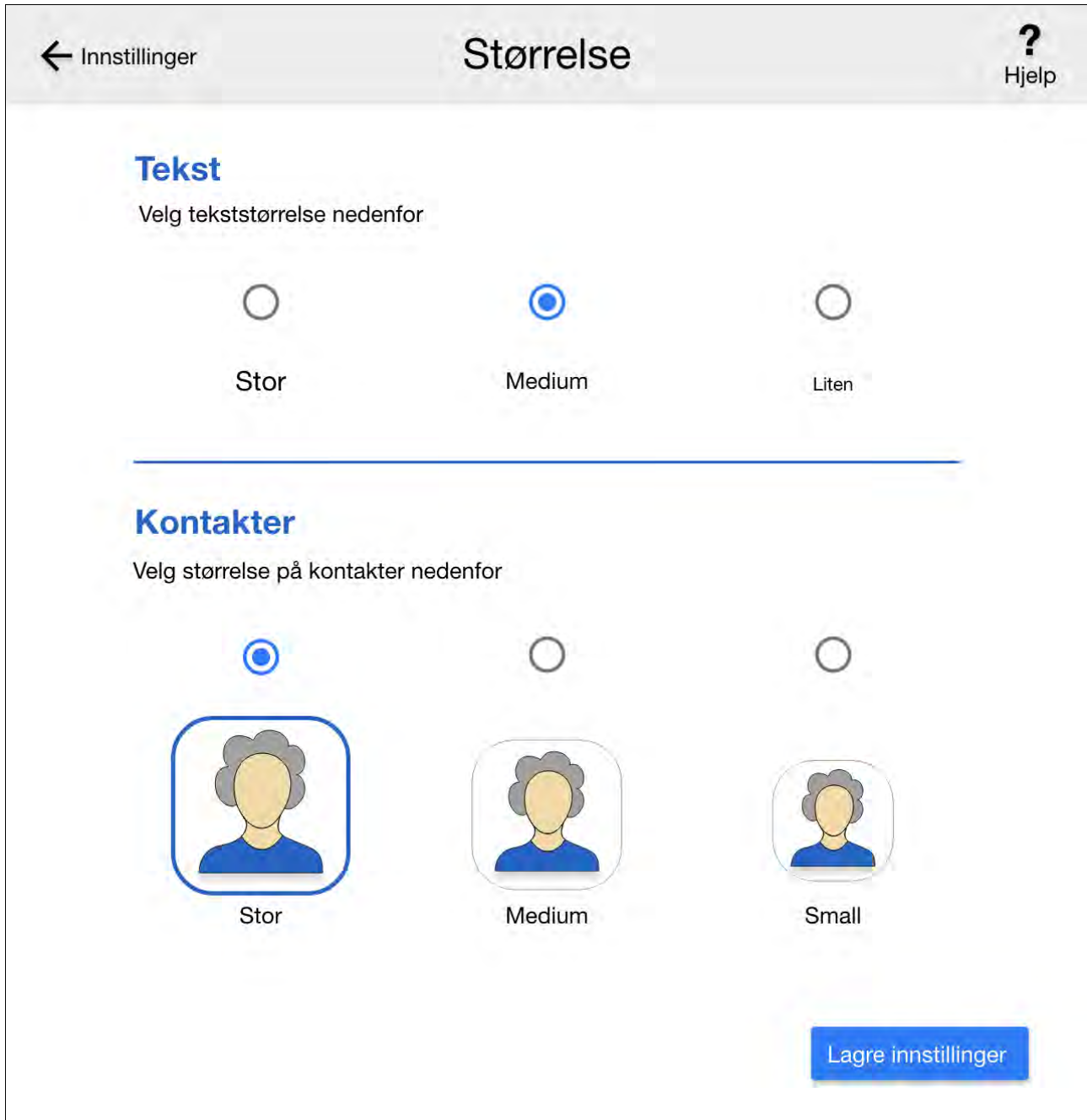
Figure 41; *Settings for adjustability*

8.12. Message view

In the detail contact view the user can choose to send a message to the contact. This is done by pressing the envelope icon. Inside the message view the user can see the newest arrived massage appearing or press *Earlier messages* on top for seeing older ones. The user can press the text box in the bottom to write an answer or click the microphone icon for *Voice control* on the left side.

Figure 42; *Message view*

Figure 43; *Message view – write message*

When pressing the on *Voice control* the user can talk in the message instead of writing. By pressing the red button saying *Start recording* the record starts. By pressing the blue *Send* button the record is stopped and sent to the contact.

Figure 44; *Voice control in message view - start recording*

Figure 45; *Voice control in message view - recording*

9. Discussion

Under this chapter, challenges and insights that appeared in the project are presented, and how those could have been accounted for. Future work for the system is also presented and some thoughts on the system seen from a broader perspective of inclusive design, and the societal challenge with increased amount of elderly people that we will face in the future.

9.1. Process

The goal with the thesis was use participatory design for involving elderly users in the design process and together with them shape the design for the OldPhone system. The plan was to conduct one or more workshops to let the users influence the design and involve them as co-workers instead of informants. However, this turned out to be harder than I planned and it lead to a couple of challenges. Those challenges are presented and discussed below.

9.1.1. *The importance of creating relationships with users*

The users that were recruited in the first field study came from a wide geographic area in both Sweden and Norway. The plan was to involve the same users again for workshops and it was therefore investigated how this could be performed. It turned out to be a bit tricky to find a place to conduct the workshops in connection to the first two locations. It needed to be somewhere not to far from the users' homes. The last interview location was connected to a Senior centre in the central parts of Oslo. This was a meeting point for many elderly people and a good place for conducting workshops as there were conference rooms avaliable. The centre was also the base for the organization SeniorNett which gave a lot of possibilities for observations and further studies on elderly people's technology use. A decision was made to try to recruit users for the workshops in connection to this centre. However, it had been much more beneficial to continue with the same users as took part in the interviews, as a relationships already had been established with them.

The recruitment of users was done by sending emails to leaders, talking with elderly people in the café and give out hand outs with a description of the project. At that time, no one recognised me at the centre which made it hard to reach out to people. After one and a half week of recruiting, I had received one answer from a man that was interested in participating. One user seemed weak for a workshop which made me consider to continue with a less participative process and go further with user test directly. The man was invited to take part.

At the same time when I started to attend computer classes at the Senior centre, people began to recognise my face. Some people came up and small talked with me curious about what I was doing

there. In the classes I helped the elderly students with tablet and computer related tasks, and soon relationships were established with a bunch of elderly people. After some weeks it was suddenly much easier to recruit users as many recognised me. At this time it was too late for conducting workshops if I would follow the time schedule, and users were therefore recruited to take part in user test instead.

An important insight to take along to future design projects with elderly people, is to plan for establishing relationships with users. I believe that the creation of relationships with elderly users is necessary for conducting a successful PD process with them. By creating relationships to users, understanding and empathy are gained from both parts which I believe will benefit the process significantly. If the project had continued for some months longer it had, much likely, been easier to recruit users for workshops because of the established relationships.

A good example of this is when a man made it clear he did not want to participate in the study or workshop the first time I talked to him. After some weeks at the elderly centre a relationship was established with the man as I helped him with some smartphone related tasks during the technology classes. The man suddenly got interested in the project and accepted to participate in a user test saying he wanted to help me back, as I had helped him.

I also belive that establishing relationships with users could lead to more engaged users as they feel comfortable to be involved. As mentioned earlier in the theorethical framework *"the closer designers could get to their users' lives and experiences, the more likely that their products and services could meet the users' expectations and needs"* [31]. When establishing a relationship with a user you will come closer to the person which will influence the design in a positive way.

9.1.2. *Users ability to imagine ideas and articulate them*

Another challenge that was observed in the process was how well the users could articulate their ideas and come up with improvements for the system, especially the users with least technology experience. Bratteteig [30] mentioned mutual learning as an important part in a PD process. The users need to learn about the technology and concept to be able to imagine solutions and improvements. Low expertise of the involved technology makes it harder to let the elderly users have an equal role in the process, as co-workers. I could feel this challenge in the project, as the users many times had too little knowledge and experience of the included technology to be able to have the same role as me. Bratteteig [35] also mentions that the depth of participation depends on the expertise of the participants, which suits well with the insight gained from the project.

Anyhow, I think the users got a change to influence the design in a successful way during the project, since many of the functions in the system came directly from users' desires. I though think

it could had been influenced more e.g. by conducting workshops and use the same users in more activities. This had hopefully increased the users' learning process and ability for imagining ideas and improvements.

9.1.3. *How participatory was the process?*

As discussed above, some major challenges appeared which limited the PD process and forced me to continue with a less participatory one.

However, you can still discuss wheather the process was participatory or not and to what extent. Even though workshops not were conducted and the users didn't had the same role as me, participatory elements were used. As presented earlier, in a PD process the users should take part as co-workers to be able to influence the decisions made regarding the design. The users did not take part in the process as co-workers as this was to hard with their little experience of technology, but they still influenced the design decisions by taking part in user tests and suggested improvements for the system through out the whole process. The user tests were performed in a less structured manner, being more like a dialog between me as a test leader and the participating user. The tests started by some introductive tasks but were later steered by the user's interests and the problems that occurred. This was followed by a discussion around how to solve those problems, together with the participant. In a usual usability test, the test leader had most likely taken a role as a natural observer, for avoiding interaction with the user and not influence the results. My role in the user tests was more like a participatory observer who asked follow up questions. I would therefore claim that the tests were done in a more partcicpatory way, by including the user more as a participant than a tester.

In summary, it might be hard to say wheather this process was fully participative or not, but it had participative elements included even though the process to some extent took a more human-centred direction.

