Design and Prototypical Implementation of a Video-Assisted Public Service Support Software for the Elderly

Master Thesis

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Declaration

I declare that I have developed and written the enclosed Master Thesis completely by myself, and have not used sources or means without declaration in the text. Any thoughts from others or literal quotations are clearly marked. This work was not used in the same or in a similar version to achieve an academic grading or is being published elsewhere.

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Place, Date Signature

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Abstract

Nowadays, a huge number of digital devices and services make a person's everyday life easier. People benefit from the computing power of modern mobile devices. However, older people often have challenges with using a mobile device. When living alone the elderly must cope with challenges concerning public services in their daily life. Digital technologies can help to gain more autonomy and support people in those challenges.

The assumption is, that solutions for these problems can be found with the help of information and communication technologies. An elderly-friendly tablet application can help the generation 65+ to stay in contact with relatives and exchange information about public service documents.

The work is structured according to a user-centered design process. After specifying the context of use, the requirements got characterized. Then the designing phase started with creating mock-ups. A prototype of a video-assisted public service support (PSS) software was coded and developed in Android.

The conducted usability test showed very good results. For test evaluation the System Usability Scale was selected. The participants valued the usability of the video-assisted PSS software as excellent in the adjective ranking. They would like to use the software in the future to quickly get in contact with their relatives. Daily public service challenges could be solved in a fast and easy way.

Prospective studies should focus on developing detailed functionality for the user group of 65+. Furthermore, the public service providers should be integrated in future development in order to increase independent living of the elderly.

Key words: elderly, public service, video-assisted software, Android, active assisted living

Kurzfassung

Heutzutage erleichtern eine Vielzahl digitaler Medien und Dienste den Alltag eines Menschen. Ältere Menschen haben jedoch häufig Probleme mit der Verwendung neuer Informations- und Kommunikationstechnologien. Wenn SeniorInnen allein leben, werden sie immer wieder vor Herausforderungen gestellt, die die Daseinsvorsorge betreffen. Digitale Technologien können dazu beitragen, ältere Menschen bei diesen Schwierigkeiten zu unterstützen, um ihnen so mehr Autonomie zu ermöglichen.

Mit Hilfe von Informations- und Kommunikationstechnologien können Lösungen für dieses Problem gefunden werden. Eine nutzerfreundliche, altersgerechte Tablet-Anwendung kann der Generation 65+ helfen, mit Verwandten in Kontakt zu treten und relevante Informationen über Dokumente zur Daseinsvorsorge zu erhalten.

Die Arbeit ist nach einem User Centered Design (UCD) Prozess strukturiert. Nachdem die Nutzergruppe und die Anforderungen an die Software definiert wurden, begann das Entwerfen einer passenden Benutzeroberfläche anhand von Mock-Ups. Danach wurde ein Prototyp einer videobasierten Software programmiert und entwickelt, der ältere Menschen bei der Daseinsvorsorge unterstützen soll.

Der durchgeführte Usability Test zeigte sehr gute Ergebnisse, welche mittels des SUS Bewertungssystems dargestellt wurden. Die TeilnehmerInnen bewerteten die Benutzerfreundlichkeit der Software als „ausgezeichnet“. Sie würden die Software auch zukünftig nutzen, um schnell mit Verwandten in Kontakt treten zu können. Tägliche Herausforderungen in der Daseinsvorsorge können auf einfache Weise gemeistert werden.

Zukünftige Studien sollten sich auf die Entwicklung der detaillierten Funktionalität für die Benutzergruppe im Alter von 65+ konzentrieren. Darüber hinaus sollten die Anbieter der Daseinsvorsorge in die künftige Entwicklung mit einbezogen werden.

Schlüsselwörter: SeniorInnen, Daseinsvorsorge, videobasierte Software, Android, Active Assisted Living

Table of Content

1 Introduction

Nowadays, a huge number of digital devices and services make a person's everyday life more easily. Especially the younger generation is fascinated by the overwhelming amount of different functions and they use the mobile devices as a companion in their everyday life. People are always in touch with each other and they are sending and receiving messages on a fast pace (Fuhrländer, 2016). Furthermore, there is not only the aspect of communication possibilities which gets developed for everyone. People are able to book their vacation via digital devices and via the internet. Moreover, anybody who owns a mobile device can order food or get informed about latest news by reading journals and newspapers online. Furthermore, there exist different applications for online banking and money exchange. Another growing type of digital services is the e-government. The use of information and communication technologies (ICT) helps the authorities, to make services available to the public. Requests to public service providers like insurance companies or healthcare providers can be submitted and the corresponding forms can be filled directly online. With several services, the government wants the citizens to participate in society and support them in their everyday life concerning governmental matters (Bundesministerium für Digitalisierung und Wirtschaftsstandort, 2018b). Another aspect is mobile healthcare which is more and more becoming an important part of the society (Gastaldi, 2014). The Austrian government initiated several digitalization efforts in the healthcare system. The country started to implement an electronic healthcare system called ELGA as well as the e-medication and the digital Mother-Child-Passport. Furthermore, the government supports elderly and people with special needs to get medical and therapeutic equipment (Bundesministerium für Digitalisierung und Wirtschaftsstandort, 2016).

People benefit from the computing power of modern mobile devices. According to the latest use of technology census, in the year of 2018 89% of all households in Austria had access to internet. The interviewed people were between 16 and 74 years old. 88% of them used the internet in the past three months before the survey. 80% of the users even used the internet several times a day. Figure 1 shows that also older people use the internet regularly (Statistik Austria, 2018).

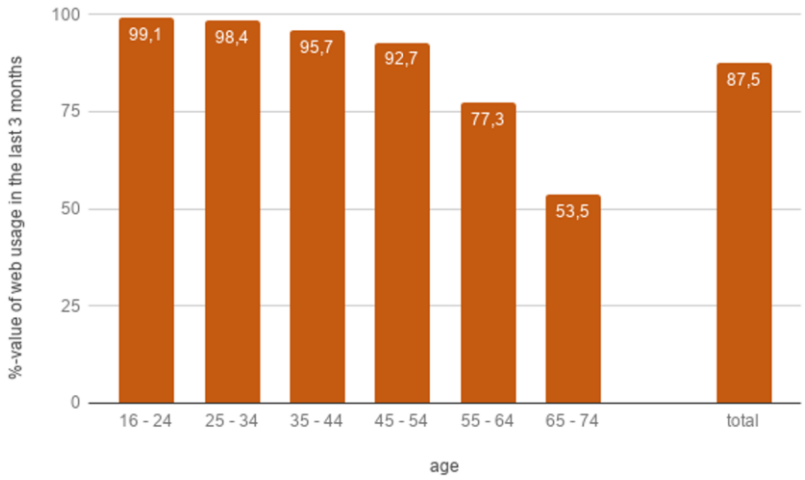

Figure 1: Web usage in the last 3 months in Austria (Statistik Austria, 2018).

Another important fact is that the life expectancy increased over the last years. In 2050, 34,2% of the Austria population will be older than 60. With higher age the risk of getting socially isolated and the need of care rises (Hofer & Moser-Siegmeth, 2010). From a psychological perspective there is a trend of increased loneliness for older people (K. Hofer & Moser-Siegmeth, 2010). Literature shows that more and more older people (especially women) live in a single-person household (S. Hofer, 2018). Around 50% of people over 80 years often feel lonely and isolated (Dykstra, 2009). If loneliness lasts for a long time it can result in a person getting sick. The feeling of being socially isolated is a significant risk factor of depression and there is also a connection to cardiovascular diseases and other related health problems (Raue, 2018; Sarki, Haeun, & Kwon, 2015).

In Austria the proportion of people who live alone has increased in the last 50 years. In 2017, 15% of men and 18,2% of women were living in a single-person-household. In the European Union the proportion is almost a third. The former model of a big family living in one location is not the standard anymore. Especially older people often live alone. The proportion of men living alone with an age of 60 or higher is around 20%. The proportion of single women is even bigger. 28,2% of the 60 to 69 years old and even 58,7% of the over 80 years old women live in a single-person household. These numbers can be explained with the higher life expectancy of women and the average age difference between couples (Hofer, 2018). When considering these aspects, it is obvious that loneliness is getting an important fact. It is worth to be paid attention to in the next few years when thinking about health and geriatrics. (Hofer & Moser-Siegmeth, 2010).

1.1 Motivation

Considering the importance of mobile devices and digital services on the one hand and the social isolation and the increasing life expectancy on the other hand the question rises, if an ICT can help older people to stay autonomous and connected with their relatives. An overview about current innovations of Active Assisted Living (AAL) technologies will be described in section *2.3 Overview of Active Assisted Living Technology.* Figure 2 illustrates the percentage of people aged 65+ increased since 2017. According to the prognosis, one can also see that this percentage is further increasing in the next years (Statistik Austria, 2019).

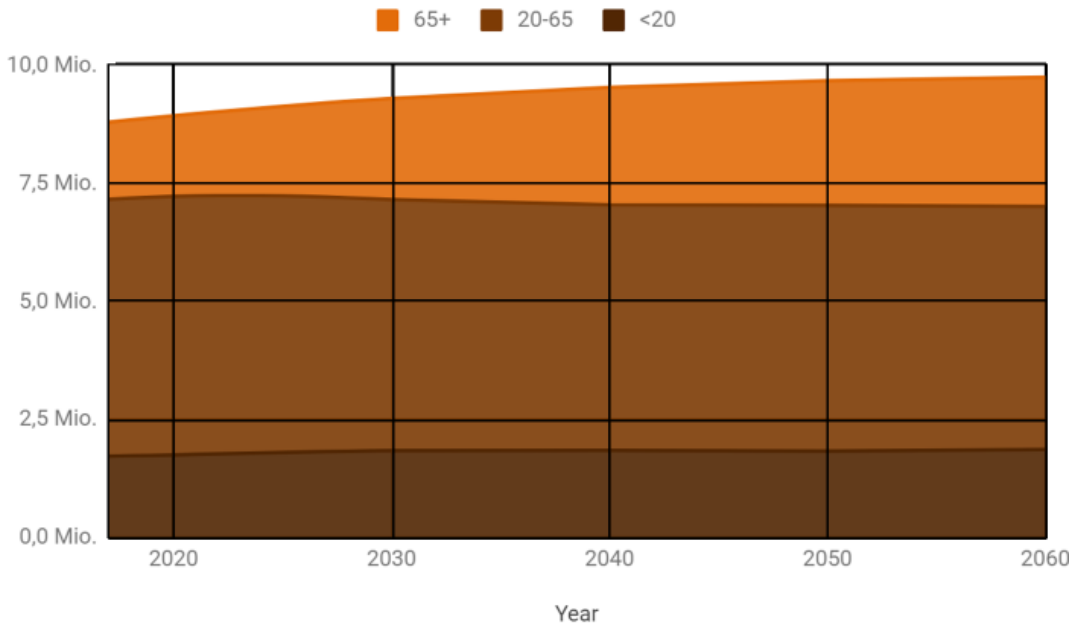

Figure 2: Percentage of people aged 65+ in Austria (Statistik Austria, 2019).

Digital applications can contribute to active aging. The new digital devices have a positive impact on society, also for older user. The challenge consists of including elderly in the same way as younger people in this trend. The quality of life can be increased in every stage of life (Gil & Goncalves, 2017). Social interaction should be increased to build mental stability and health of elderly (Sarki et al., 2015).

Another main aspect is public services for the older generation. All different fields of public services are needed to live independently in a household. Public services include aspects like water provision, healthcare providers or social services. Given the detailed and hard to perceive information in letters for billing, service and maintenance elderly might get confused easily. Also often changing terms in legal

and technical sections could be hard to understand. If they have poor sight or cognitive constraints the understanding becomes even more difficult.

The assumption is that solutions for these problems can be found with the help of ICT. An elderly-friendly tablet application can help the generation 65+to stay in contact with relatives and exchange information about public service documents such as energy bills or letters from public authorities. Uncertainties about the information or the required actions might be dissolved faster with someone explaining it.

Mobile devices enable elderly to communicate fully with their family and friends. Often there is one big problem for older people using smartphones or other devices: the designs are not elderly-friendly. While programming an application it has to be considered that elderly require a user interface adjusted to their needs. (Salman, Wan Ahmad, & Sulaiman, 2018). The older generation overall has higher challenges in motor skills, sensory processing and cognitive functioning. Literature shows that these aspects must be included in the planning and programming process. A detailed requirement elicitation is the basis of a profound work because then the needs of the future users can be understood more thoroughly (Jakkaew & Hongthong, 2017).

1.2 Explanation of the Problem

The master thesis deals with the problem of increased social isolation of elderly and the actual trend of living in a single-person household (K. Hofer & Moser-Siegmeth, 2010; S. Hofer, 2018). When living alone elderly must cope with challenges concerning public services, the own health and further daily aspects in their life. Digital technologies can help to gain more autonomy and support people in their daily life (Gastaldi, 2014). Elderly nowadays use digital media less than the younger generation but they do not completely refuse to work with new technology (Statistik Austria, 2018). Older people can use devices to communicate with family and friends as well as the younger ones (Salman et al., 2018). Especially when living alone an application for communication can affect positively on mental health (Hofer & Moser-Siegmeth, 2010). With the use of technology elderly can gain more autonomy in their daily life. They can choose on their own if they need help and can contact their relatives or not. Difficulties exist for elderly in the usability of applications. They have different needs in functionality and design which has to be considered (Jakkaew & Hongthong, 2017). By having an appropriate device and a user-friendly interface, elderly can profit from technology. Public service concerns might be confusing but are important to live independently. If elderly have the

possibility to get suitable advice for specific questions concerning public service, their daily life might become easier. Furthermore, they are able to live in their own household as longer then currently possible without feeling left alone. This would empower elderly's autonomy and increases their life quality.

1.3 Questions of Research

Considering all aspects of the literature research the following research questions were derived.

1. How do older, low media-literate people benefit from a mobile application for understanding information that is contained in public service documents by sharing and video-communicating over those with their relatives?
2. Which functional and technical requirements does a public service support application for Android have to meet for a high usability and user-friendliness towards people aged 65+?

1.4 Goal

The aim of this thesis is the design and implementation of a functional prototype to support the elderly aged 65+ in gaining information about public service documents. At the beginning, the focus lies on a detailed literature research about the usage context. Afterwards an appropriate user interface should be designed, followed by the development of a prototype. One goal is that the future users should have the possibility to get fast advice from their relatives concerning follow up actions required by information in these documents. Therefore, the prototype should include simple functions for a video-assisted call to the relative. A video chat is to be preferred because the relative can see the senior's emotions. Moreover, besides the voice, they can see facial impressions, gesture and body language to understand the senior's challenge even better. The seniors can describe their problems and through sharing the screen and switching the camera, the relative can take a photo of the relevant document. Viewing the documents on his or her own device, the relative can give appropriate explanation. The prototype will be developed in Android Studio Code. One goal is it to code a public service support (PSS) software for the elderly. After the coding process the prototype gets tested for its usability. The results will then be evaluated and further discussed.

1.5 Methodology

After the literature research concerning research questions and background, the work is structured in a user-centered design (UCD) process. Figure 3 shows the structure of an UCD process (Maguire, 2001, p. 589).

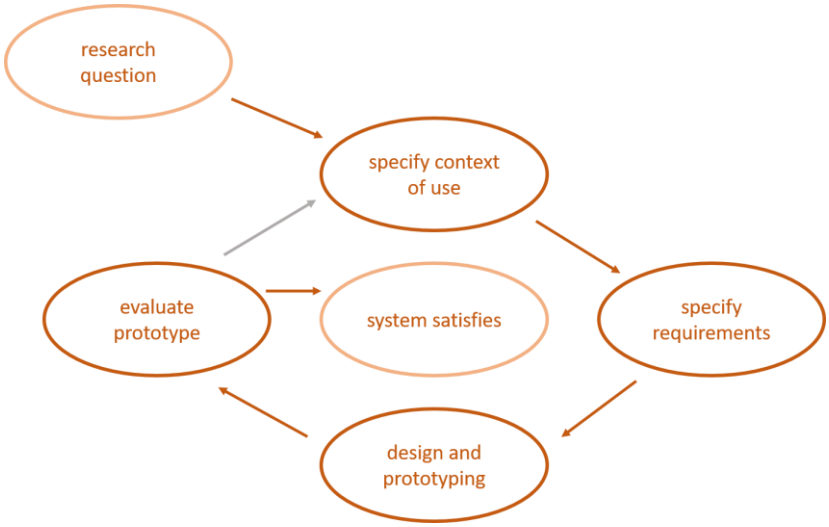

Figure 3: User-centered design process (Maguire, 2001, p. 589).

With the research question stated in *1.3 Question of Research*, the usage context will be described and defined in an UCD process. Before starting to code, a requirement elicitation is a very important step. In this phase of software engineering one tries to collect all requirements for the functionality and design. The developer communicates with future users and analyzes needs and preferables. The usability can be increased by this preliminary work. (Jakkaew & Hongthong, 2017). As part of this requirements analysis, personas will be defined. This is a tool to communicate about the different types of users. The different needs can be demonstrated more easily (Cooper, Reimann, & Cronin, 2007, p. 21-22). Additionally, special needs of the future user group will be described as well as the requirements concerning use cases and technical aspects. A broad requirements elicitation helps for the subsequent coding. The first step of developing is the design of mock-ups. A user interface will be conducted that shows how the software may look like without any programming functionality. Then the functional prototype gets designed and developed. The PSS software will be coded in Java for Android. For the video calls a framework named *OpenTok* will be integrated too. *OpenTok* is a cloud platform for interactive videos, voice and messaging (TokBox, 2018). Via a video call people can talk to each other and can also see the other's emotion which makes the talk more familiar and natural.

The final prototype gets evaluated with the help of a usability test and a questionnaire. With the System Usability Scale (SUS) the results of the questionnaire can be analyzed and valued. The usability test consists of different tasks the users are requested to do. The analysis of the user observation while testing the software will also be part of the results.

1.6 Thesis Structure

This thesis is structured into seven chapters.

- Chapter 1 describes the problems, motivation, research question and the methodology of the work.
- Chapter 2 covers the theoretical background of important issues, which are necessary to know for understanding the software. It starts with a medical background about the future user group and their characteristics. The next part shows a theoretical definition of public services as well as their relevance for elderly. Then the chapter gives an overview about technologies of active assisted living (AAL) which have a connection to the thesis' work. The last part shows the state of the art of video-assisted online communication.
- Chapter 3 illustrates the requirements analysis. It describes the target group as well as technical and functional requirements for the PSS software.
- Chapter 4 covers the process of design and prototyping.
- Chapter 5 describes the usability testing and the analysis of the results.
- Chapter 6 consists of the discussion of the results in relation to the theoretical background and the research questions. Additionally, it provides approaches for future work.
- Chapter 7 is the conclusion which summarizes all findings.

2 Theoretical Background

2.1 Gerontology

Gerontology is a scientific field which deals with description, explanation and modification of physical, mental, social, historical and cultural aspects as results of the aging process (Baltes & Baltes, 1992, p. 8). While designing and prototyping a software for the specific age group of 65+, the aspects described below have to be considered. The requirements for using a technical support software for the elderly is different than for younger generations.

Important is the fact that gerontology never describes the age but a dynamic process of changes and developments while getting older (Becker, 2014, p. 23). This scientific field is very wide and diverse. Wahl and Heyl describe twelve "essentials" to specify gerontology which can be seen in the listing below (Wahl & Heyl, 2015, p. 84) .

1. Aging is a dynamic process of loss and gain
2. Aging is a biologically and medically determined process.
3. Aging is a life-long and biographically embedded process.
4. Aging is defined by social determinants.
5. Aging is a product of the personal and physical environment.
6. Aging is a process determined by economical aspects.
7. Aging is a gender-specific process.
8. Aging is a diverse process.
9. Aging is a multidimensional process.
10. Aging is a multidirectional process.
11. Aging is a process of objectivity and subjectivity.
12. Aging is a vivid process with limits.

All these essentials together point out that it is important to look at a person's aging status at a certain time in life. The status of an older person cannot only be described by his or her age, but all aspects of life need to be considered. Life always offers possibilities for a person to learn something new while growing old (Wahl & Heyl, 2015, p. 83).

The essential 4, 5 and 6 characterize three key aspects of aging. The social, physical and economical environments contain important external influences. Growing old is not only a biological process. In fact, social relations play an

important role for the elderly. The environment has a deep impact on the quality of life. The essential number 8 picks up once again the aspect of diversity while growing old. Various points concerning physiological, cognitive, social, personal, gender-specific aspects have an impact on individual aging too (Wahl & Heyl, 2015, p. 86-87).

These insights demonstrate that describing aging with standards is not the right way to do. It is important to see a person in all facets in order to extrapolate her or his health condition (Wahl & Heyl, 2015, p. 83-94).

Common Clinical Pictures

Although aging is an individual process, some clinical pictures are common when growing old. The medical and therapeutical goal in geriatrics, which is the medical discipline of gerontology, is the maintenance or recovery of independence. Each old person should have the opportunity of a high quality of life. Unfortunately, in the age group of 65+ acute diseases are frequently occurring. Furthermore, many disorders and symptoms might occur simultaneously. This is called multimorbidity and needs an interdisciplinary care by doctors and nurses. Occupational and physical therapy are often required. Also speech and language therapist or social workers are part of this care process. The next list shows the most frequent diseases for people above 65 years of age (Wrobel & Niefer, 2008 p. 820).

1. Cardiovascular diseases
2. Diseases of the motor system
3. Tumor illness
4. Chronical-degenerative diseases
5. Metabolic disorder

A person of 70 years or older will face an average of seven to nine diseases at one time (Wrobel & Niefer, 2008, p. 821). This aspect is an important one for the development of a software for people aged 65+, as it is described below.

Cognitive deficits like dementia or disorientation are more likely to occur in a higher age. The risk of getting dementia is increasing exponentially starting at the age of 60 (Wrobel & Niefer, 2008, p.822). The cognitive deficits have an impact on the ability to learn. It is difficult to understand and use a software for the first time when having cognitive deficits. Another aspect are memory deficits which commonly accompanies the aging. This affects the remembering of information in a learning process (Jakkaew & Hongthong, 2017).

Further common geriatric symptoms are visual and auditive impairments. Deafness or visual disturbances are the most frequent sensory disorders for

people aged 65+ (Wrobel & Niefer, 2008, p.822). The interface of a software for the elderly has to be adopted to the these changed requirements. Visual deficits have an impact on the ability of reading information (Jakkaew & Hongthong, 2017). Furthermore, the visual impairments can decrease the ability of differentiating colors, therefore a high contrast of colors is needed. (J. Nielsen & Budiu, 2013, p.69). Auditive impairments affect the ability of detecting sounds (Jakkaew & Hongthong, 2017).

Older people are commonly affected by bone and joint diseases which lead to a restricted motor system. Examples for bone and joint diseases are osteoporosis or degenerative diseases like arthrosis. The diseases of the motor system are frequent among the elderly. These impairments can affect the upper or the lower limb as well as the whole body (Wrobel & Niefer, 2008, p. 832-837). It has to be considered that these diseases have an impact on the ability to manipulate and control a mobile device. The elderly need more time than younger people for the same task because their slowed movements. Additionally, the elderly's speed of reaction is lower compared to younger people (Jakkaew & Hongthong, 2017).

A restricted motor system especially in lower limbs often leads to immobility. Immobility can occur after medical treatment, an accident or due to a chronical-degenerative disease. (Wrobel & Niefer, 2008, p. 822). Immobility has a deep impact on social participation. The elderly are not able to visit friends or participate in other activities of social life. They might feel lonely and isolated (Hofer & Moser-Siegmeth, 2010, p.1).

Another important aspect is the fact, that depression is the most common psychiatric disease in higher age classes. The prevalence is around 15%. Especially decreasing social contacts and the limited body conditions foster depression. Additionally, certain anxieties appear. Elderly are likely to be afraid of illness, dependence, loss of performance or poverty and therefore often feel helpless (Wrobel & Niefer, 2008, p. 825). An appropriately designed communication software can help maintain the social participation. Information and communication technologies (ICT) can increase mental stability and mental health of older people (Sarki et al., 2015).

The mentioned impairments and diseases describe only a small excerpt but are the most important ones when thinking about developing a software for them. Every single impairment has an impact on the ability to learn how to use a software and on how to manipulate a mobile device. Hence it is important to involve the older people in the design and development process of a new elderly-friendly software (Jakkaew & Hongthong, 2017).

2.2 Definition of Public Service and Relevance in Elderly's Daily Life

Public service is a service which is provided by the government to all citizens living in its jurisdiction. The people can live directly in the area of responsibility or get financial provisions by the public services. Those public services should be available to all citizens, regardless of physical ability, mental acuity or income. A public service can be either publicly provided or publicly financed. All public services are important for the daily life and contribute to a higher life quality (McGregor, 1982). The following list shows the various sectors of public services:

- Courts
- Electricity
- Education
- Emergency services
- Healthcare
- Social services
- Public transportation
- Transport infrastructure
- Telecommunications
- Environmental protection
- Military
- Public buildings
- Urban Planning
- Waste management
- Water supply network

A quick and easy accessibility to public services is important. Citizens should have the possibility to make use of these high-quality services for a better life quality (Stadt Wien, 2019). In Austria most public services are provided by the governmental staff of the country, the states, the cities or the municipals. These levels of government are commonly referred to as "public administration". Additionally, there are agencies that have split off from the different levels of government in recent years. Various companies and institutions are charged with providing public services and get financial support by the government (Federal Ministry for the Civil Service and Sport, 2018).

In 2015, 683.900 people were employed in the general governmental sector. Most of them (29,8%) worked in the education sector. 23,4% of the staff was employed in the healthcare sector followed by the staff employed in general public

administration (15,1%). Figure 4 illustrates the staffing levels in general government sector in 2015 (Federal Ministry for the Civil Service and Sport, 2018).

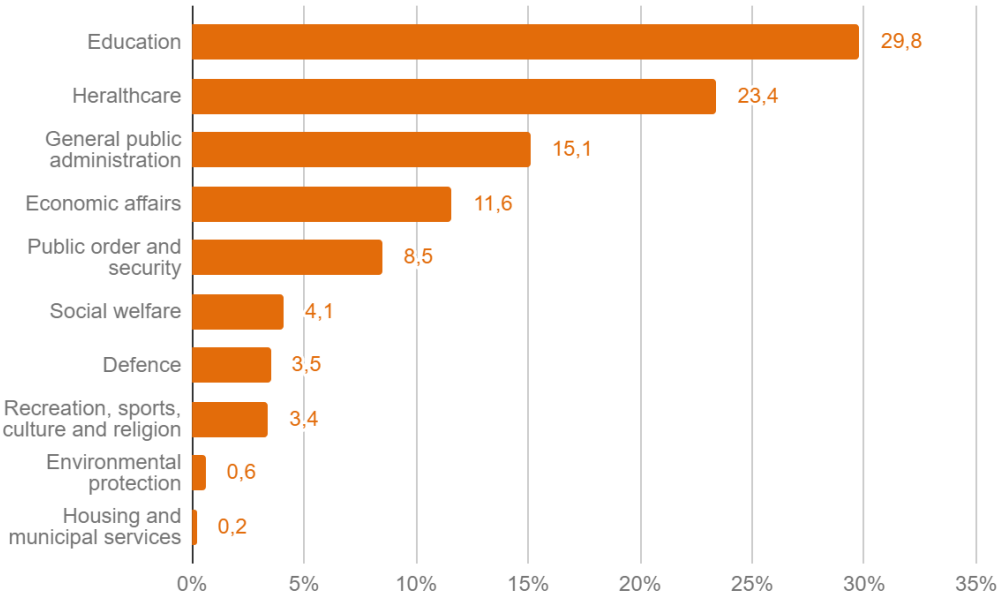

Figure 4: Staffing levels in the Austrian government sector 2015 (Federal Ministry for the Civil Service and Sport, 2018).

Acess to public service is a main condition to live independently. However, the large number of various providers can easily lead to difficulties and might be confusing. With increased age this becomes more and more difficult.

Digital Public Services

Researches show that the digitalization is recognizable in the field of public service. One report from 2017 of the European Commission shows significant improvement of digital public services and accessibility to public websites for mobile devices in the EU member states. The study also points out that there is a need for improvement of transparency in public service delivery. Furthermore, the study indicates the need for use of supporting technology like eIDs or eDocuments (European Commission, 2017).

Considering the increasing offers of digital public services, the EU funded a project called Mobile Age. This project helps older people to access public services digitally. As public administrations are becoming more digitalized, there is s risk of the elderly feeling excluded from public services. Older people do not always have access to the internet and are not familiar with mobile devices and information and communication technology (ICT). The project Mobile Age deals with the creation

of elderly-friendly applications. These applications should make administrative tasks easier. Furthermore, it contributes to an active aging process (European Commission, 2018c).

Furthermore, the Austrian government provides digital public services. It provides a platform called *Digitales Österreich*. Citizens can manage governmental issues via the internet. This should be faster and more efficient than the common way (Bundesministerium für Digitalisierung und Wirtschaftsstandort, 2018a).