9.2. How inclusive is the design?

It might look like the users without experience of technology are left out of the designed video communication system, as it is based on a modern technology with touch interaction. My intention was to design a system that would work for as many people as possible in the diverse user group involved. A tablet might of course be difficult at first for a user with no experience at all, but it was discovered in interviews that touch can be an intuitive product for elderly people, if the system is adapted for them and if they are presented to it by one step at the time. Touch is widely used in products for elderly people [17] [22], and that adapting it for them can improve their performance

significantly, as Jin at al present. I believe that elderly people can learn to use tablets, as long as the interface contains a simple design adapted for their abilities. The OldPhone system is designed with elderly users in mind by following the recommendations.

The system is designed with voice control, colour blind design, as well as adaptable sizes for text and icons. This makes the design inclusive for many people. However, many things can still be improved in the system, as even more adaptable functions, smarter colour use as well as voice control and auditory feedback for all functions.

9.3. Attitudes and skepticism by users

Some elderly users might be skeptical to video communication and the tablet concept, as it is based on new, modern technology. They might not even give the concept a chance because they don't see benefits with using it, or have fear for not managing it. I believe the users need to be introduced to new systems and products slowly, and be instructed by a person through one step at the time, which also were suggested by some users in interviews. By doing this the users will realise that they can master the system and come over the fear. They might then also see benefits with using it.

A great example was when an elderly woman in an interview said that she did not want to use video communication, but after getting more familiar with the idea changed her mind. She argued with herself saying *"I have a relative in America I use to call by phone once in a while, I have not seen her in many years as we are too old for traveling so far. It had of course been lovely to see her... but I don't know, video communication feels so strange and new"*. The woman did not have any motivation for using video communication until she found a personal interest that could benefit from it. It was also clear that she was unsure about how it worked and did not want to use it because it felt new and strange.

When elderly people say they *do not need* a new system or technology I think it can be based on their little knowledge of the area, and because of fear for not manage using it. As mentioned in the theoretical framework, it is important to listen to the elderly users and not force them to use something they do not want to use [17]. However, I believe that technical solutions many times can benefit elderly people, and that their negative attitude often derives in their limited knowledge. I also think many products can be accepted and liked by elderly people if they are taught and motivated at a slow pace by once step at the time.

9.4. Future work

This thesis has focused on video communication in a separate system. During the project many ideas appeared from users on what functions to include. Some ideas could have expanded the video system to a more general communicative system. A decision was made to keep the system focused on video communication for the time and scope of the thesis, but for future work these ideas are relevant to discuss.

9.4.1. *Social media for elderly people*

In one user test a man mentioned an idea of being able to share a document in the group call so the participants in the call together could discuss it. In similar systems presented in the background, sending or sharing photos as well as reminders were often included functions.

Some elderly people in the studies used social media, or at least tried using it, as Facebook seemed hard to understand for many. The main idea that came up was about creating a social media for elderly users. More social functions could then be implemented in the system as sharing photos, sending documents, emails, a chat function as well as galleries for photos and saving contact information. This could be a simplified version of Facebook, designed for elderly people. I believe this could have been a successful system for elderly users. If future work was going to be conducted on the video system a good idea could therefore have been to investigate the idea further.

Some of the similar products, e.g. Oscar Senior that was presented in the background, had a similar kind of setup as this idea. However, it should be discussed weather this system is easy to use or not for elderly users as it includes many functions, which might provide more complexity, as well as no function for connecting the tablet to the TV or adjusting sizes of text and icons.

9.4.2. *More user tests*

The video system as it is, also has great potential for development. More user tests are necessary for evaluating the functions that were not tested during the project. More users are also suggested to be involved for creating more reliable results and a system than meets more people's needs and abilities.

As mentioned earlier, the system has great potential for more inclusive design development, with more adjustable functions, colour use and voice control for all functions.

9.5. Contribution to the societal challenge with increased elderly population

It is interesting to reflect around the final concept and how it could contribute to the societal challenges presented in the start of the thesis. Using video communication to a larger extent, will stimulate social interaction and hopefully increase life quality for many elderly people. Starting small and showing the possibilities for a small group of people is a good start, because if many small products and systems can help a few, we will soon be able to help many, which soon enough can have a wider impact on a societal level.

Developing a system like this is also a matter of spreading the word and motivating others to engage in the field of welfare technology, both designers, stakeholders and elderly users. This will hopefully lead to more investigations and developed systems that can make an impact.

10. Conclusion

This project aimed at investigating how a video communication system best possible could be designed for meeting elderly users' needs and abilities. A research questions was formulated as such;

What device and interaction is best suited for a video communication system connected to the TV, and how should the GUI on the device be designed, to ensure that elderly people will understand and be able to use it independently at home?

The thesis resulted in many thoughtful insights about interaction and GUI design for elderly people, as well as insights about participatory design with those. The insights were translated into recommendations that other designers can use as a complement to existing guidelines, in future design work.

The first insight is about interaction for elderly people. Touch on tablets seemed to be a good choice for elderly users in the study. Many elderly people used tablets daily at home, and expressed positive thoughts about them. In literature touch interaction was also widely used as technology for elderly people. However, adapting the touch interface to the elderly users' abilities and changing needs was discovered to be important for their performance. Observations showed that touch interaction can be a challenge in interfaces not adapted to elderly people abilities, e.g. when small touch areas are used, different commands for similar touch actions as well as too much information at the same time. Some GUI recommendations that are presented in this report, are to avoid multi level menus, place menus in the bottom of the screen and have functions for adjusting size of text and icons. If following the suggested recommendations when designing touch interfaces for elderly users, common challenges can be avoided and more successful interfaces can be created.

Other gained insights from the project are the importance of establishing relationships with the elderly users to ensure a successful PD process, as well as involving the same users through the whole process to support the users' learning process.

In the introduction the problem regarding the increased elderly population in the future was presented, and that social isolation among those are a common problem. A video communication system alone, like the one presented in this thesis, is not enough to solve those societal problems, but welfare technology can at least be a part of the solution.

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12. Appendix

Appendix 1; Consent form

Deltakelse i intervjustudie knyttet till masteroppgave på forskningsprojeket BRIS

Beskrivelse av masteroppgave og prosjekt

Mitt navn er Ida Krüger og jeg studerer master innen Interaksjonsdesign og Teknologi ved Chalmers Universitet i Gøteborg. Denne våren kommer jeg skrive masteroppgave pa forskningsprosjektet BRIS under Institutt for Informatikk ved Universitetet i Oslo. BRIS står for "BRukergrensesnitt for velferdsteknologi I Stua" og handler om hvordan eldre mennesker kan kommunisere med andre gjennom videosamtaler fra hjemmet.

I min masteroppgave vil jeg utvikle et konsept for hvordan et video system for eldre kan se ut og brukes med hjelp av TVn. For å kunne gjennomføre dette vil jeg involvere en gruppe eldre mennesker for å finne ut av hvilke erfaringer som finnes og hvilke begrensninger som uppstår for dem ved bruk av ulike tekniske produkter. Dette vil gjøres gjennom intervjuer og workshops i tidsperioden fra mars til juni 2017.

Jeg ønsker å ta opp disse møtene med lyd-opptak samt ta bilder og ber herved for godkjenning fra deg. Materialet vil bli brukt for analyse for oppgaven knyttet til Chalmers i Gøteborg og ev bilder som presentasjons material. \I

Frivillig å delta

Deltagelse er frivillig, og du kan trekke deg når som helst. Du kan når som helst avslutte deltakelsen eller trekke tilbake informasjon som er gitt underveis. Du kan kreve at personopplysninger om deg slettes.\I

Anonymitet

Notatene og eventuelle lydopptak vil bli anonymisert. Ingen andre enn meg og deltakerne i BRIS-prosjektet vil kjenne til hvem som har deltatt eller få tilgang til lyd-opptakene. Ved bruk av bilder i presentasjons materiell vil navn og ansikt bli sensurert sa at informasjon ikke vil kunne tilbakeføres til deg.

Før vi starter intervjuet ber jeg deg om å samtykke i å delta ved å undertegne på at du har lest og forstått denne informasjonen og ønsker å delta. Studien er meldt til Personvernombudet for forskning, Norsk samfunnsvitenskapelig datatjeneste AS.

Kontaktinformasjon

Hvis du har noen spørsmål om kring studien min kan du spørre meg, eller kontakt meg senere på krida@student.chalmers.se, ellers ringe pa 40 47 47 57.

Samtykke

Jeg har lest og forstått informasjonen over og gir mitt samtykke til å delta i dette intervjuet.

_____   _____
Sted og dato   Deltakers signatur

_____   _____
Sted og dato   Students signatur

Appendix 2; Interview guide

Jag heter Ida Krüger och skriver en masteruppgave där jag skal ta fram ett förslag på en design för ett videokonferenssystem som äldre användare kan använda för att öka socialt engagemang och deltagande. Detta är ett projekt knytet till forskningsprojektet BRIS på UiO där man forskar inom detta område.

För att genomföra detta vill jag involvera äldre användare i processen, för att undersöka vilka erfarenheter de har med olika teknologier och system, samt vilka begränsningar som kan uppstå med dessa.

Du ska få fylla i ett formulär och godkänna att jag använder din information i min studie.
Är det okej att jag spelar in denna intervju?

SOCIALT DELTAGANDE, TEKNOLOGI och ANVÄNDNING

1. **Berätta lite om dig själv.**

2. **Berätta hur en typisk vardag/vecka ser ut för dig.**
   - Rutiner, speciella aktiviteter, speciellt intressant - sociala möten?

2. **Är det några av dessa möten som känns extra viktiga för dig?**

3. **Önskar du att du hade fler möten eller att du var mer aktiv/social än vad du är? I så fall med vem?**

4. **Berätta gärna om ditt förhållande till tekniska produkter. Vad för typer av tekniska produkter använder du idag?**

   - Hur ringer du? (Mobiltelefon knappsats el. smartphone?)
   - TV?
       - Smart TV?
   - Dator/laptop?
   - Ipad?

5. **Hur använder du dessa? Vilka funktioner använder du?**

6. **Hur upplever du att dessatekniska produkter är att använda? Tycker du de är lätta att förstå?**

7. **Har du någon deltagit i ett videosamtal/videokonferens?**

   Om Ja, kan du berätta lite om det? - Hur upplevde du att det var?
   Vilket system (Skype, Facetime, Facebook, Google etc)?

   Om Nej, varför inte? Är det något du skulle kunna tänka dig att använda/se
   användningsområde för? T.e.x. för att ha kontakt med vänner och familj?

   Om inte, varför inte?

8. **Elsa är 80 år och relativt aktiv. 2 ggr i veckan möter hon sina vänninor där de lagar mat tillsammans. Elsa ser fram emot dessa möten varje vecka och det ger henne mycket socialt som hon behöver. En dag ramlar Elsa och bryter benet, vilket gör att hon blir sängliggande under en längre tid. Hon klarar inte att ta sig till möterna med sin vänninor och känner sig efter några veckor väldigt trist och deprimerad.**

Hur ser du på Elsa's situation? Kan du känna igen dig/se dig själv där?
Hur ser du på videokonferens som ett hjälpmedel för Elsa? Tror du att det kunde hjälpa Inger att ha kontakt med sina vänninor och känna sig mer deltagande?

9. **Bengt 80 år bor hemma i sin lägenhet. För ett par år sen miste han sin fru och är sedan dess ensamstående. Han försöker att hålla sig aktiv och engagerad både socialt och fysiskt då han vet att det är viktigt om han ska hålla sig frisk och i form, men han har en del problem med höften sen många år tillbaka och har svårt att gå och ta sig längre sträckor då han är rädd att ramla. Han har inte många äldre vänner kvar i livet och familj och barn bor en bit bort och har inte mycket tid att mötas, speciellt på veckodagar. Han känner sig ofta trist och ensam och önskar han hade fler av sina vänner tillgängliga.**

   Hur ser du på Bengt's situation? Kan du känna igen dig själv eller någon annan bekant i denna situation? Vad tror du om videokonferens för att Bengt skulle kunna möte fler?

10. **Om något oförutsätt plötsligt skulle hända dig, där din sociala situation drastiskt skulle förändras, skulle du kunna tänka dig att använda videokonferens som ett hjälpmedel då? Tror du det skulle kunna hjälpa dig att känna dig mer socialt deltagande?**

11. Vad tror du skulle krävas av ett sådant system, för att äldre som Elsa eller Bengt skulle kunna tänka sig, och klara av att använda det?

12. Hur upplever du att det är att lära sig nya tekniska produkter och teknologier?

Känns det det lätt, utmanande, omöjligt eller kul?

Om svårt, vad är det som känns svårt och varför tror du att det känns så?
Brukar du få hjälp med installation av dina nya produkter? I så fall av vem?
Hur upplever du det?

Appendix 3; Requirements list

Interaction
The system should be designed for a large and distinct screen

Interface/screen
The system should be presented in a simple way with an clear overview
Colour coding should be used to simplify the use
It should be a small amount of buttons and few alternatives
The buttons should be adapted to older peoples hands, e.g. tremor, stiffness, dry hands
Options should be self-explanatory with clear and simple icons and symbols adapted for elderly
Information should be presented in steps and not include to many
It should be few steps to make a call
Text and buttons must be larger than normal for elderly with reduced sight
The system should follow general guidelines of button sizes and space
Sounds should have low frequency
The interface need to be customisable for different users

Functions
It should be possible to call one person at the time (BRIS)
It should be possible to call a group of people at the same time (BRIS)
It should provide a function for zoom in on the person(s) present in the call
It should be possible to adjust volume on the person(s) in the call.
If login is needed, it must be designed for support memory loss
A help function should be available
It should be easy to understand when the system is ON or OFF

Navigation
It should not be used more than two level menus
Menus should be placed at the bottom of the screen to prevent error selections

Grete Hansen

Age: Retired, 76 years old

Previous profession: Teacher

Interests and activities: Meet her old ladies for coffee and bakery, walk her little dog in the park, meet the knitting group for sharing the latest work, visiting grandchildren.

Technology use: Smartphone for calls, sms, bank, social media and sending email.
Tablet for playing bridge, listen to sound books and reading newspapers. Smart TV installed, but often doesn't use much more than the regular channels.

Health condition: She is active and mobile. Her hearing is still okey but her sight really starts to impair her. She needs to use strong glasses and zoom in on screens to be able to ready properly. Her cognition is still good thanks to her active kind, but she forgets more and more as the years passes.

"I'M AFRAID TO PRESS THE WRONG BUTTON AND NOT BE ABLE TO FIND THE WAY BACK TO WHERE I WAS"

Description: Grete is a retired teacher and widow with a lot of energy and will to learn new tings. Her husband past away a few years ago so to not get isolated she tries to be active, engaged and meet people. She also tries to be updated on technology and string along with all the new products that constantly are produced, because she thinks it helps her to feel more participation in society. Even though her curiosity and will are excellent, she experiences difficulties in learning new technologies and new functions on her existing ones. She's afraid of pressing the wrong buttons so she gets lost in the interface and won't be able to come back to where she was.

She often feels tired and confused when too much information are presented at the same time and to not mention all the password she needs to remember to websites and applications, this is a great problem for her. Also when she is not sure if the product or system is activated or not she can feel unsafe and afraid that someone might infringe on her privacy by monitoring her or similar.

When something goes wrong with her technical products she calls her grandchildren to come and help her, and if they're not in town she calls the helpdesk (if there is one avaliable). She feels safe when there is a physical person helping her and she is not happy at all with self-helping systems or vocie-mails.

Harald Haugen

Age: Retired, 83 years old

Previous profession: Engineer

Interests and activities: Once a week he participates in a group on a senior center in town. The group consists of seven other retired men with similar interests, namely to play cards and Schack. Harald also have great interest of nature and so he loves to walk in the forest and picking mushrooms or berries.

Technology use: He uses a smart TV and a mobile phone with tangible buttons daily, he also owns a computer but it's used only for the most important tasks, namely for paying bills.

Health condition: Harald is mobile and still going strong but he has really bad hearing from many years back. Even though he wears a hearing aid daily he still experiences difficulties when people talk fast or unclearly.

"I DON'T HAVE THE ENERGY TO LEARN A NEW SYSTEM OR COMPUTER, MY BRAIN IS TIRED THESE OLD DAYS. BUT IT'S OK TO USE THE ONES I ALREADY KNOW"

Description: Harald is living with his wife that is a few years younger than himself. She was active on technology and was the one steering the computer at home, until some year ago when she got sick and could not longer use her hands properly. Harald have since then taken over some tasks as paying the bills on the computer, but he doesn't see any need for using it for other tasks. If he can do the tasks other ways than through a computer, he prefers that. It takes too much time to learn new systems on the computer, he means he's too old for that.

Harald watches the news on the TV every evening. After that he often watches documentary series that are sent on a regular times. He likes to have fixed times for TV programmes and does not see any benefit with using the smart TV functions installed. His hearing problems makes him add subtitles whenever possible, but on the news it's sometimes not possible which leads to misinterpretations of content in some cases. He is lucky to have his wife those times.

Harald uses his mobile phone for making calls to children or friends. He thinks it's pretty easy to make calls, but sending sms he experiences as very clumsy and unintuitive, as he needs to press three times on each button to write a letter. The buttons are also very small and he feels they are not at all customized for his old stiff hands.

Appendix 5; Digital wireframes

5.1 Add new contact

By pressing the empty picture in the end of the *My contact* list, the user can add a new

contact. The name and the email address of the new contact needs to be filled out.

Figure 46; *Add contact*

If the user tries to go further without filling out the email address, an error message is shown saying "*Please fill out the contact's email address*". The error message uses both a symbol and text to make sure it stands out even for colour blind people.