Moreover, the use of digital media is an important aspect in healthcare in Austria too. The electronic health records (ELGA) provide an infrastructure for all citizens which are cared for by the Austrian health services. The modern information system assists the handling of health data. One part of ELGA is eMedication. Doctors have the access to an overview of the patient's medication which is only available on prescription or relevant to avoid bad side effects (ELGA GmbH, 2019). eMedication is important for elderly because they often need to take several different types of pills.

One of the biggest problems of digital public services is that these opportunities require a basic knowledge concerning internet, digital media and mobile devices. Thus, the digital public services and applications are often hard to use for elderly. However, especially the generation of medium-aged adults can profit from new ICT and media. Managing some issues from home would help elderly to increase their quality of life. However, this means that mobile applications and services have to be elderly-friendly to expand the usability for the older generation so that the goal of living independently can be achieved. (European Commission, 2018c).

In daily life citizens are facing various digital support applications. Electricity providers for example often provide support application to handle accounting or custom services. Moreover, one can find these support applications in several other sections of public service. Concerning public transport for example online tickets are in common use. One can buy and download a ticket for train or bus via the internet, which would be a further example of digital public services.

2.3 Overview of Active Assisted Living Technology

In the recent years many assistive technologies appeared. The new developments in information and communication technology (ICT) aimed at empowering people's capabilities to satisfy human needs with the help of a digital environment. Active assisted living (AAL) technologies have the goal to support especially older adults

and people with special needs concerning topics like independent living, improving health or communication. Tools for medication management, an emergency response system or a fall detection system can improve safety and independence of elderly.

Another important part of AAL is communication. AAL technologies can help older people to communicate with friends and family in a simple and customized way (Dohr, Modre-Opsrian, Drobics, Hayn, & Schreier, 2010; Rashidi & Mihailidis, 2013). The major goal of AAL is to extend the time elderly can live in their own home by supporting activities of daily life, foster autonomy and increasing safety of their home and in lifestyle in general (Dohr et al., 2010; Sun, Florio, Gui, & Blondia, 2009). AAL is one important part in the digital health context. It describes all technologies which support living independently (Knöppler, Neisecke, & Nölke, 2016, p. 7, 27).

As explained in *2.1 Gerontology* the aging process is accompanied by physical changes. These new circumstances can be supported by technology. In this context the *European Union* (EU) speaks from an "active and healthy aging". The EU supports many projects concerning active aging (European Commission, 2018b).

The AAL joint programme with its slogan "Aging Well in the Digital World" is a funding programme of the EU that aims to create better quality of life for the elderly. One goal of the AAL programme is to foster the emergence of ICT-based products and services for aging in a good way at home and in the community. Furthermore, the programme wants to create a critical mass of research and development in technology for good aging at EU level. Moreover, it provides a European-wide framework that supports the development of standardized solutions. The AAL programme is co-financed by the European Commission. Since the programme has started it funded 220 collaborative projects in Europe working in products for improving the quality of life for older people (AAL Association, 2019).

One example of a funded project is the *Domestic Robot for Elderly Assistance* (DOMEO). DOMEO helps older or disabled people to live independently at home as long as possible. Due to internet access and dedicated applications the users can stay in permanent connection to the outside world. The project focused on developing a possibility to communicate and interact decrease isolation (European Commission, 2018a).

Not only in the EU but also in Austria many AAL projects get started. In 2012 the platform *AAL Austria* was founded. Goal of *AAL Austria* is to provide a network to expand the AAL community. The network has several members spread across

Austria. One aim is it to make AAL well known in society. Additionally, AAL supports a lot of projects in Austria. Each of these projects is dedicated to increase independence of the elderly. Furthermore, developed products should be adopted to the needs of the elderly. Another important aspect is that the new ICTs should fit in the daily life of an older person. In eight testing regions projects were funded. The aim of this projects is to define solutions for new smart home systems especially for the elderly (AAL Austria, 2019). Despite the many efforts in developing technology concerning AAL, there are just a few products on the market. A lot of projects are currently in the testing phase. However, the handling is often too difficult for the elderly. An additional challenge is the purchase of expensive applications or mobile devices. The work of this master thesis aims at developing a simple software which can simply be used on a tablet.

2.4 Video-Assisted Online Communication

2.4.1 Video Communication

Video calls are a widely used form of communication and offer a lot of opportunities. To see each other during a conversation allows to perceive emotions and builds up more trust than with voice-only phone calls.

Commonly used software for video communication currently on the market are *Skype* or *WhatsApp*. Figure 5 shows the world wide amount of monthly users of the common video communication software (Brandt, 2018). The users can send text messages to stay in contact with family and friends which is described as the most popular function. Because of that, the video communication is getting more and more popular. Another growing use case is the simple communication with companies (Mösender, 2018).

These messaging systems are designed to be operated by people who are used to digital media technologies. They can profit from the various functions and the possibility to communicate.

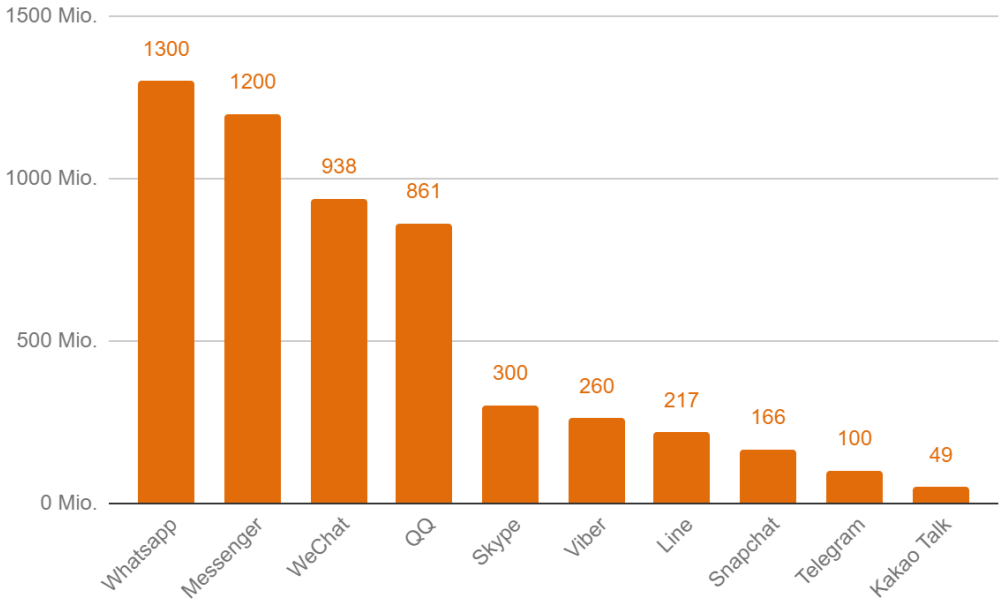

Figure 5: Monthly active users of communication software worldwide (Brandt, 2018).

The problems start to occur when people from an older generation try to use these systems. They did not grow up in a digital environment and therefore have difficulties in using more complex software. The amount of functions and the complex usability might overwhelm or confuse such users. Some functions are even hidden or not intuitively to perform. This is most likely one of the root causes why elderly are not able to or do not want to use these software systems (Awada, Mocanu, Florea, & Cramariuc, 2017). Usually, the interfaces are overloaded with information which leads to an even more difficult usage. Another aspect is that gesture control for elderly is not that intuitive than for younger users (Salman et al., 2018). These applications need to be simplified and redesigned in an elderly-friendly way so that seniors can also profit from new ICTs and do not feel isolated.

2.4.2 **TokBox**

TokBox is a Platform as a Service (PaaS) company and provides the infrastructure to maintain a secure conversation via internet. *TokBox* functions as a WebRTC platform (TokBox, 2018). RTC stands for real time communication. A WebRTC is an open source standard that enables real time communication via the internet with a simple application programming interfaces (API). It allows video and audio communication to work within webpages or applications. It provides three APIs: camera and microphone access, sending and receiving media as well as sending non-media directly between browsers. The standard is currently supported in

Mozilla Firefox, *Google Chrome* and *Opera*. It can also be used for programming *Android* or *IOS applications* (W3C, 2019). *TokBox* developed OpenTok, which is a platform for adding video and audio communication as well as a messaging service to websites and mobile applications. The company provides tutorials and Software Development Kits (SDKs) to support while coding. TokBox offers the infrastructure for a secure communication via the internet. OpenTok can be integrated in commercial applications as well (TokBox, 2018).

2.4.3 Communication Software Systems Currently on the Market

The following section describes two products that are similar to the topic of this thesis. Although there is little competition in Europe concerning communication software for the elderly, the two following examples were selected. Both of them integrate the goals of the thesis differently. The first product was developed for the elderly to minimize loneliness. The second one comes from the industrial sector and aims to answer questions concerning industrial machines with the help of Augmented Reality (AR).

KOMP

KOMP is a project from the Norwegian start-up *No Isolation*. Its goal is it to reduce loneliness and social isolation by developing communication tools. KOMP is a product which looks like a small tv screen and has one button on the lower right corner. This button is not a touchscreen button but one big, accessible one. That's the reason why KOMP requires no digital knowledge. Children and grandchildren can share photos or messages with their "analogue" older relatives. Furthermore, they can make video calls. It is easy to use because of a high contrasted screen, a clear audio connection and a one-button, physical interface. Besides this device, *No Isolation* offers a family application which builds the bridge between relatives and seniors. This projects got supported by the EU (No Isolation, 2019).

However, at the moment it is not possible for the senior to call the children and grandchildren on her/his own. The seniors are dependent on their relatives to call, so they cannot fight loneliness on their own. They have to wait if a relative wants to talk or send pictures.

Vuforia Chalk

Vuforia Chalk is a collaboration application that empowers people to solve technical difficulties in a fast way. It provides appropriate instructions and guidance for technicians quickly. The application got developed by *PTC Inc*, a company based in the United States (PTC Inc., 2018).

This type of application is called an AR remote assistance. If guidance concerning technical problems is needed, Vuforia Chalk makes it possible to solve problems although certain situations are not covered in training or service manual. Expert and technician can accurately markup live video views to highlight details and describe difficulties well. Moreover, experts can guide through solutions. By using this application, potentially costly mistakes in handling machines can be reduced (PTC Inc., 2018).

The use of AR makes it much easier to describe a problem to someone else. The helping conversation partner knows about problems more detailed and can explain the solution again with the use of AR. This increases the understanding on both sides. The handling and the application in its actual design are customized for technical support. By adopting the interface and simplifying the functionality it offers possibilities for other user groups as well.

3 Requirements for a Video-Assisted Public Service Support Software for the Elderly

The requirement elicitation is a substantial part of a user centered design (UDC) process for software development. A UCD process consists of 4 predefined steps. Figure 3 illustrates this process. After the research questions got defined, it is important to specify the context of use. This means that information gets collected to define the theoretical background and the use cases. The primary users should be defined as well as the future usage environment (Maguire, 2001, p. 594). After specifying the context of use, one has to identify and specify the user's requirements. Requirements elicitation and analysis is one of the most important parts in software development. They play an important role on whether the future product will be a success or a failure. Two of the most common reasons for failure are an incomplete needs analysis and a lack of involvement of future users in the design and development process. During requirement elicitation it has to be considered that a detailed identification of relevant users takes place (Maguire, 2001, p. 598-599). One possibility to identify with the future user group is the creation of personas. A persona provides the possibility to represent the user's needs (Maguire, 2001, p. 600). In section *3.1.1 Personas* the process of creating personas is described. The next step in the UCD process is designing and prototyping. Considering the received knowledge about usage context and requirements of the user group, the design process starts by creating mock-ups. Followed by coding the first draft of the software, a functional prototype gets developed (Maguire, 2001, p. 610). The last step of the UCD process consists of the evaluation of the prototype. The usability gets tested as well as valued in the end of survey (Maguire, 2001, p. 611-614).

In the following chapter the user group will be described. One goal is to develop a functional prototype of a Public Service Support (PSS) software for older people. For the part of requirement elicitation, personas are going to help for a better understanding of the user group. Furthermore, it shows special requirements of the user group concerning the development of a software. Additionally, this chapter gives an overview about functional and technical prerequisites which ensure a good usability of the video-assisted PSS software. The PSS software will consist of two different applications which interact with each other. One application gets

installed on the senior's mobile device. The other application has more functionality and needs to be installed on the relative's mobile device.

3.1 Definition and Description of the Future User Group

The video-assisted PSS software is designed for a particular user group. This user group has some criteria which are described below:

Inclusion Criteria:

- retired people aged 65+
- living in an independent household
    - The user doesn't live in the same house as her or his younger relatives.
- low media literacy
- basic interest in new technology
- regular need of advice concerning public service documents
- wish of regular participation in family life and communication with relatives
- access to internet

Exclusion Criteria:

- not able to operate the PSS application
    - because of for example cognitive/visual/auditive disabilities

3.1.1 Personas

Personas are a good kind of way to illustrate a detailed sample of a person in a specific user group. They represent the user's needs. A Persona has a name and personality and is associated with at least one scenario of use. A persona points out the motivation and needs of the user group (Maguire, 2001, p. 600-601). Important to mention is that the described personas are fictive. It illustrates a fictive user who does not exist as a specific person but combines the beliefs and preferences of a homogenous group of users. The description is based on information from potential and real users. The creation of personas helps to get ideas for the design and functionality of software products and systems. It is a good way to identify with the users and think like themselves within the process of design and development. Additionally, the persona gives the opportunity to create a detailed idea about how the user will operate the product and in what context the

product will be used (Nielsen, 2013, p. 1). It defines the characteristics of the elderly with similar goals, behavior patterns, motivations and expectations like a real person of the user group (Jakkaew & Hongthong, 2017).

Based on the literature research and the observations in the field of work as occupational therapist older people often struggle with activities of daily life. According to these experiences two different personas got created. Figure 6 and 7 show the description of these personas. First the personal and family background is written down. After that the problems are described followed by the persona's needs and wishes. These two people present typical user for the video- assisted SSP application and will work as basis for design and development phase.