Check mark symbols and colour indicate that the user is found and can be added.
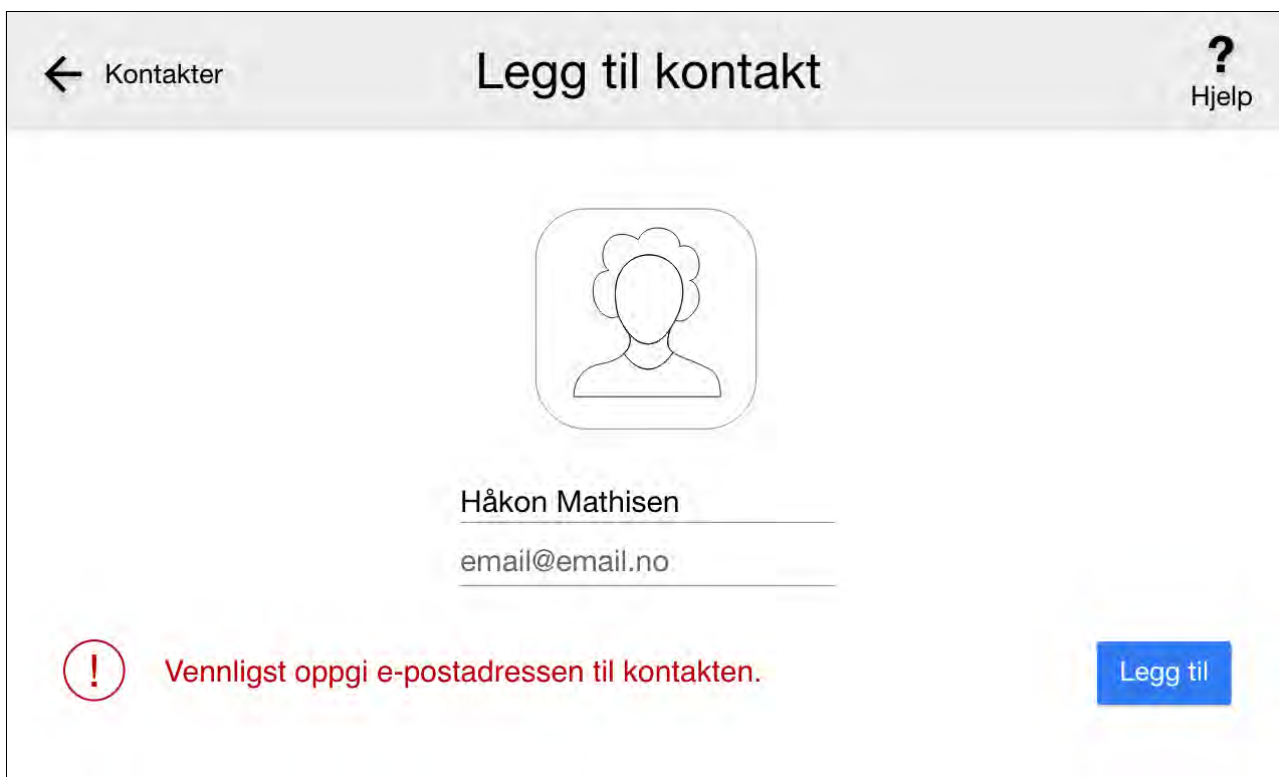
Figure 47; *Add contact – error message*
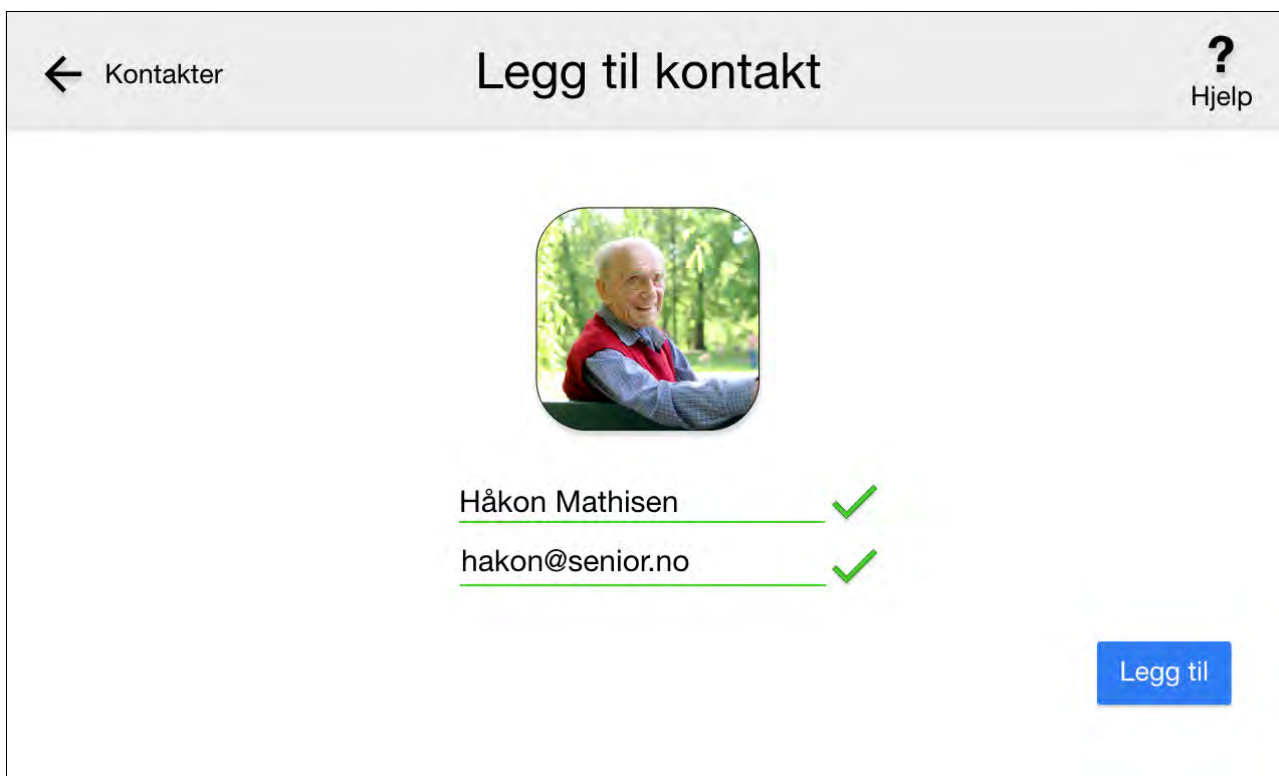
Figure 48; *Add contact – contact found*

If the contact is not found in the system the user can send an invitation to the contact's email address. A confirmation is then shown if the invitation was sent.
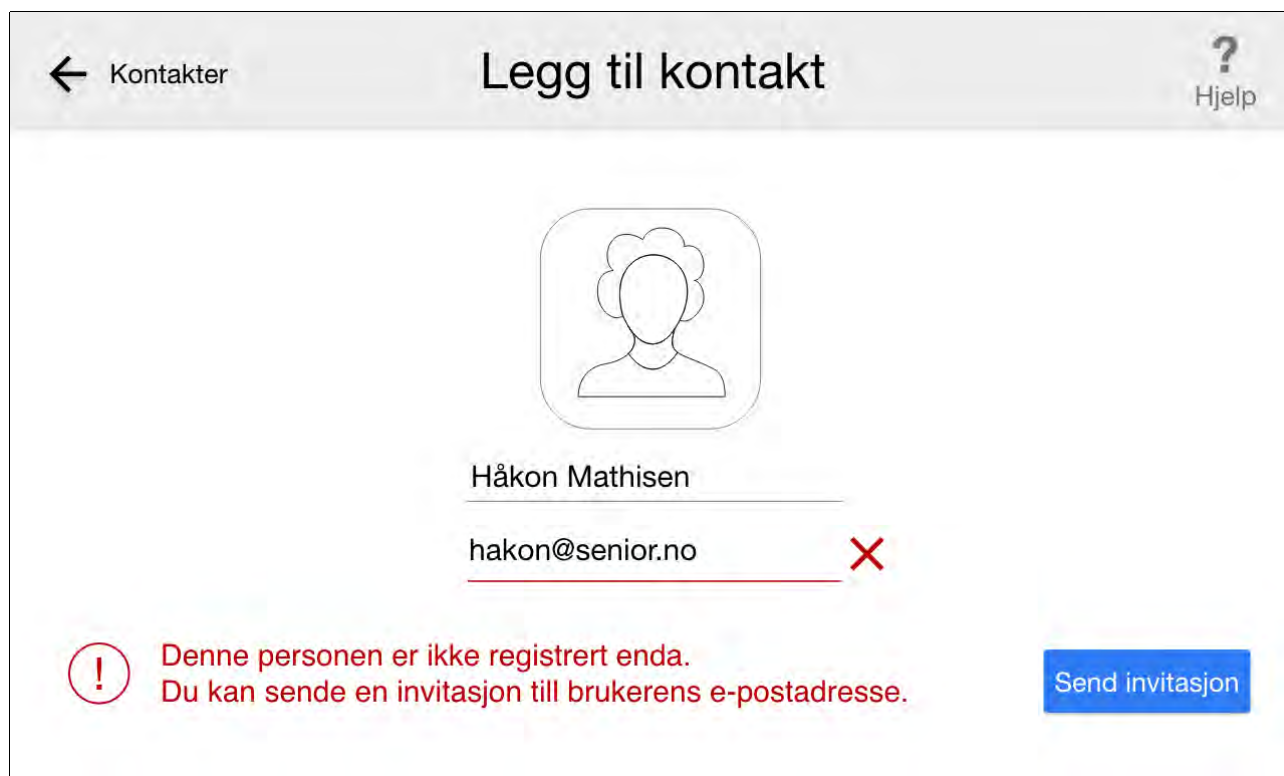
Figure 49; *Add contact – contact not found*
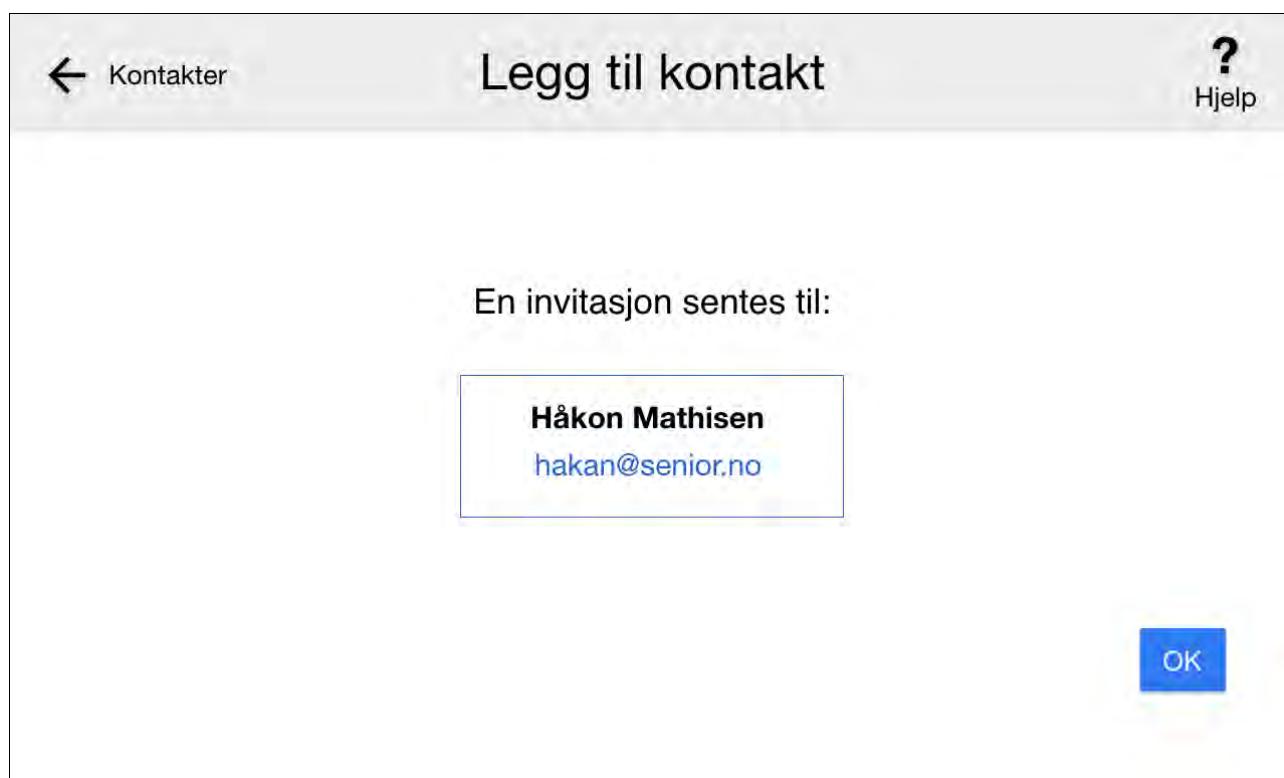
Figure 50; *Send invitation to contact*

5.2 Adjust volume in call

By pressing the Volume button at the remote control the user can adjust the sound of the person in the call. The volume function gets isolated for making it easier to use.

Figure 51; Remote control
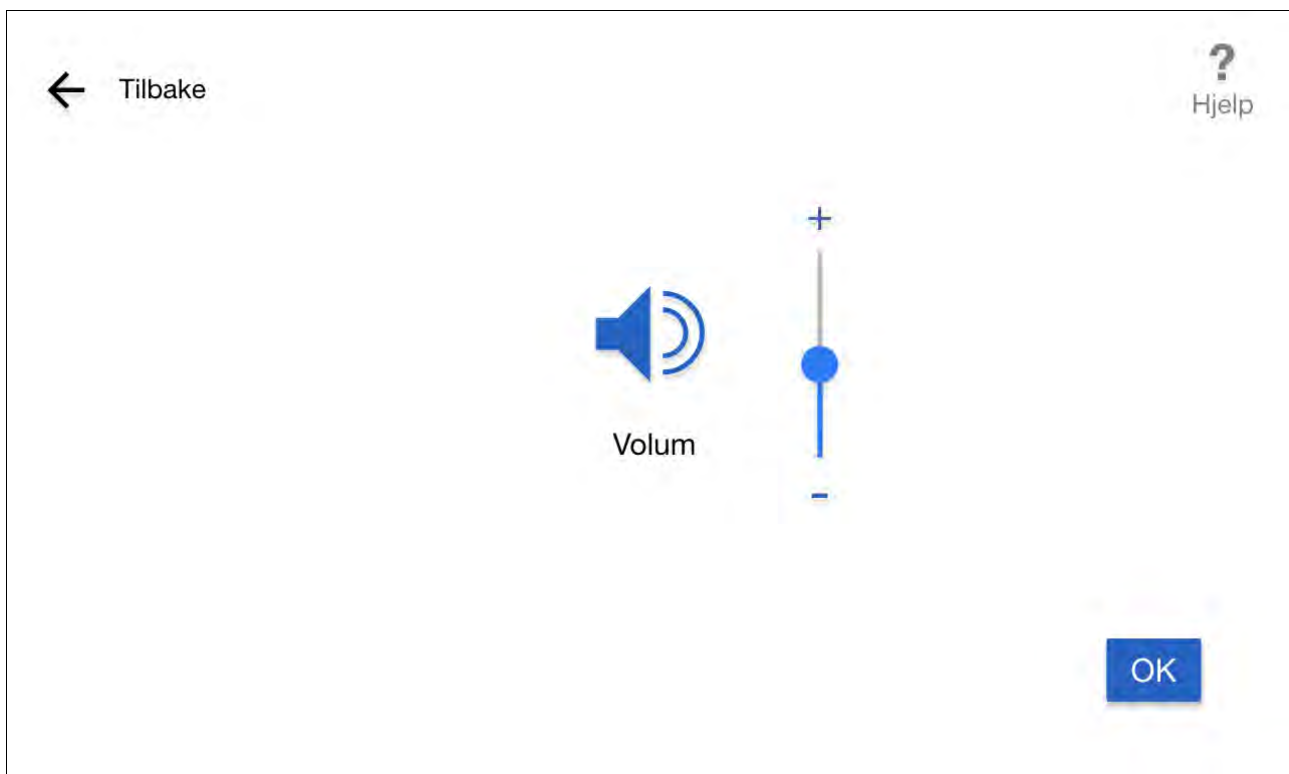
Figure 52; Remote control – adjust volume

5.3 Adjust volume in group call

When the group call is connected to the Tv the volume can be adjusted the same way. This is the view the user meets when pressing the volume button. Each contact's volume can be adjusted by using the sliders or the plus/minus buttons.
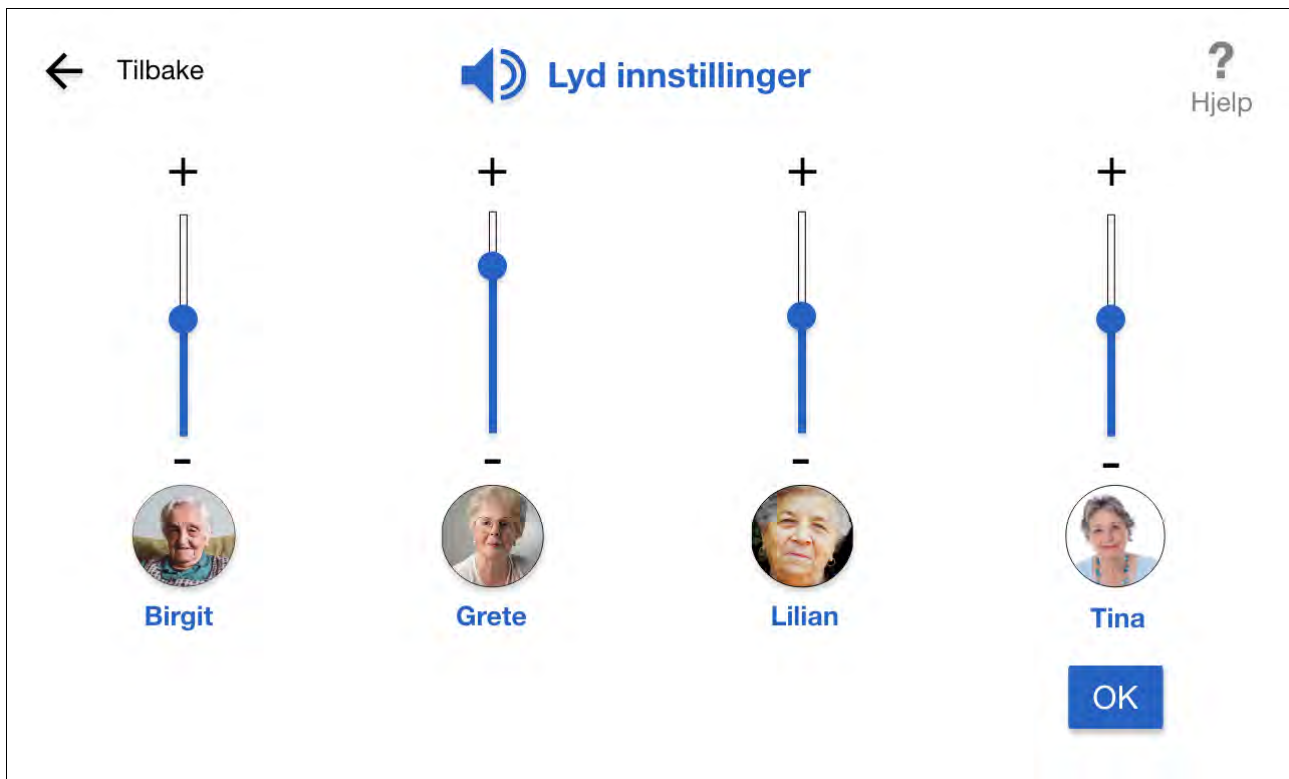
Figure 53; *Remote control – adjust volume in group call*