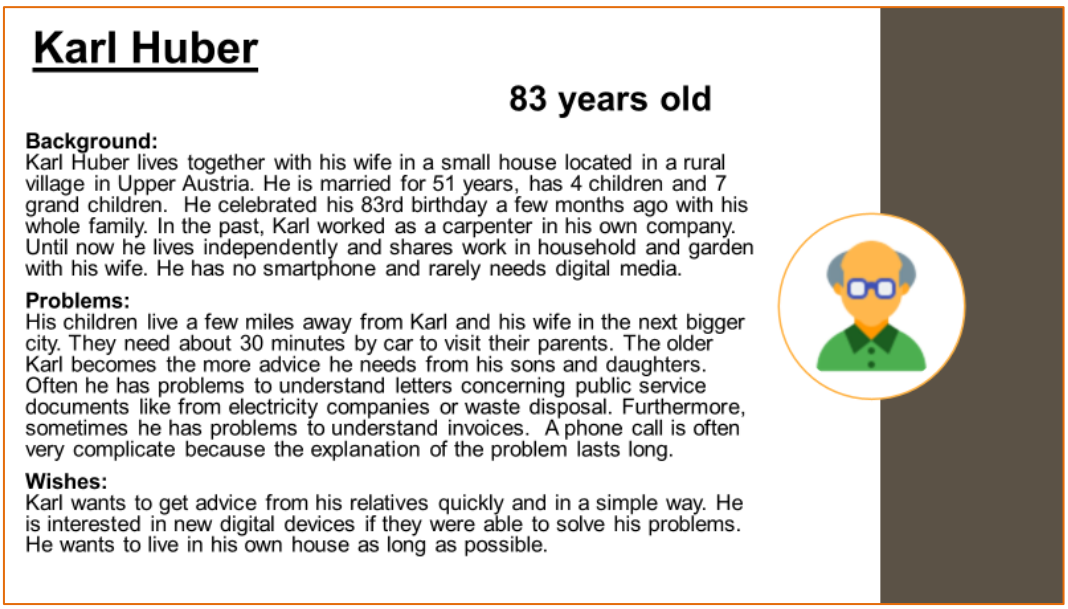

Figure 6: Persona "Karl Huber".

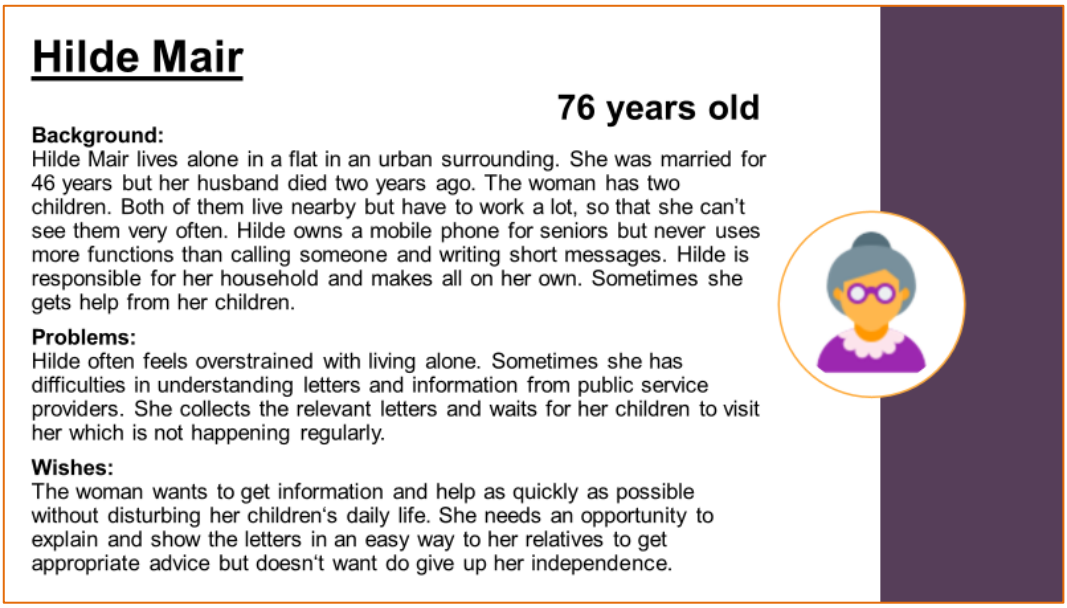

Figure 7: Persona "Hilde Mair".

Looking at both personas one can see that their personal background is completely different. However, both have the same troubles and problems in life. Hilde Mair as well as Franz Huber sometimes need help to live independently. From time to time they have difficulties concerning public service documents. A new and simple technology could help to solve their problems as quickly as possible.

3.1.2 Requirements for the Elderly to Use Interaction Technology

This section deals with the characteristics of the user group which has to be considered for the software developed within this thesis. *2.1 Gerontology* gives an overview about the impact of aging for a person and its effects on body conditions.

First, the design of a software for a mobile device must consider the application to fit into the small display. That means buttons should have an appropriate size for clicking. Second, the amount of provided features has to be reduced. Only relevant and necessary functions should be available in mobile applications. Because of the display size every wasted space has a negative effect on the further use and makes the interface more confusing (Nielsen & Budiu, 2013, p. 69).

Especially for older, less media-literate people a reflected user interface is important to prevent reluctance or rejection. One aspect is that the use of gestures should be eliminated as far as possible for more intuitive usability. A simple “tap” should be integrated as main and sole gesture. Another important aspect for elderly is to make it obvious that their action has an effect by providing immediate

feedback. This should be a mix of a visual and an auditive feedback and it should be always the same response for the same actions. Furthermore, an elderly-friendly interface is necessary. The first category which will be described below deals with aspects concerning appearance of user interface elements followed by principles for language use (Salman et al., 2018).

Design Principles for Appearance (Salman et al., 2018)**:**

- An element of a user interface is supposed to be in the most visible color and in a noticeable size.
- Sensitive and important elements ought to be in a visible area.
- "Tap-able" elements are obviously recognizable and supplemented with text.
- Uncommon and drastically new design have a negative effect on usability.

Design Principles for Language Use (Salman et al., 2018)**:**

- Ambiguous terms have to be avoided. Familiar vocabulary is to be preferred for elderly to clearly indicate functionality.
- The software benefits from combining text and icons.
- The user interface is supposed to be supported by instructions.
- Unique, precise terms for different user interface elements helps to get a better usability.

The most important information is supposed to be in front. Moreover, it is important to avoid unwanted information on the display. The user interface can be supplemented by visual cues to be aware of hidden content (Salman et al., 2018).

By developing a software for the elderly, possible physical and cognitive body changes need to be considered. Becoming old is accompanied by changes in motor movements, cognitive functions as well as sensory processing. This effects on how the elderly are able to use the video-assisted PSS application. The changed motor functions have an impact of how they can manipulate or control the device. Cognitive impairments can create difficulties in learning the handling of the application and remembering important information. A good principle for designing and developing for elderly is "less is more". Less but relevant information helps elderly to control and use a software more satisfyingly. (Jakkaew & Hongthong, 2017).

3.2 Definition of Use Cases and Prerequisites for the Public Service Support Software

The prototype of the PSS software consists of two applications that interact with each other. The design process and the final prototype are described in chapter 4. This section gives an overview about use cases which got derived by the requirements elicitation. The use cases describe the necessary functionality to meet the requirements.

3.2.1 Use Cases for the Public Service Support Software

The application should have several different use cases. The initial situation is that a senior wants to communicate with his or her younger relative because of a problem concerning daily life or public service. The older person is faced to challenges appearing because of public service documents. The senior needs quick advice from a relative to understand the document as well as to plan necessary actions. Therefore, the older person has the PSS software installed on a tablet. Also, the relative has an application on a mobile device. A basic understanding for application handling is one condition for the relative. The relative's application and the senior's application have different functionality wherefore they are coded separately. Both applications are necessary to use the PSS software. For a better differentiation two logos were designed. Figure 8 shows the different logos. Both applications together can be understood as the video-assisted PSS software "Frag nach!". The target users are Austrian citizens. That is the reason why the title of the PSS software is in German. An English translation for the title would be "Ask for!".

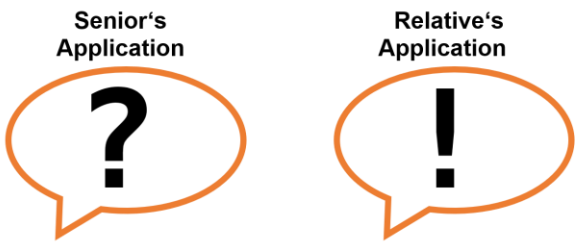

Figure 8: Application logos.

Use Case 1: How to Call

The first use case is about calling, which is shown in Figure 9. The senior is able to call the relative after opening the application on the tablet. The user opens the

application with a tab on the icon. With one click he sends a call request to the relative's app. The relative can accept the call and in both applications the talk activity is displayed. The applications communicate via *OpenTok* with each other. That means by sending a call request a signal is sent to *OpenTok*. This signal gets transmitted to the relative's application. After accepting, it sends a signal back to the senior's application.

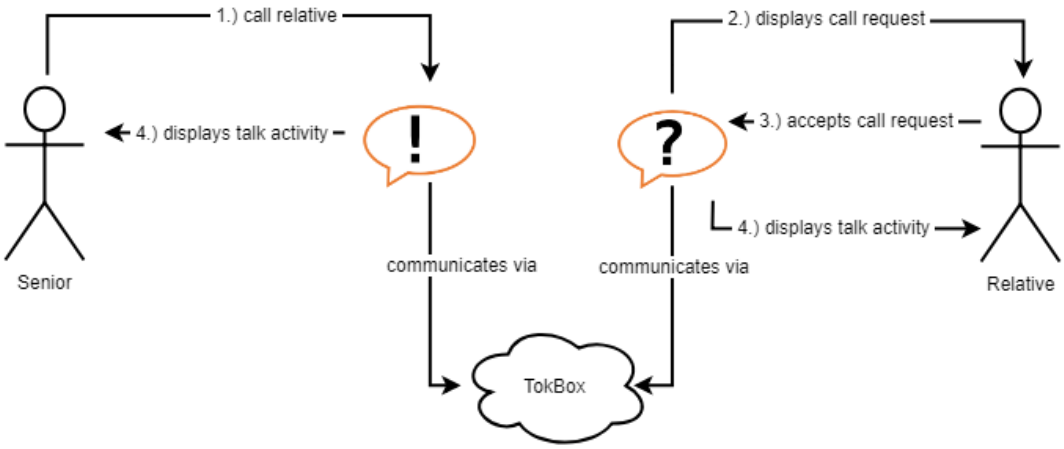

Figure 9: Use case 1: How to call.

Use Case 2: How to Talk

A further use case is "Talking" to each other with some further functions which are described below. This use case is visualized in Figure 10. The applications send and receive video and audio during the whole sequence of talking. The senior can see the relative on a big screen and the own video in a small frame in the upper left corner as well. The same screens but reversed are visible for the relative as well. The two participants can now conduct a conversation. The senior has the possibility to explain her or his problem to the relative who is able to switch between the senior's front camera and the back camera. So, the relative can see the relevant document. The relative can take a photo and read the words on her or his own device for a better understanding. During this process they are able to talk to each other as usual, only the visible video screens change. After taking a photo the relative can switch the camera view again and they are able to continue their conversation with the screens described at the beginning.

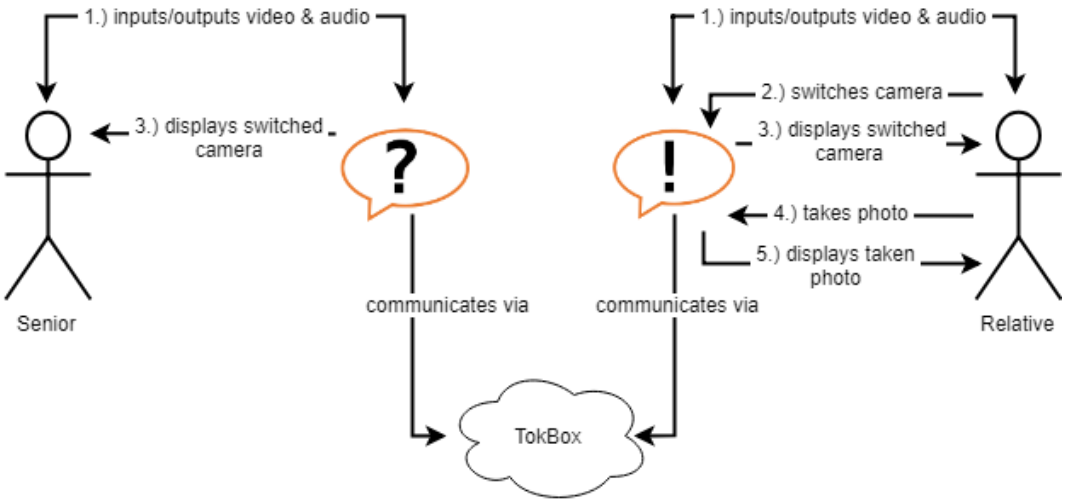

Figure 10: Use case 2: How to talk.

Use Case 3: How to End a Call

Another use case is presented in Figure 11. If the senior is satisfied with the relative's advice and the problem is solved, she or he can end the call with one click. In this case the talk activity closes for both conversation partners.

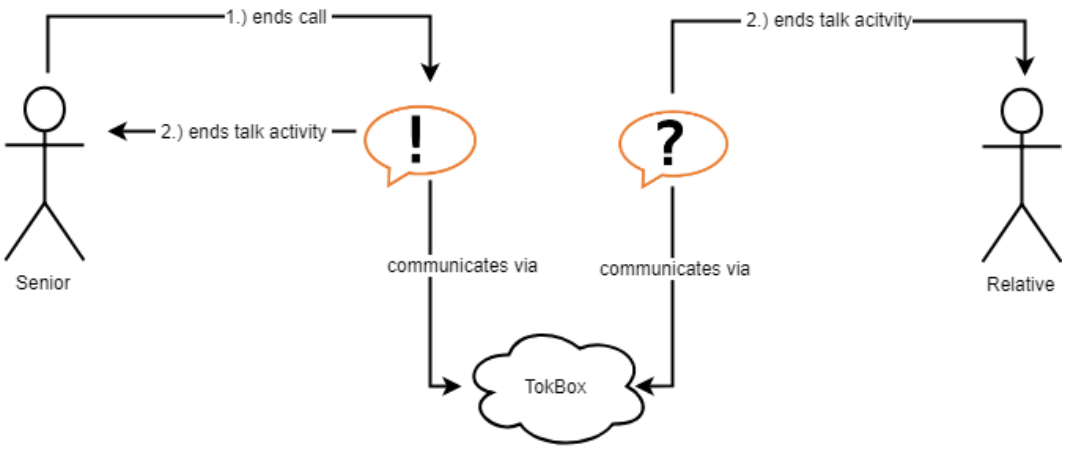

Figure 11: Use case 3: How to end the call.

3.2.2 Technical Prerequisites

The lists below give an overview about technical prerequisites concerning hardware and software. These preconditions are necessary for the use of the video-assisted PSS software.

Hardware Prerequisites

Table 1 shows the prerequisites concerning hardware. It is obvious that the possession of a mobile device is necessary to use the applications which communicate together and form the main part of the PSS software. In case of the senior it is an advantage that the device is a tablet or at least a large sized smartphone because the user interface gets adjusted to a big display to make the usage simpler. Furthermore, the user interface elements can be designed larger. For the relative it is not important which device she or he will use. The application fits in every screen size. Both mobile devices must have the ability to connect to the internet. The applications interact with each other and with the server via the internet. The front camera enables the two participants to see each other while talking; the resolution doesn't play an important role in this case. The resolution certainly plays a central role for the back camera of the senior's device. The resolution of this camera has to be good enough to take a picture on which the relative can for example read words from a document afterwards. The relative should see a sharp picture even if it is zoomed. A microphone as well as speakers should be integrated in both devices to conduct a conversation.

Table 1: Hardware prerequisites.

	?	!	**description**
mobile device	✓	✓	senior: large sized smartphone or tablet relative: arbitrary mobile device
internet connectivity	✓	✓	how to access to the internet can be chosen by the user e.g. Wi-Fi
front camera	✓	✓	camera facing the user
back camera	✓	✗	moderate resolution
microphone	✓	✓	integrated in the mobile device
speakers	✓	✓	integrated in the mobile device

Software Prerequisites

Besides the hardware prerequisites also software prerequisites are needed for the application usage. These are described in Table 2. Because the applications are coded in *Android Studio Code* the two devices need to run with an android operating system. If that is the case, the applications can be installed. The minimum version of the operating system is 5.0, “Lollipop”. The relative’s device additionally requires a gallery application to display the taken photos. The photo shows up immediately after it was taken but can also be viewed after the conversation.

Table 2: Software prerequisites.

			**description**
android operating system	✓	✓	min. version 5.0 (“Lollipop”)
gallery application	✗	✓	app for displaying pictures

4 Design and Prototyping of the Video-Assisted Public Service Support Software

After the requirement elicitation, the code development starts. The use cases are defined in the subsection *3.2.1 Use Cases for the Public Service Support Software.* The next part of the user centered design (UCD) process is designing and prototyping. The goal is to code a functional prototype of a public service support (PSS) software especially for the elderly. The older people should have the opportunity to call a relative if they are facing challenges with public service documents. A video-assisted software consisting of two applications, one for the senior and one for the relative, should provide quick and easy help. The first step is the visualization of the mock-ups. Subsequently considerations about the application architecture will take place. After these steps the actual prototype is going to be coded. The application will be developed for German speaking seniors. Because of that, the language in the application as well as the title are German.

4.1 Mock-Ups

Mock-ups are important to have the possibility to visualize the interface concerning all aspects of the requirements analysis. The mock-ups provide a look at the future software without having to build the underlying functionality. The design of the mock-ups should be as simple as possible. Figure 12, 14 and 15 illustrate the senior's interface. The senior's application will be developed to fit a tablet's screen. A tablet can provide a bigger screen and its handling is easier than those of a smaller mobile device. The relative can open her or his application with the device of her or his choice. Figure 15 shows one possible screen at a relative's view.

Figure 12 shows the first draft of the senior's user interface of the start screen. There is as little information as possible and just a few buttons to click. After opening the application the senior can choose which relative he wants to call. The relatives are illustrated by images with the name below.

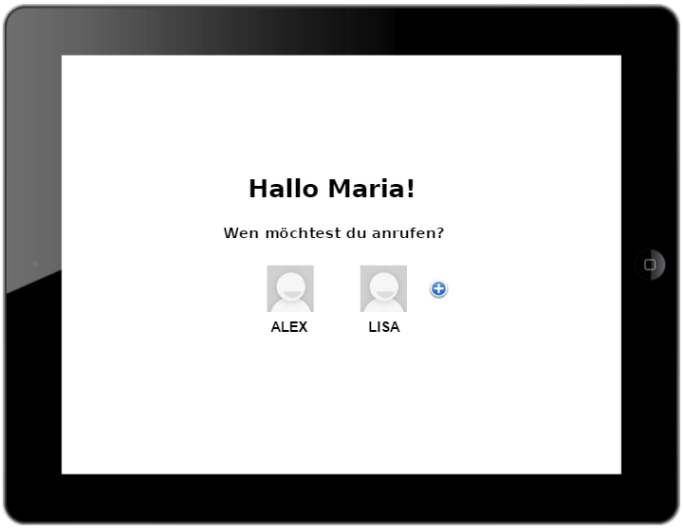

Figure 12: Mock-Up: senior start view.

While dialing one's relative another screen will appear. Figure 13 shows how this screen should look like.

Figure 13: Mock-Up: senior call view.

For talking a third screen gets illustrated. How the screen may look like can be seen in Figure 14. The senior is able to see his own camera output in the smaller box in the upper left corner. The video which is made from the relative's front camera can be viewed by the senior in the bigger box in the center of the screen.

The senior should have the opportunity to end the call wherefore a button to hang up will be displayed at any time during the call. The relative has a similar view while talking.

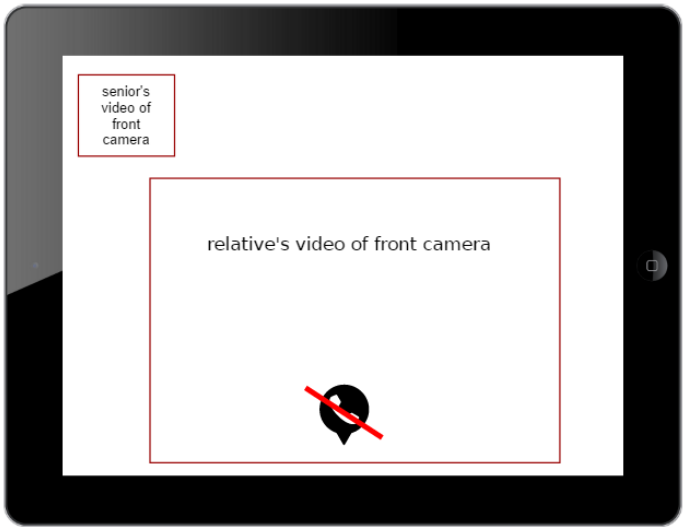

Figure 14: Mock-Up: relative talk view.

For her or him the senior's video is in the bigger box and the own video is in the smaller box (Figure 15). The relative will have more functionality while talking. The relative can also end the call, as it can be seen in Figure 15 as well. Additionally, there are buttons for switching the senior's camera as well as for taking a photo.

During this process of design, the most important aspect was to keep the senior's interface as simple as possible. The senior doesn't have many opportunities concerning functionality which makes the probability of mistakes lower.

The shown mock-ups provide a template for coding. The designs are simple and consider the requirements which are described in chapter *3*.

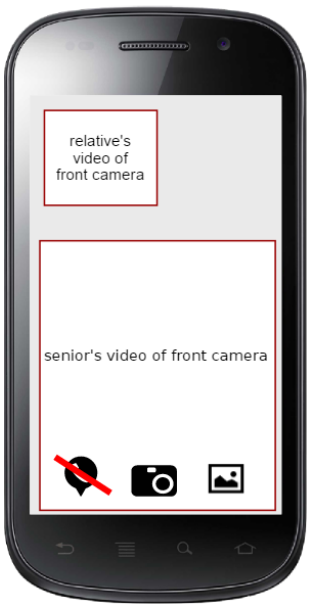

Figure 15: Mock-up: relative talk view.

4.2 App Architecture

The PSS software consists of four components which communicate with each other in a certain way. Figure 16 gives an overview about these components and how they interact.

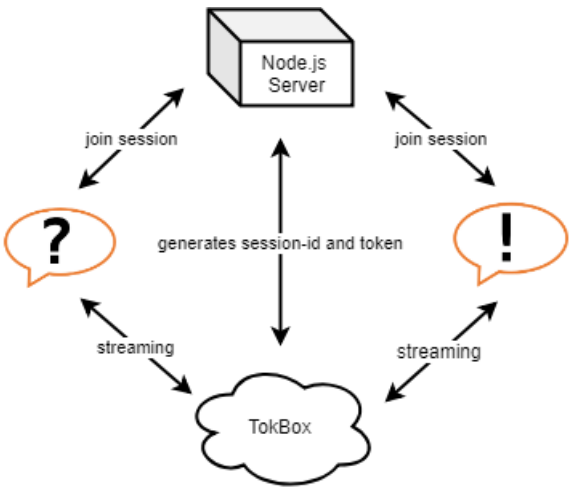

Figure 16: Application architecture.

Node.js Server

Node.js is an open source server environment. It runs on various platforms like *Windows* or *Linux*. The server executes JavaScript code outside a browser. An interesting aspect is that *Node.js* uses asynchronous request handling. That reduces the waiting time for a request and allows faster continuation of the next request in line. *Node.js* can generate a dynamic page content and is able to create, write, open, read, close and delete files on the server. Furthermore, it can add, delete and modify data in a database. A *Node.js* application contains functions and tasks that are waiting for events to be executed. First of all, a *Node.js* application has to be initiated on a server. After the initialization events can take place (Refsnes Data, 2019).

For the PSS software the *Node.js* server generates a new session for talking when started. Additionally, the server generates a new session every 24 hours, always at 0:00. For this session generation the *Node.js* server sends a request to the platform *OpenTok* developed from *TokBox.* With the request, an api-key and an api-secret is sent to *OpenTok* to authenticate and to get the relevant information. Listing 1 illustrates the code of the *Node.js* server. This figure also shows that the modules “node-schedule”, “opentok” and “http” must be loaded which allows the use of needed methods for scheduling, requests to *OpenTok* and HTTP request handling. When a new session is generated the *Node.js* server is able to provide the session-id and a token to open a stream.

```
1     var schedule = require('node-schedule');
2     var OpenTok = require('opentok');
3     var http = require('http');
4
5     var port = 8082;
6
7     var apiKey = *********
8     var apiSecret = ********************************
9
10    var sessionId, token;
11
12    var opentok = new OpenTok(apiKey, apiSecret);
13
14    generate();
15
16    schedule.scheduleJob("0 0 * * *", () => { generate(); });
17
18    function generate() {
19      opentok.createSession(function (err, session) {
20        if (err) return console.log(err);
21
22        sessionId = session.sessionId;
23        token = opentok.generateToken(sessionId);
24      });
25    }
26
```

```
27    var app = http.createServer(function (req, res) {
28      res.setHeader('Content-Type', 'application/json');
29      res.end(JSON.stringify({ sessionId: sessionId, token: token }));
30    });
31    app.listen(port);
```

Listing 1: Node.js server

OpenTok

TokBox developed the platform OpenTok which provides the server that is used to send and receive data while the users are talking with each other (TokBox, 2018). The company TokBox is described in *2.4.2 TokBox.* It is a WebRTC platform that enables applications to embed video and audio streaming as well as messaging (W3C, 2019). With the first registration one gets an api-key and an api-secret. These two variables make it possible to generate a session-id and a token, which in turn enable the applications of the PSS software to find each other and connect to the same session.

The Interactions Between the Components:

- *OpenTok* / *Node.js* server

During this interaction the session-id and the token are generated. The *Node.js* server sends a request with the needed api-key and api-secret to *OpenTok* to authenticate and to get the relevant information. The *Node.js* server provides the session-id and token in JSON-format for upcoming requests.

- *OpenTok* / PSS applications

Via *OpenTok* it is possible to communicate. For streaming audio and video data, the TokBox server is needed. The android applications can communicate with each other by connecting to a stream running on the TokBox server. For this connection, the session-id and token are necessary to identify the correct stream and to authenticate within the OpenTok environment.

- *Node.js* server / PSS applications

The *Node.js* server enables the user to join a session. The server provides the proper session-id and token and provides this information for the android applications. Therefore, the android applications perform an http-request to the Node.js server.

If the interaction between all four components is upright the video-assisted PSS system can perform correctly.

4.3 Final Prototype and Functionality

Besides the *Node.js* server which is explained in part *4.2 App Architecture* two android applications were coded. The code is written in Java for Android. There are two separate applications – one for the senior with limited functionality and one for the relative. Many areas of the code are similar, but some are different. Part 4.3 describes the two different applications with their functionality and design. Both applications are needed to use the video-assisted PSS software “Frag nach!”.

Title and Logo

The title “Frag nach!” was chosen because it points out directly for what the PSS system is going to be needed for. The elderly can already recognize what they can do with this software by just reading the title. The title is similar for both applications because it functions as one support software. After the title was generated the next step was to design a logo.

To keep both applications apart from each other, two different logos were developed. Figure 8 shows the logos. For the senior a question mark points out that this person has a problem to solve. An exclamation mark is part of the relative’s logo. That’s because she or he aims to have a proper solution or advice for the senior. These two marks are surrounded by a speech bubble to demonstrate that they can communicate via the video-assisted PSS software. One of the finalized logos can be seen as the icons of the application in Figure 17.

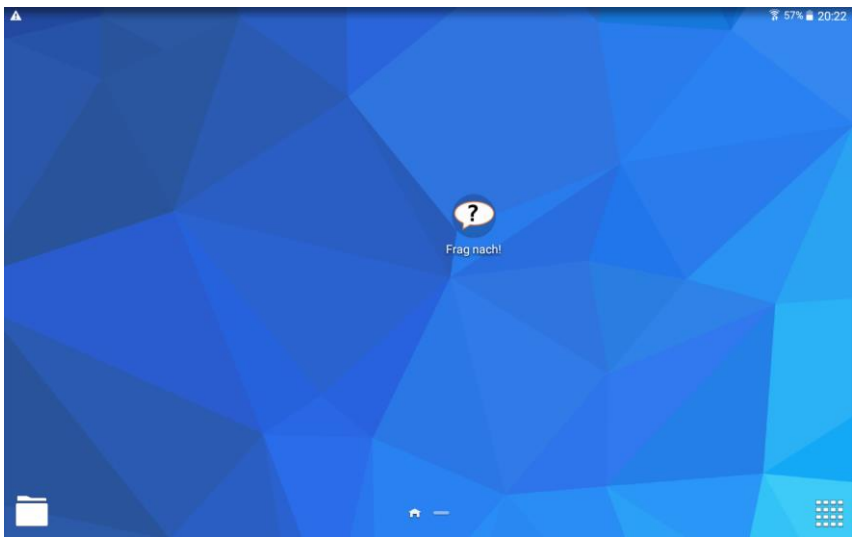

Figure 17: Screenshot: application icon.

4.3.1 Public Service Support Application for Seniors

At the senior's application all functions are as simple as possible. The senior has to tap on the icon to start the application and she or he has to tap on the relative's image to call. The third tap-function is to end the call. Summarized the senior has three different functions during his use. All three are tap-functions. Therefore, the senior only has to learn a single action to perform.