5.4 Zoom in group call

The same way the user can zoom in on each person in the call when the group is connected to the Tv. By pressing the magnifiers or pictures the selected person will be zoomed in and be shown on the Tv screen.
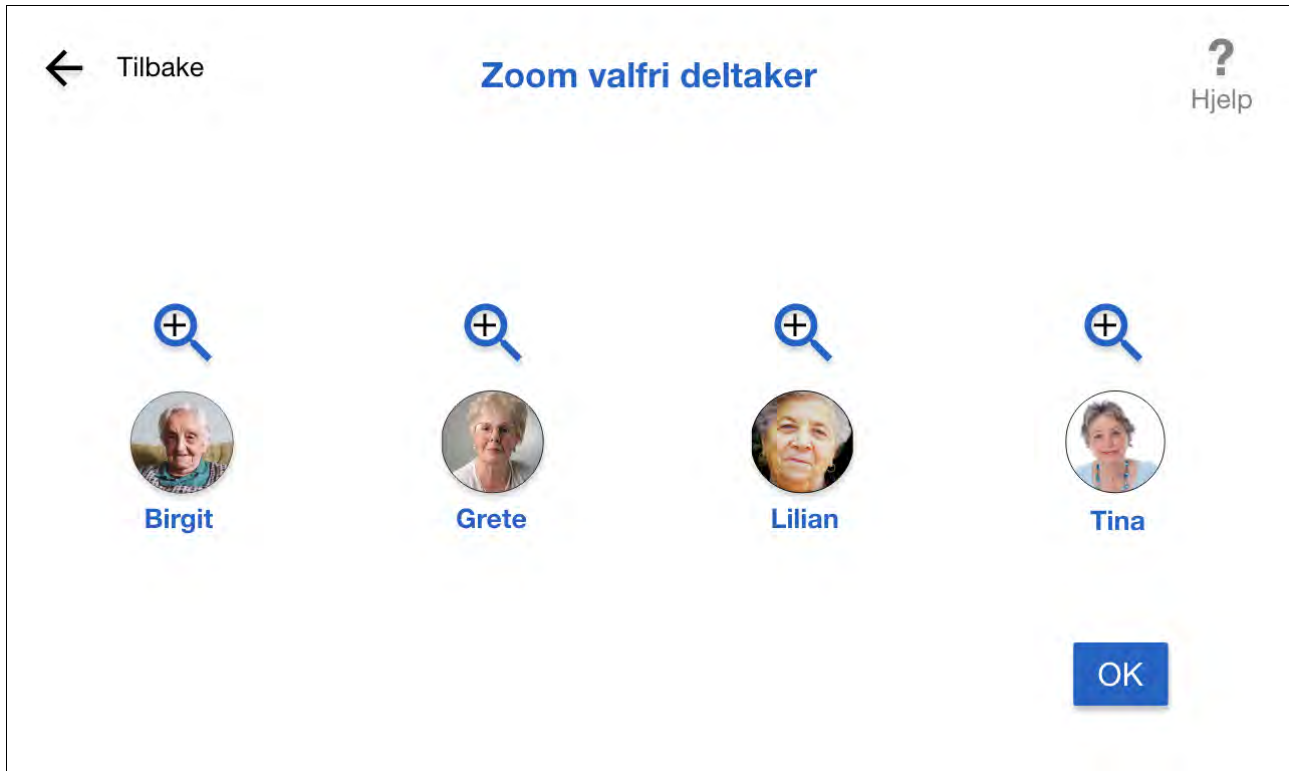
Figure 54; Zoom in group call

5.5 Add new group

By pressing the empty box in the group view the user can add a new group. The first step is to create a name of the group and press the blue next button.

Figure 55; *Create new group*

Figure 56; *Create new group*

The next step for the user is to choose what contacts to add to the group. By pressing a contact it will be selected. By pressing the blue button the group are created.
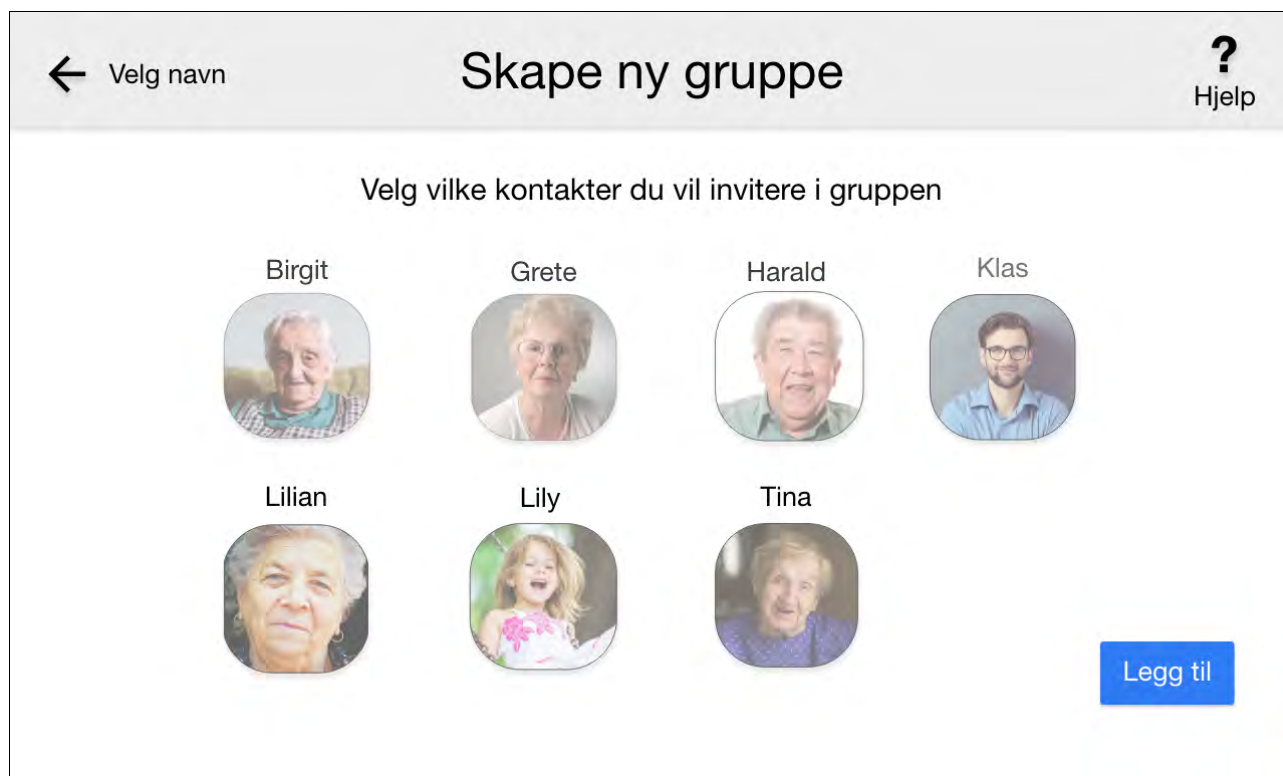
Figure 57; *Create new group – choose contacts*
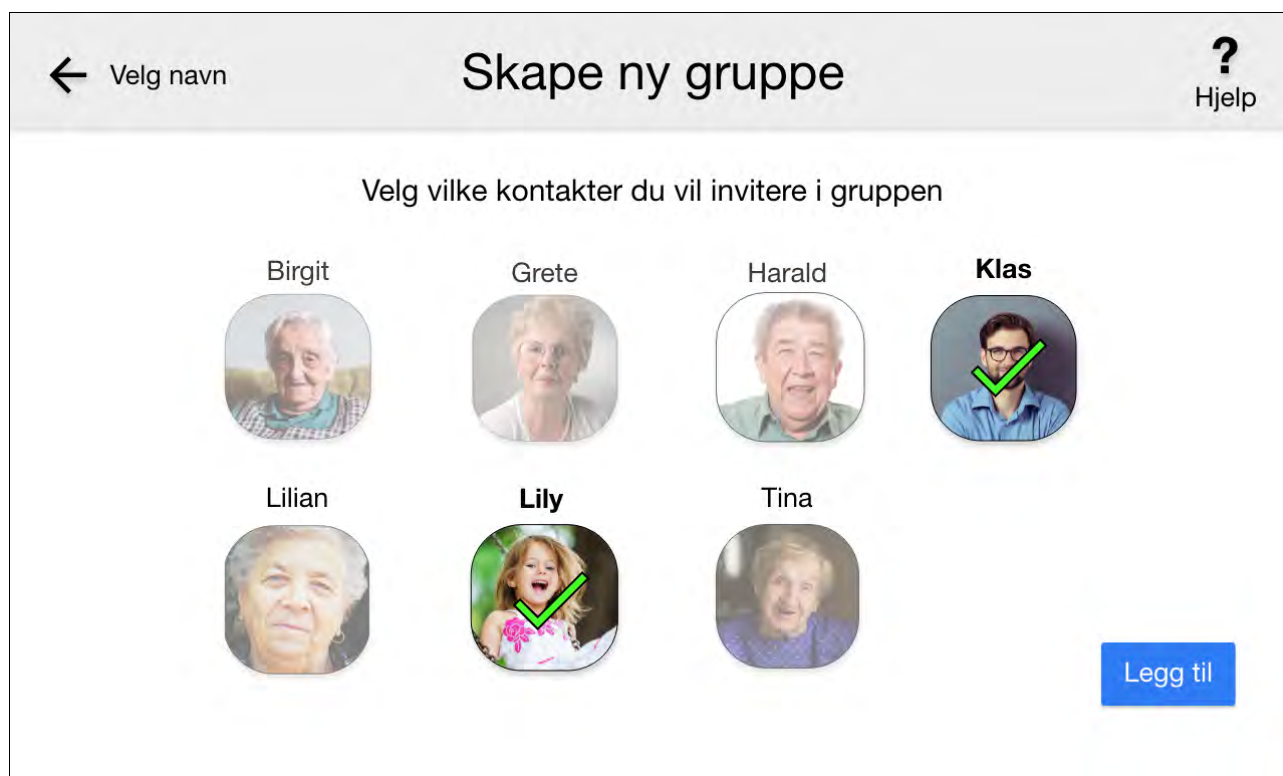
Figure 58; *Create new group – choose contacts*

The user has to add at least two users to create a group, otherwise an error message is shown saying *"You have to choose more than one contact to the group",* when pressing the blue add button. The last picture shows that the new group now is added.
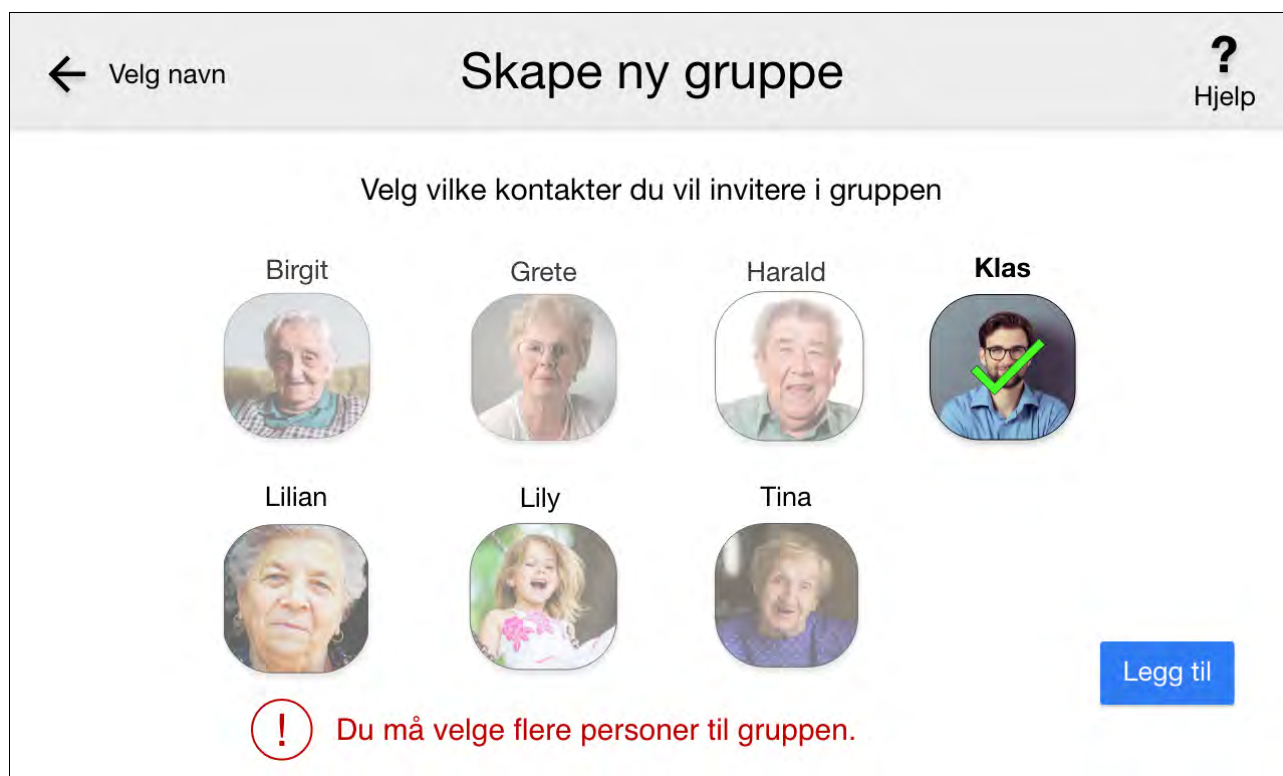
Figure 59; *Create new group – error message*
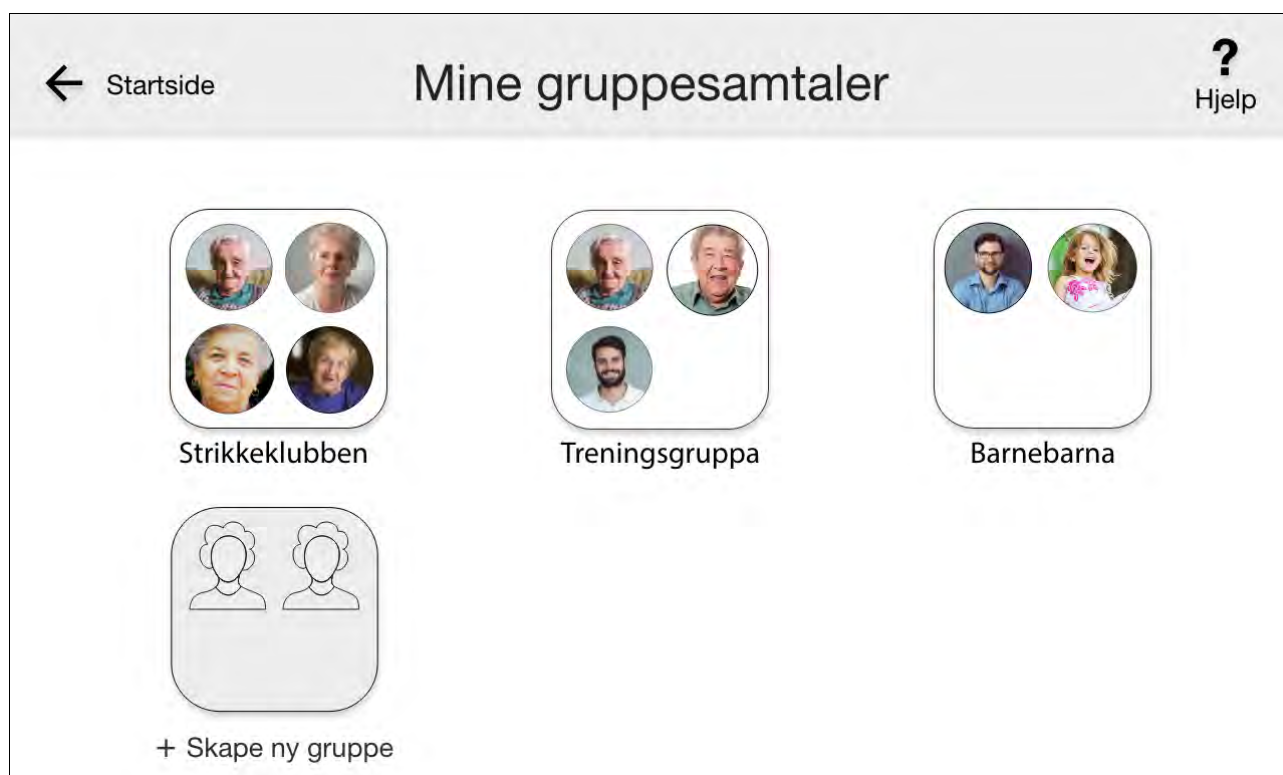
Figure 60; *Overview group calls – new group added*

5.6 Edit group

By pressing *More choices* in the group detail view the user can add or remove contacts in the group as well as edit names or delete the whole group. When pressing *Add or remove contact* the users is directed to the same view as when creating the group, and can here select or deselect contacts. Similar the user is directed to the name view when pressing *Edit name*.
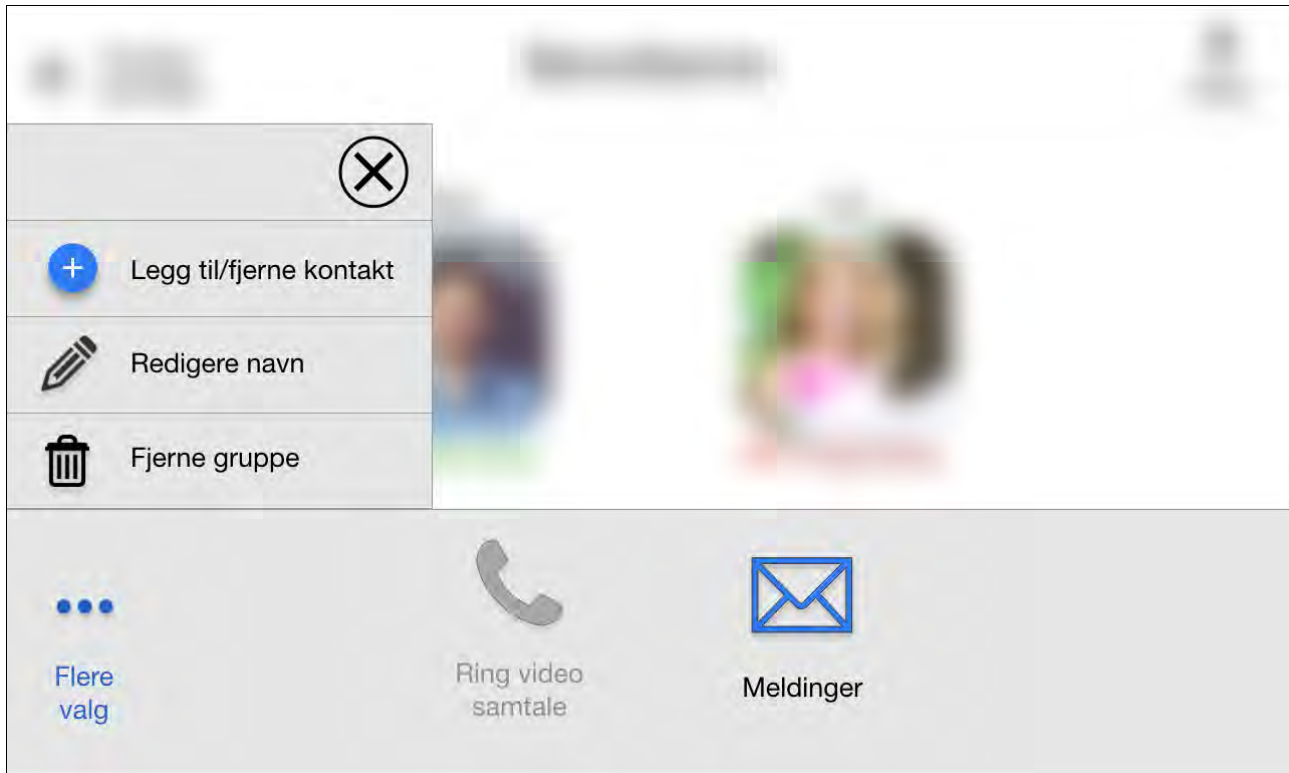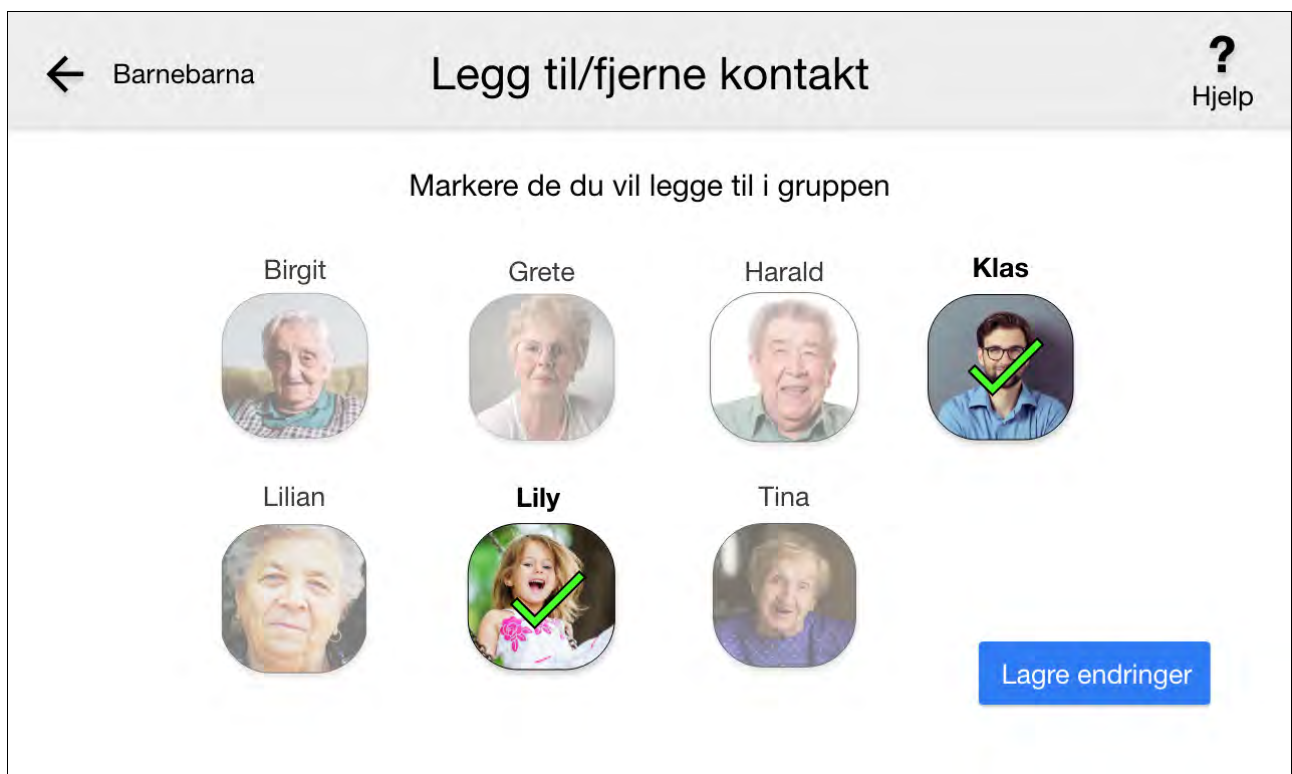