In *Android Studio Code* the application is built up as a gradle project. In total the application consists of three activities and one service. These parts of the project are described in the following sections.

Main Activity

The main activity is responsible for the start screen which appears after entering the application. Figure 18 shows the screen of the main activity. The senior sees a picture of his relative and can call her or him by clicking on it. This is the only function the senior is able to perform here. Textual instructions supplement the functionality to minimize a chance of failure. After tapping on the picture, the application leads to the call activity.

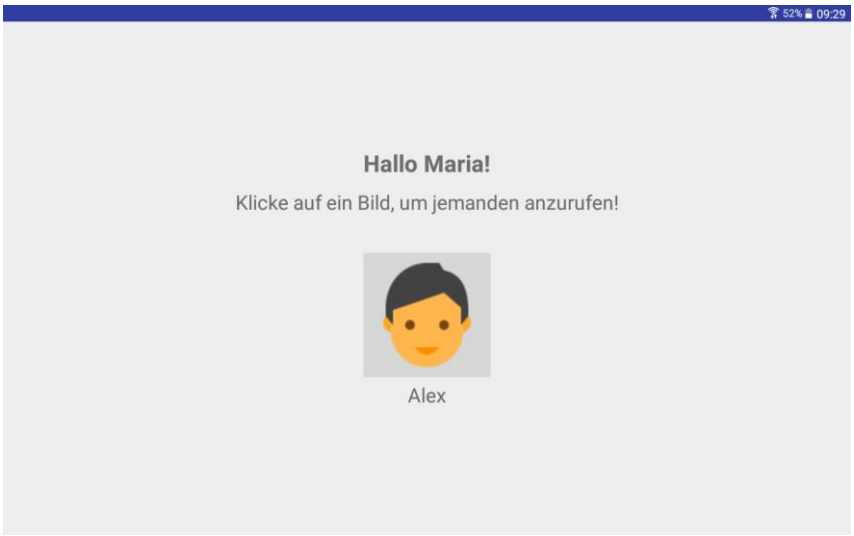

Figure 18: Screenshot: Senior main activity.

Call Activity

The call activity gives the senior feedback that her or his tapping in the main activity had an effect. Again, textual description accompanies visual elements. The image

of the called relative gets larger as well as the text size becomes bigger. The call activity's interface can be seen in Figure 19.

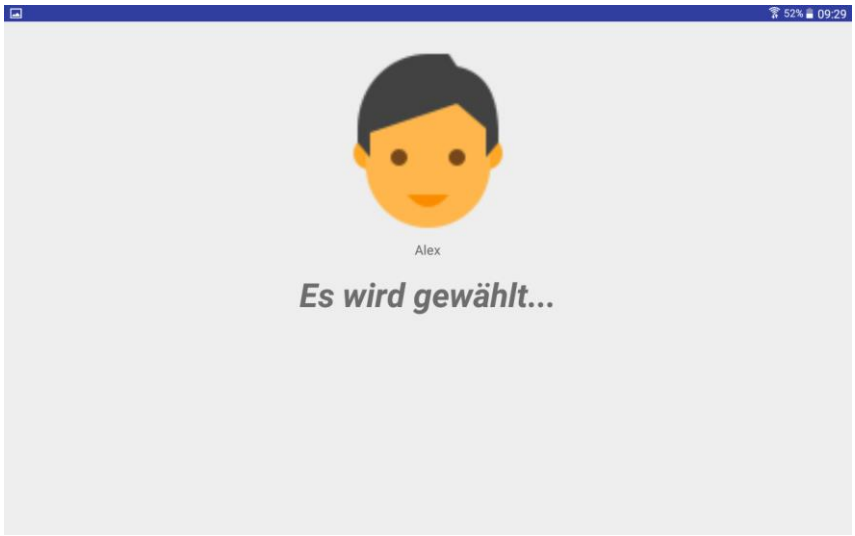

Figure 19: Screenshot: Senior call activity.

Talk Activity

If the relative accepts the call, the application automatically opens the talk activity. Figure 20 shows the appropriate user interface. The small box on the upper left corner shows the own video. The big box in the middle of the display represents the relative's front camera footage. So, the senior can control what the relative is able to see by moving the mobile device around.

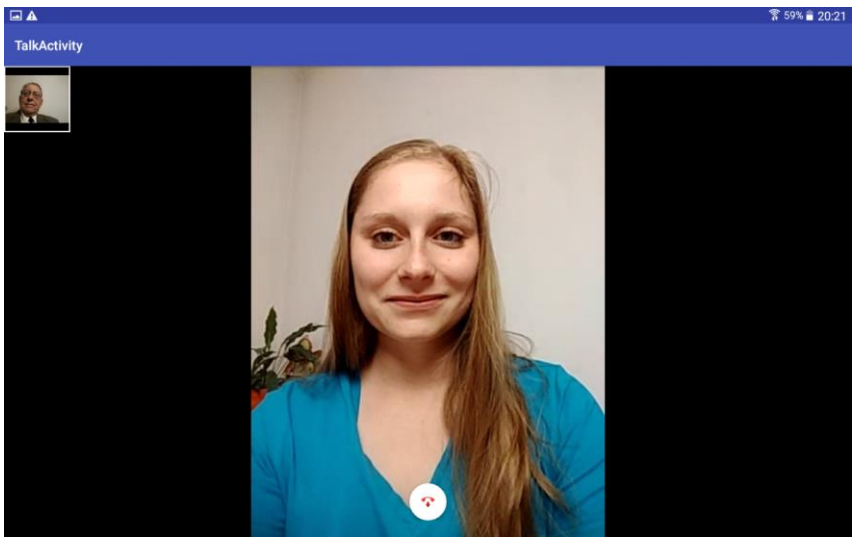

Figure 20: Screenshot: senior talk activity.

The relative has the opportunity to switch the senior's front camera to the back camera and vice versa – This function is explained in the subsection *4.3.2 Public Service Support Application for Relatives*. If the relative has tapped the appropriate button the senior's view switches. At this point the senior sees her or his own video in the big box and the relative's video in the small one. This happens if the relative thinks he need to see and read the appropriate letter or account on her or his own.

The senior can position his device in a proper way to enable the relative to take a photo. Therefore, it is an advantage that the senior can see her or his video in the big screen. The senior has only one function on her or his device while this activity is active. The person can just talk and describe the problem. Everything else is handled by the relative. If the senior got satisfying advice, she or he can decide to end the call. Therefore, the user has to tap on the icon which is located in the bottom center of the big box. The icon is a red telephone receiver which intuitively is used to hang up. If the senior hangs up the call, the application opens the main activity again. The functionality of streaming is explained in the subsection *4.3.3 Public Service Support Application Components.*

4.3.2 Public Service Support Application for Relatives

The relative's application is equipped with more functionality than the senior's one. The user of this part of the PSS software will have a higher media literacy and the potential to use this application. The structure is similar to the senior's application, but the functionality is different in all activities. These functions get explained below.

The relative's part is built up in *Android Studio Code* as gradle project too. It consists of three activities, two classes and one service.

Main Activity

The main activity (Figure 22) shows up if the user opens the application. It displays an image of the senior who has installed the appropriate application on her or his device. The prototype's functionality is based on the use cases. Thus, the relative has no functions at the main activity yet. The use case shown in Figure 9 demonstrates that the initial call comes from the senior.

Call Activity

If the senior calls the relative, the call activity opens immediately. By tapping on the icon displaying the green telephone receiver, the call gets accepted. In addition to the icon an image of the calling senior is shown which can be seen in Figure 21.

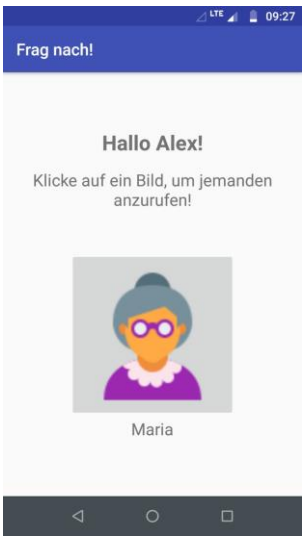

Figure 22: Screenshot: relative main activity.

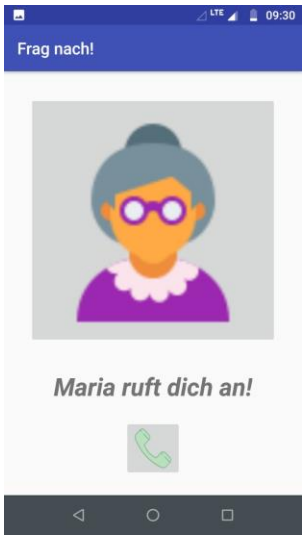

Figure 21: Screenshot: relative call activity.

The icon is accompanied by textual description which supports intuitive handling. If the relative accepts the call the talk activity of both applications will open automatically.

Talk Activity

The relative plays the main role in the talk activity which opens by call acceptance and is demonstrated in Figure 23. When opened, the user sees her or his own video in the small box in the upper left corner and the senior's video in the big box in the middle. The conversation takes place as a usual video call. The senior explains his problematic document or account concerning public service. The relative has two options:

1. The relative understands the problem immediately and knows how she or he can solve it together with the senior. In this case the senior or the relative can end the call by tapping on the icon with the red telephone receiver.
2. The relative needs further information.

If the relative needs further information, she or he can decide to switch the senior's camera view to the back camera. If the senior position her or his device in a proper way, the relative can have a look at the document. The relative can guide the senior how to position the device. In the proper moment the relative can use the third function of the talk activity. The user can take a photo of the document. This image shows up immediately in a gallery application and allows her or him to read the letter or zoom into relevant parts. If the user clicks the return button on his device,

he is back in the talk activity's interface. The functionality of streaming is explained in the subsection *4.3.3 Public Service Support Application Components.*

Figure 23: Screenshot: relative talk activity.

Basic Custom Video Renderer

This is a class which collects data while the talk activity is active. It provides function which can be used in activities and services. It receives the data from the subscription to the stream data sent by the senior's application. The function of this subscriber is explained in the subsection *4.3.3 Public Service Support Application Components.* By clicking on the button to take a photo the collected data gets transformed into a picture. This picture gets saved in the device's external storage. Simultaneously a gallery application opens and shows the picture.

Generic File Provider

The Generic File Provider is a class. It provides a path to an external file (e.g. image) for other applications. It facilitates secure sharing of files by creating an *Uri with a content:// prefix* instead of a file:// prefix for a file. A content URI allows a granted reading and writing access using a temporary access permission (Android Developers, n.d.).

In case of this code an intent which contains this content-URI is created. This intent is received by another external application, for example a gallery app. The permissions are available as long as the Service is running. It is a secure way of using file system permissions.

4.3.3 Public Service Support Application Components

Some parts of the code are identic but are integrated in both applications to ensure functionality. These parts are described below.

Talk Activity – Streaming

As part of the talk activity the application generates a publisher and subscriber which is needed to feed and receive from a stream.

```
1    [...]
2    mPublisher = new Publisher.Builder(this).build();
3    mPublisher.setPublisherListener(this);
4
5    mPublisherViewContainer = (FrameLayout)findViewById(R.id.ownVideo);
6
7    mPublisherViewContainer.addView(mPublisher.getView());
8    mPublisher.startPreview();
9    SessionService.INSTANCE.publish(mPublisher);
10   [...]
```

Listing 2: Code snippet: Publisher.

In Listing 2, line 2 one can see that the publisher gets created via a builder. This builder is provided from an *OpenTok* library which is installed as a gradle dependency. This happens in the *Gradle Build Scripts*. In line 5 a reference to the publisher view container gets allocated which is the small box containing the camera feed of the relative in Figure 23. Lines 7 to 9 describe how the container gets a view added via the publisher and starts a preview, so that the user can see its own video as well. This happens in connection with the session service. Via a stream the data gets published to the other application.

Additionally, the application gets data from a subscriber. This subscriber listens to data from the other application. The code of this process can be seen in Listing 3. A reference to the subscriber view container gets allocated (line 2) which is the large box containing the camera feed of the senior in Figure 23. If a stream is created a subscriber gets built as well as a basic custom renderer gets instantiated, which is necessary for the relative to take a photo. This function is explained in the subsection *4.3.2 Public Service Support Application for Relatives*. The data retrieved via the stream gets displayed on the subscriber view. This in turn gets integrated into the subscriber container so that the user can see the video of her or his conversation partner. This information comes from the session service (line 11).

```
1     [...]
2         mSubscriberViewContainer = findViewById(R.id.seniorVideo);
3         SessionService.addStreamListener(this);
4     }
5
6     @Override
7     public void onStreamCreated(Stream stream) {
8         mSubscriber = new Subscriber.Builder(this, stream).renderer(new
9             BasicCustomVideoRenderer(this) ).build();
10        mSubscriberViewContainer.addView(mSubscriber.getView());
11        SessionService.INSTANCE.subscribe(mSubscriber);
12    }
13    [...]
```

Listing 3: Code snippet: Subscriber.

If a preview is started, OpenTok ensure the sending and receiving of audio and video data.

Session Service

The session service opens parallel to the main activity. The service constitutes the connection to the *Node.js* server as well as between the two applications. On creating the service, it starts a session. The service interacts with the *Node.js* server and gets the session-id and the token as a string. The *Node.js* server provides information as JSON data. With this information the service can provide relevant information to connect to a stream via *OpenTok* between senior's and relative's application. This code is presented in Listing 4.

```
1     [...]
2     private void createSession() {
3         // initialize and connect to the session
4         mSession = new Session.Builder(SessionService.this,
5             API_KEY, SESSION_ID).build();
6         mSession.setSessionListener(SessionService.this);
7         mSession.setSignalListener(SessionService.this);
8         mSession.connect(TOKEN);
9     [...]
```

Listing 4: Code snippet: Create session.

Furthermore, the session service is responsible for sending and receiving small data sets between the senior's and relative's application. This happens with the use of sending and listening to signals. Thus, it is possible to call the relative for a talk. Moreover, signals are used to switch the senior's camera or end a call.

4.3.4 Sequence Diagram of Application Communication

Figure 24 illustrates the functions of the developed prototype of a video-assisted PSS software. The figure is separated in four parts. If comparing these steps with

the use cases (Figure 9, 10 and 11), one can see that the use case “Talking” is described in more detail. “Camera switching” and “taking photo” are part of a single use cases in this figure.