Figure 61; *Edit group*

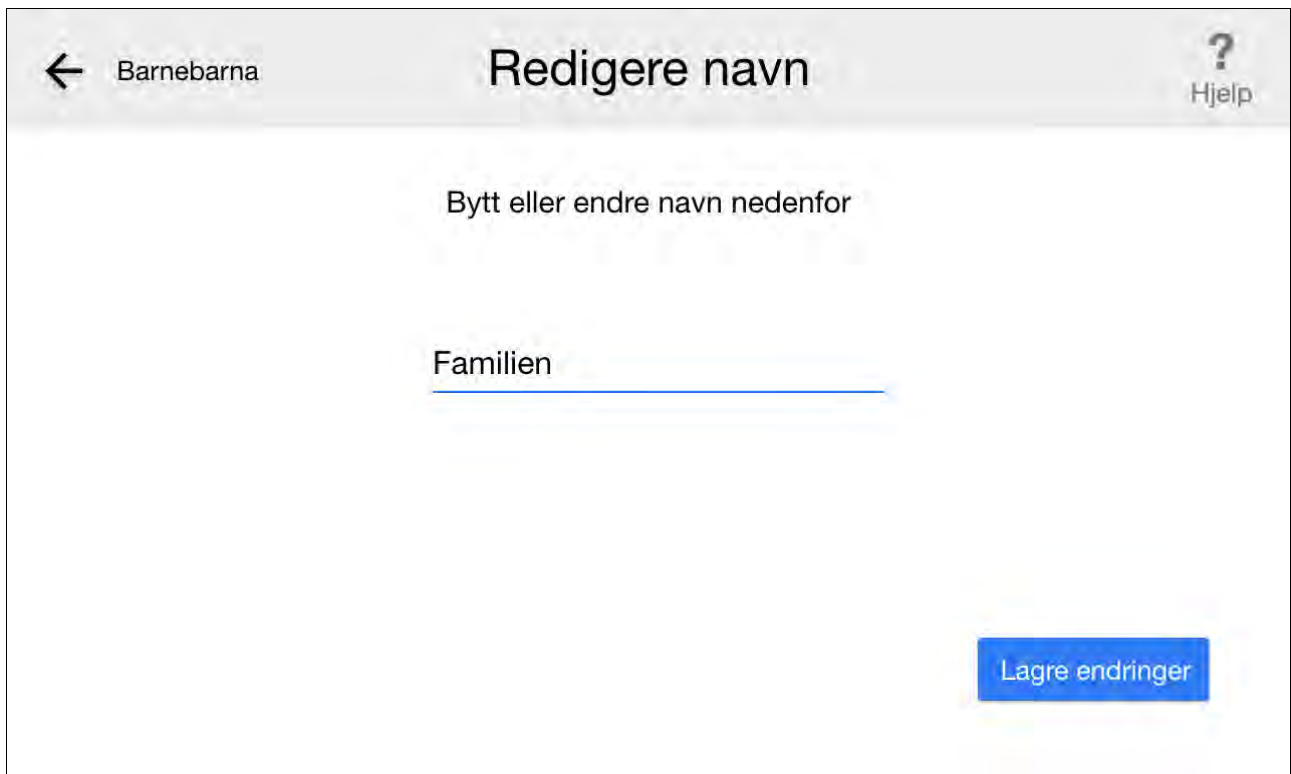***Figure 62;*** *Edit group – add or remove contact*

Figure 63; *Edit group – change name*

5.7 Help view

By pressing the help icon in the upper right corner the user can get guidance on how the current page works. By pressing *More Help* in the end of the page the user can get more information in a specific help section. This is not implemented yet but is left for future work.
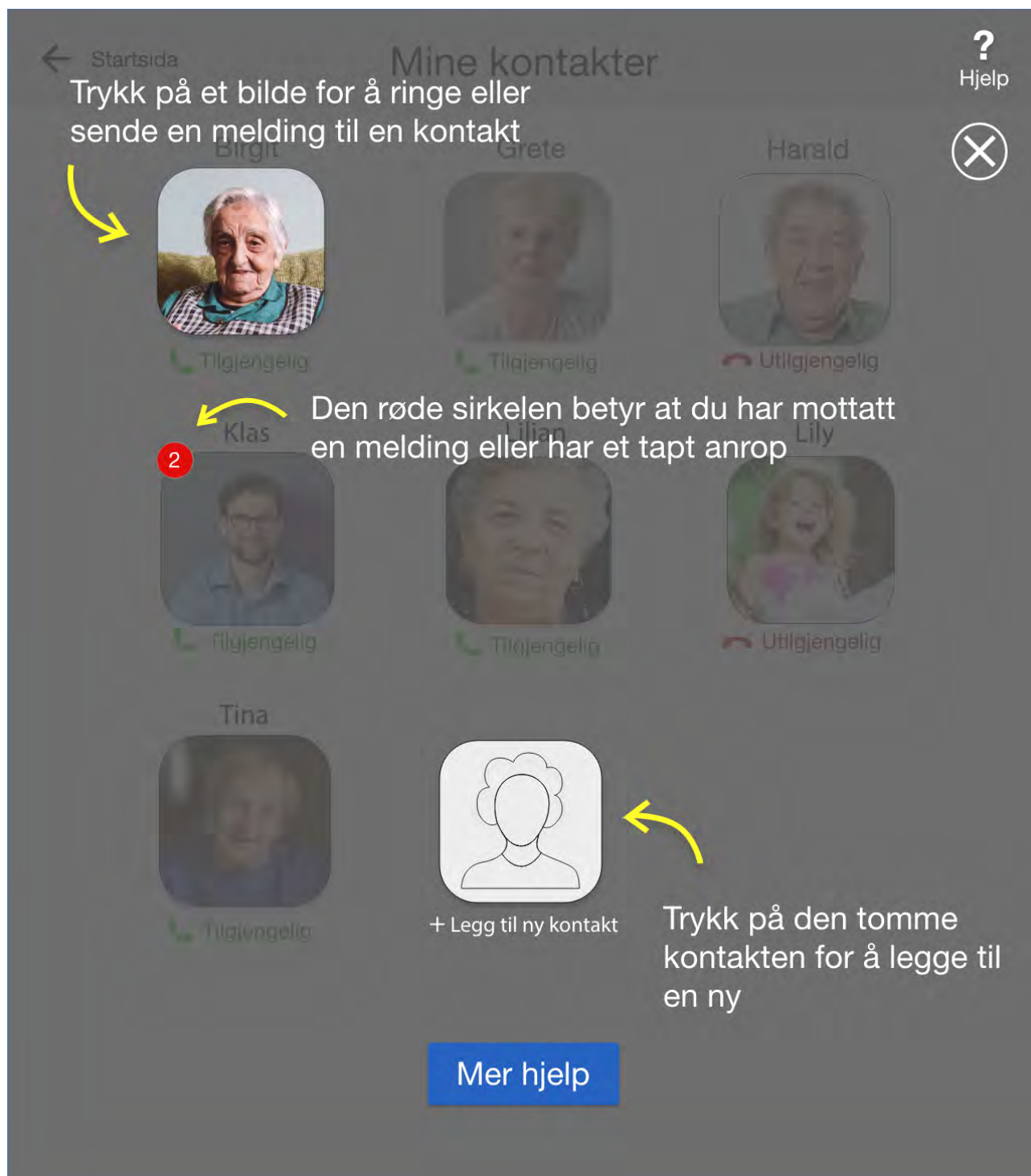

Figure 64; Help function