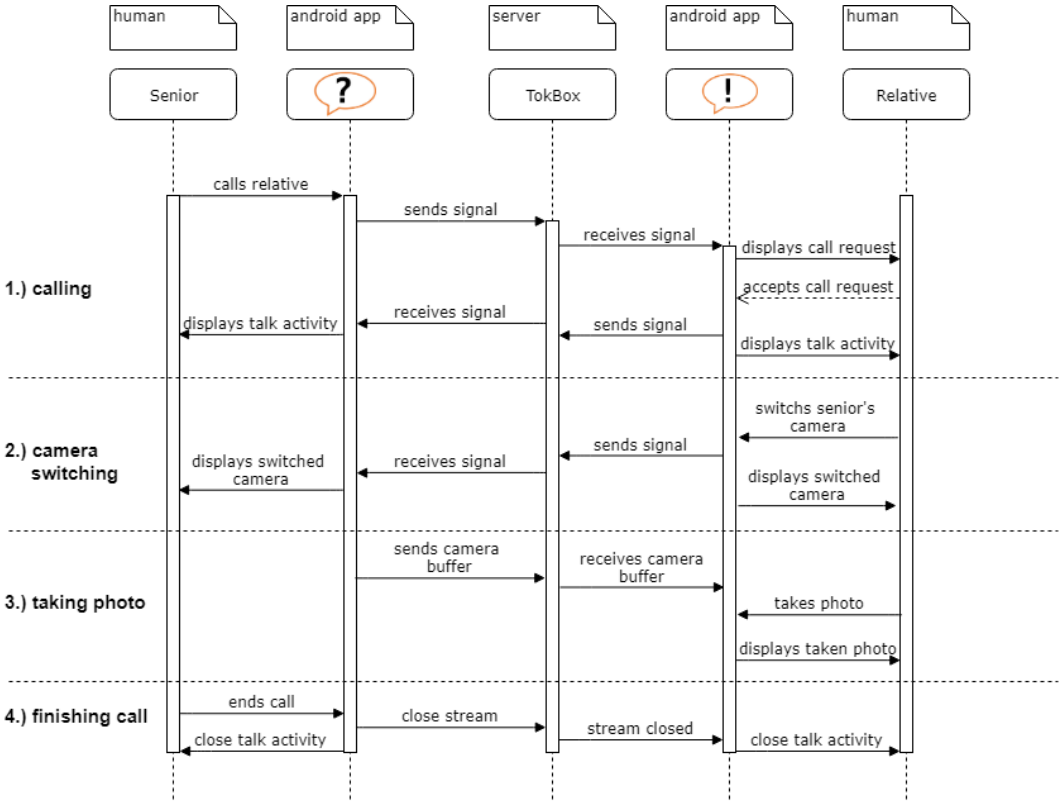

Figure 24: Sequence diagram.

5 Usability Testing and Evaluation of the Public Service Support Software

After the prototype was designed and developed as well as functionality got checked, a survey took place in April 2019 in Upper Austria. Aim of this survey is to test the usability of the video-assisted Public Service Support (PSS) software "Frag nach!". The collected data will be handled sensitively and confidently. The guidelines of the *Datenschutzgrundverordnung* (DSGVO*)* are respected. The data received from the questionnaire and from audio and video recordings are exclusively used for the survey evaluation. A further main aspect is that the participation in the usability test is voluntary. Every participant signed an information sheet. With this sheet they get informed about the aim of the study and the data handling. Additionally, the participants gave their consent of participation on this document. One document is for the participant and one for the study archive. A blank version of this document is attached in the appendix (*A*).

5.1 Participants of the Usability Test

The participants of the study got chosen after the defined inclusion and exclusion criteria described in section *3.1. Definition and Description of the Future User Group.* Five participants join the usability test. Nielson and Landauer pointed out that a sample size of five is sufficient for a small test. These number of participants is able to find almost all usability problems. The study shows that more than five users don't provide appreciably more insights (Nielsen & Landauer, 1993).

In the survey handed out for this master thesis 5 people joined the test. The age ranges from 75 to 83 years. Two male and three female participants did the usability test.

The women are 75, 79 and 81 years old. One female participant graduated with "Matura", which means a high school certificate. The other two female participants graduated at a commercial school. Two of the three women only use mobile devices rarely. Both possess a mobile phone but without internet connection. They use the device just for calling friends and family and rarely to read or send messages. The third participant in this group possesses a smartphone and knows

how to use many functions. This phone has wi-fi and she uses it for calling others. Furthermore, she uses *WhatsApp* and the camera function. The woman knows how to send and receive images. Her media literacy is higher as of the other two women.

The two male participants are 78 and 82 years old. One graduated with “Matura”, the other one joined primary school only. The younger participant of this group has a higher media literacy. He owns a smartphone and tries to use functions like the camera or *WhatsApp*. This happens sometimes with problems but in general he knows how to use such functionality. The 82-year-old male participant has a mobile phone. He uses his device for calling friends and family. The usage goes along with difficulties from time to time. If this is the case, he receives help from his younger relatives.

5.2 Usability Test

The usability test consists of two parts. First the video-assisted PSS application “Frag nach!” gets practically tested. After the usage the participants will be asked to complete a questionnaire concerning usability and experience during usage.

5.2.1 Testing

Test Scenario

The participants are left with a scenario of receiving two letters from an electricity company. The documents describe increasing cost. The participants should figure out why the increasement took place and what they will have to pay in future. Furthermore, there is the difficulty that the electricity company provides night electricity too. The participants are supposed to work out if they are affected of the increased costs of night electricity as well.

To answer these questions as fast as possible the participants are requested to use the video-assisted PSS application “Frag nach!”. A relative will be able to give quick advice.

Test Questions

- How high are the increased electricity costs?
- What has changed?
- Are you affected of the higher night electricity costs as well?

Test Realization

For a positive completion of testing the participants receive instructions. The following list shows these instructions.

- Open the video-assisted PSS application “Frag nach!” with a tap on the application’s icon.
- Call the relative. A call can be made with a click on the relative’s picture.
- Describe your problem to the relative to solve the uncertainties with electricity costs. The relative will guide you through further functions of the public service support application.
- If the problem is solved end the call by tapping on the red phone receiver.

For evaluation these four tasks will be analyzed, and the participants will be compared to each other concerning usage, time duration and comprehension.

The instructions and explanations for the test are given in German and written in a simple language for better understanding. The document of the usability test in German is shown in the appendix (*B*).

5.2.2 Questionnaire

After testing “Frag nach!” the participants get a questionnaire to rate the usability test. This questionnaire is the *System Usability Scale* (SUS) questionnaire which can be analyzed with a standardized scale.

This scale is described to be reliable and of low-cost. It has been proven as a valuable evaluation tool that measures usability. The questionnaire as well as the assessment guidelines are freely available (Brooke, 1996, p. 194).

The questionnaire consists of ten predefined questions about system usability. The answers of the SUS questionnaire are valued with a Likert Scale which means that the participants can disagree or agree to a statement on a five-point scale starting from “strongly disagree” to “strongly agree”. Figure 25 illustrates this scale.

Figure 25: Five-point Likert Scale (Brooke, 1996).

The following list shows the ten statements of the SUS questionnaire (Brooke, 1996).

1. I think I would like to use the system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most of the people would learn to use the system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using this system.
10. I needed to learn a lot of things before I could get going with this system.

For the questioning of the video-assisted PSS application “Frag nach!”, the statements got translated to German. Instead of the textual description of the scale, images were used. A positive smiling face stands for “strongly agree” and a negative looking face for “strongly disagree”. At the beginning of the questionnaire, instructions were given, and the scale got explained and the participants could have a look to this legend. Furthermore, the questionnaire was extended by one open question. The participants had the possibility to write down experiences from using the PSS application.

The adopted questionnaire is attached in the appendix (*C*).

5.3 Test Execution

The usability testing took place in the participant’s own household because that’s where they would use the video-assisted PSS software in reality. In the following list the test process is described;

1. Talking about the information document, explanation of survey’s aim, sign one’s name
2. Explanation of the usability test, present the instruction document
3. Time to get to know the tasks as well as the survey questions
4. Usability testing
5. Answering SUS questionnaire statements

An extensive explanation at the beginning was necessary to ensure a smooth test performance. During the usability test the participant communicated with one of her or his relatives. This made it possible for the test leader to observe the participant while operating the PSS application. Moreover, the test leader could intervene if uncertainties or challenges occurred. The help of the relatives required a broad explanation for them too. These explanations took place in advance to the test. Additionally, the test lead had the opportunity to make detailed notes to the different tasks. The participants were asked to give 30 minutes of their time for the usability test.

5.4 Results

This section deals with the upcoming results. The section is separated in three subitems – the observation results, the *SUS Score* and the open statements for the video-assisted PSS software “Frag nach!”.

5.4.1 Observation and Reflection of Tasks

The participants were interested and motivated to explore the new technology. Three of the participants seemed a bit nervous. They also mentioned that they hope to be able to use the video-assisted PSS system on their own even though they don’t use digital media in their daily life. Two participants acted confidently, who were also considered to have more competence concerning digital media.

Task 1 – Opening the Application

For two participants this task was simple. These two are used to handle a smartphone, so they know how to tap on a touch screen and open an application. The other three participants weren’t that confident. One pressed the icon very hard, the other tapped on the icon too long. Both gestures showed no reaction by the android system. After a short explanation of operating an android device by the survey leader, they managed the first task. The duration of this task reached from one second to around one minute.

Task 2 – Call the Relative

This task was a very short one for every participant. They quickly adopted their actions to the explanation about the gestures. The tapping on the relative’s picture was no problem anymore. All participants managed this task rapidly within a maximum of ten seconds.

Task 3 – Explain and Solve the Problem with the Help of the Relative

The participants had to make themselves familiar with the video call situation. All of them needed a short introduction on how to position the tablet so that the relative could fully see them. After getting to know the situation, all were able to explain the problem very well. The relative explained them the additional functions and switched the front camera to the back camera. Positioning the tablet in the proper way to let the relative read the documents was difficult again. Therefore, three participants needed little help from the survey leader. Two participants managed this sub-task independently. One woman mentioned that she would like to take a picture on her own. All participants could solve the problem satisfyingly. The duration of this part was the longest. It took between 5 and 10 minutes to complete the task.

Task 4 – Hanging up the Call

This task was a simple one for all participants. After the tasks before they had gotten familiar with the tap-gesture. In all tests the relative gave the initial command to hang up. This task needed from one to five seconds.

Summary

The tests pointed out that especially the older participants were not confident in handling an android device. The three older persons often looked back on the instructions and tried to find confirmation from the survey leader. They could operate the software but at the beginning they needed some support. Two participants (75 and 78 years old) had almost no difficulties in handling. For positioning the device for a video call all participants needed help and explanation. The tests showed that the older generation responded well to the easy-to-use software. In the end all test participants mentioned that they would use the PSS application in their daily life.

5.4.2 **Evaluation of the Questionnaire**

As mentioned in one of the sections above the *SUS Score* is composed of ten statements. The statements get scored on a five-point scale which evaluates the strength of agreement. Final scores can reach from zero to one hundred. The higher the score the better the usability of the tested system is. The statements alternate between negative and positive statements which has to be considered in the evaluation. The answers get transformed into point equivalents which reach from zero to four. The sum of all points per question gets multiplied by 2.5 to get the *SUS Score* (Bangor, Kortum, & Miller, 2008). Following the findings of Bangor et al., Figure 26 shows the average adjective ranking of the *SUS Score*. This ranking describes every step of usability with an adjective which makes understanding and interpretation of results easier. Besides this ranking the acceptability ranges can be seen in this figure (Bangor, Kortum, & Miller, 2008).

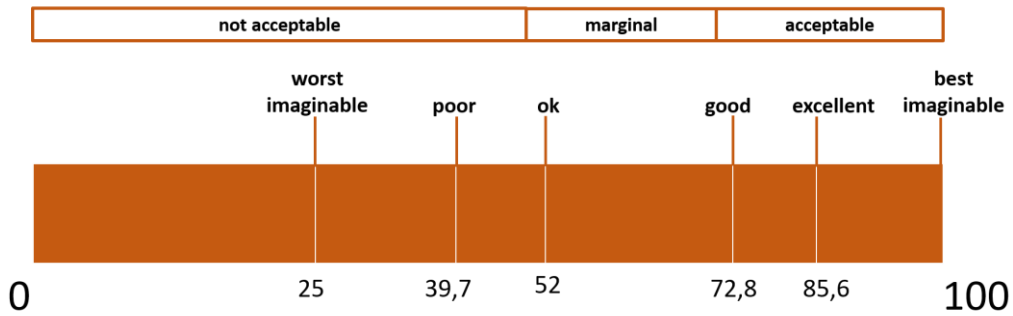

Figure 26: *SUS Score* - acceptability range and adjective ranking (Bangor et al., 2008).

A *SUS Score* from zero to fifty is not acceptable, a score from fifty to seventy is marginal. With a score from seventy or higher a system is acceptable (Bangor et al., 2008).

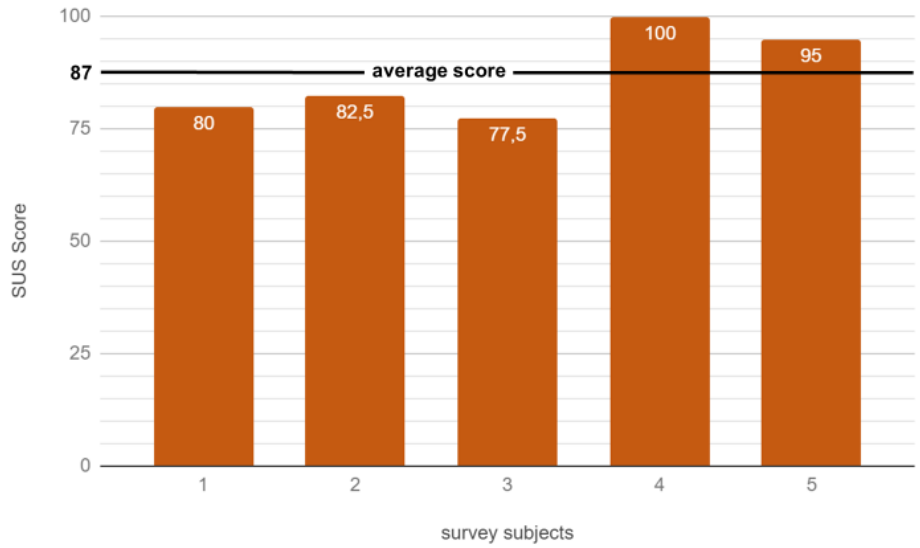

Figure 27: Outcome *SUS Score.*

Every participant answered all ten questions of the questionnaire. Thus, every questionnaire can be used for the evaluation. The outcome of this evaluation is illustrated in Figure 27 The video assisted PSS application “Frag nach!” reached an average *SUS Score* of 87. In consideration of Figure 26, this means an excellent usability of the system. The lowest rating was 77,5 the highest was 100. Figure 27 demonstrates the outcome of all participants separately. The lowest score (participant 3) is associated with a good usability (77,5). Also participant 1 and 2 rated a good usability (80 and 82,5). Participant 5 classified the application’s usability as excellent (95) and participant 4 even rated the usability as best imaginable. An additional conclusion is that all participants scored the application as “acceptable”. The average score of 87 is high above 70 which has to be reached for “acceptable” as it can be seen in Figure 26.

The first column of Table 3 shows all questions whereas the first row shows the anonymous user-ID of each participant. Every consecutive row illustrates the point equivalents given for each question. Furthermore, the total of points as well as the calculated SUS Score can be seen in the last rows. Table 3 also shows that two questions reached the maximum of points (4). For six questions the average value is between three and four. Two statements got evaluated under an average score of three.

By considering all *SUS Score* results in the video-assisted PSS software “Frag nach!” can be described as a software with excellent usability and can be graded as acceptable.

Table 3: *SUS Score*: points per question and total score.

user-ID	1	2	3	4	5	**mean**
I think I would like to use the system frequently.	3	4	3	4	4	**3,6**
I found the system unnecessarily complex.	3	4	3	4	4	**3,6**
I thought the system was easy to use.	4	4	3	4	4	**3,8**
I think that I would need the support of a technical person to be able to use this system.	2	2	3	4	3	**2,8**
I found the various functions in this system were well integrated.	4	4	4	4	4	**4**
I thought there was too much inconsistency in this system.	1	1	3	4	4	**2,6**
I would imagine that most of the people would learn to use the system very quickly.	4	4	2	4	4	**3,6**
I found the system very cumbersome to use.	4	4	4	4	4	**4**
I felt very confident using this system.	4	3	3	4	3	**3,4**
I needed to learn a lot of things before I could get going with this system.	3	3	3	4	4	**3,4**
total score	**32**	**33**	**31**	**40**	**38**	**34,8**
SUS Score	**80**	**82,5**	**77,5**	**100**	**95**	**87**

5.4.3 **Open Statements**

The participants gave a very positive feedback to the video assisted PSS software. All subjects pointed out that they liked the idea and would use the PSS software in their daily life. Additionally, they mentioned that the handling was rather easy. Within the questionnaire, the participants had the opportunity to write down their thoughts and experiences about the usage. Table 4 illustrates the open statements.

Table 4: participant's open statements at the end of the survey.

Participant' statements	**English translation**
"Ich finde die Idee sehr gut und brauchbar. Der Gebrauch war sehr einfach!"	„I find the idea very good and usable. The handling was very easy!"
"*gut gefallen*"	"liked it"
"*Obwohl ich mit Computern nicht vertraut bin, war alles schnell verständlich.*"	„Although I am not used to computers, everything was quickly understandable."

6 Discussion

The usability test showed very good results. Three participants valued the usability as excellent, one participant even as best imaginable. The last participant rated the usability as good. The mean usability was scored as excellent in the adjective ranking. Furthermore, the acceptance criteria were fully met. The expectations were met too because all tasks were able to be executed successfully and the participants received and understood the software rather well. They reported that they would use a service like that in the future. The motivation to get to know new information and communication technologies (ICT) became apparent as well. It is possible to expand the communication base between the younger and older generation with a similar application service.

As mentioned, one participant valued the usability with the highest possible score. The woman is already familiar with messaging systems like WhatsApp. She had fun while testing the video-assisted PSS software and was confident in testing the functionality. Moreover, she was fully satisfied with the provided PSS software.

The assumption that there is a need for appropriate software, which supports the elderly regarding public services, was also confirmed. The participants mentioned that they often have problems in everyday life, which could be easily solved with an PSS software like “Frag nach!”. The good usability and the elderly-friendly user interface were advantages when using the application.

Furthermore, this application can help to prevent social isolation. With a quick way of getting in contact with relatives, the seniors feel less excluded and can participate in the family life more easily. This aspect has a positive effect on the quality of life.

With higher age the possibility of developing diseases increases, which is associated with rising health care costs. A negative trend is the reduced number of caregivers. It is unavoidable that the dependency to other people increases with age. However, high quality care should be offered where possible (Rashidi & Mihailidis, 2013). In addition, it should be noted that the proportion of the generation 65+ in Austria is getting higher (Figure 2) (Statistik Austria, 2019). For all the reasons mentioned, it is important to support this age group as good as possible in everyday life and to develop adapted ICTs.

It should be noted, however, that elderly have not grown up with the latest ICT. Therefore, there is a higher risk for misuse of digital services. During the

investigations, it was observed that the seniors were sometimes unable to come up with their own solution strategies when dealing with the application. This means for the developers that a detailed analysis of the user's needs is unavoidable. In addition, simple and fast technical support must be offered.

The study describes how older people can benefit from the use of digital services and aids. And, above all, it highlights the area of public service to be especially important.

The results show that it is needed to be careful during development that the senior has simple functions at his disposal. In addition, as little information as possible should be present on the screen. This information should be reduce to the most relevant points. It was also an advantage that a text was always supported by the use of matching images. This allows a more intuitive operation of the application. Furthermore, success was shown with the use of simplified functionality. The seniors were quickly familiar with the application. Also, the importance of the fact, that every action was followed by immediate visual feedback, was recognized. For example, one click initiated the opening of another screen. The relevance of a simple and adapted user interface is also evident in the literature in various studies.

Limitations

Although literature describes that five subjects are sufficient for a usability test, the sample size is still very small (Nielsen & Landauer, 1993). It will be advantageous to incorporate the results in the prototype. Also further tests will help to improve the application and to continue development of new functionality.

Another limitation is the very homogeneous sample. All participants live in urban space. Further studies should be done to find out if rural seniors rate the usability equally.

It should also be noted that the upcoming generations will already be familiar with technical services and devices. The simple functionality was developed for people unfamiliar with these technologies. Therefore, the target group will change in the next years. The product can also help people with special needs. People who have cognitive limitations can benefit from the simple functionality as well. Increasing independence and quality of life can also be achieved for this target group.

Future work

Currently, the number of users is limited. One senior can only communicate with one relative. Through further development, it should be possible for multiple families to use the PSS software "Frag nach!". In addition, a senior should be able

to communicate with multiple relatives and vice versa. This can be implemented with the use of an account system. One possible solution may be that each family registers a common account. Within the account, multiple people can then assign themselves as a “relative” user or “senior” user.

In addition, the Android service in the application should be extended. Currently, “Frag nach!” will only work if the application was opened and kept alive in the background of the mobile device. In further developments, the service’s functionality must be changed so that a senior can always call his relatives regardless of whether the application was already opened or not.

Another approach is to supplement the talk with AR elements. As the software Vuforia Chalk (see subsection *2.4.3 Communication Software Systems Currently on the Market*) shows, AR provides a good way to explain problems more precisely.

Moreover, one can strengthen the cooperation with public service providers. Already existing public service applications could be modified especially for senior citizens as additional support. However, the abilities and needs of the target group need to be considered. The software should remain simple.

7 Conclusion

The aim of this thesis was to design and develop a video- assisted prototype for elderly for them to get quick advice in challenges concerning public service. Before developing, a detailed literature research and requirements elicitation took place. Getting to know the context of use was necessary for the designing and developing process. The work was structured after a user centered design (UDC) process in order to get results about usability of the software.

Literature shows the importance of active assisted living (AAL) technologies for the elderly. The percentage of the people aged 65+ will rise in the next few years (Statistik Austria, 2019). Therefore, new solutions concerning digital public service for this age group are necessary to develop.

The evaluation of the usability test results show that the elderly are interested in ICT and had fun while testing the PSS application “Frag nach!”. They would like to use the software in future to quickly get in contact with relatives. Daily public service challenges can be solved in a fast and simple way. Together with their relatives, further actions with public service providers can be planned. The senior’s life stays autonomous, which contributes to a high life quality.

Prospective studies should focus on developing detailed functionality concerning an account system so that many families can use the software. Furthermore, the public service providers should be integrated in the future development.

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Abbreviation Register

AAL	Active Assisted Living
API	Application Programming Interface
AR	Augmented Reality
DOMEO	Domestic Robot for Elderly Assistance
ELGA	Elektronische Gesundheitsakte
EU	European Union
FATE	Fall Detection for the Elderly
ICT	Information and Communication Technologies
PSS	Public Service Support
RTC	Real Time Communication
UCD	User Centered Design
SDK	Software Development Kit
SUS	System Usability Scale

Appendix

A. Participant Information and Declaration of consent

ProbandInneninformation und Einwilligungserklärung zur Teilnahme an einem Usability Test für den in der Daseinsvorsorge unterstützenden Service „Frag nach!“

Sehr geehrte Teilnehmerinnen und Teilnehmer!

Vielen herzlichen Dank für die Teilnahme am Usability Test eines funktionellen Prototypens zur Unterstützung bei Fragen bezüglich der Daseins-Vorsorge.

Im Rahmen dieses Tests erhalten Sie verschiedene Aufgaben zur Nutzung eines Service, mit welchem Sie rasch Fragen zur Daseinsvorsorge klären können. Diese Fragen betreffen Bereiche wie Wasserversorgung, Abwasser- und Müllentsorgung, Gesundheits- und soziale Dienstleistungen, öffentlicher Personen-Nahverkehr. Bitte bearbeiten Sie die gestellten Aufgaben der Reihe nach.

Danach erhalten Sie einen kurzen Fragebogen mit 10 Fragen zur Nutzung. Dieser wird ca. 5 Minuten Zeit in Anspruch nehmen. Darauffolgenden können Sie gerne im Rahmen einer offenen Frage ihre Erfahrungen mit dem Service noch einmal beschreiben und beurteilen, wenn Sie das wünschen.

Die Teilnahme an dieser Usability-Studie ist völlig freiwillig. Mit der Teilnahme sind keine vorhersehbaren Risiken verbunden.

Alle Daten werden anonymisiert und nur für den Zweck dieser Studie verwendet.

1. Wozu dient diese Studie?

Im Rahmen dieser Masterarbeit wird ein Prototyp zur Unterstützung von Senioren im Bereich der Daseinsvorsorge entwickelt und getestet. Durch einen video-basierten Service kann rasch und einfach Kontakt zu einem Angehörigen aufgebaut werden, welcher mittels verschiedener Kamerafunktionen schnelle Hilfe bei Unklarheiten im Bereich der Daseinsvorsorge bietet. Ziel des Service ist es, die Selbstständigkeit von SeniorInnen zu unterstützen und die Partizipation zu fördern. SeniorInnen werden bei Problemen und Fragestellungen nicht allein gelassen, sondern erhalten durch eine schnell aufgebaute Verbindung und ein Gespräch mit den eigenen Angehörigen Rat, was auch positiv auf ein mögliches Gefühl von Einsamkeit auswirkt. Die Studie testet die Nutzerfreundlichkeit und die Nutzbarkeit des entwickelten Prototypens.

2. Sammlung, Verwendung und Gewährleistung des Datenschutzes der akquirierten Daten

Die im Fragebogen erhobenen Daten und Ergebnisse werden verschlüsselt und anonymisiert dargestellt. Die akquirierten Daten werden ausschließlich im Rahmen dieser Masterarbeit gesammelt und verarbeitet. Die Ergebnisse werden zu keinem Zeitpunkt mir einer namentlichen Nennung verknüpft und die Teilnahme ist

ausschließlich freiwillig. Im Umgang der Daten wird darauf geachtet, dass die Richtlinien der DSGVO eingehalten werden. Auch Video- und Audioaufnahmen werden ausschließlich für Studienzwecken genutzt und vertraulich behandelt.

3. Einverständniserklärung

Name der ProbandIn: _____

Ich bin damit einverstanden, an dem Usability Test und dem anschließenden Fragebogen zum video-basierten Service „Frag nach!" teilzunehmen und bin darüber informiert, den Service im Rahmen der Studie zu testen und einen anschließenden Fragebogen auszufüllen.

Ich habe die ProbadInneninformation und die Einwilligungserklärung gelesen, verstanden und bin ausreichend über Nutzen und Risiken der Studie aufgeklärt worden. Ich bin damit einverstanden, dass die im Rahmen des Fragebogens über mich erhobenen Daten aufgezeichnet, anonymisiert und ausschließlich für wissenschaftliche Zwecke weiterverarbeitet werden.

Ich habe eine schriftliche Kopie der ProbandInneninformation und der Einwilligungserklärung erhalten und erkläre hiermit meine freiwillige Teilnahme an diesem Forschungsprojekt.

_____	_____
Datum	Unterschrift ProbandIn

B. Instructions of the Usability Test

Nutzbarkeitstest zum für den die Daseinsvorsorge unterstützenden video-basierten Service „Frag nach!“

Sehr geehrte Teilnehmerin/ sehr geehrter Teilnehmer!

Vielen herzlichen Dank für die Teilnahme am Usability Test eines funktionellen Prototypens zur Unterstützung bei Fragen bezüglich der Daseins-Vorsorge.

Bitte lesen Sie die Anweisungen des Tests sorgfältig durch und gehen Sie Schritt für Schritt vor. Anschließend wird Ihnen ein Fragebogen zur Nutzung des Prototypens vorgelegt, welcher ca. 5 Minuten Ihrer Zeit in Anspruch nehmen wird. Der gesamte Testumfang beläuft sich auf ca. 20 Minuten.

Test-Szenario:
Stellen Sie sich vor, sie erhalten ein Schreiben von Ihrem Stromanbieter. Dieses Schreiben liegt nun vor Ihnen. Sie lesen aus dem Schreiben heraus, dass die Stromkosten steigen werden.

Finden Sie heraus, wie hoch die Stromkosten sein werden und beseitigen Sie mögliche Unklarheiten, die mit dem Brief einher gehen.

Um diese Informationen möglichst schnell zu erhalten, können Sie den video-basierten Service „Frag nach!“ nutzen. Ein Angehöriger wird Ihnen dann rasch helfen können.

Fragestellung:
Wie hoch werden die Stromkosten sein? Was hat sich verändert? Warum haben Sie 2 Rechnungen bekommen?

Testdurchführung:

1. Öffnen Sie den Service „Frag nach!“ mit einem Klick auf das Symbol mit dem Fragezeichen.

2. Rufen Sie Ihren Angehörigen an. Einen Anruf tätigen Sie, indem sie auf das Bild des Angehörigen klicken.
3. Schildern Sie dem Angehörigen das Problem und klären Sie Unklarheiten zu den Stromkosten auf. Dieser wird Ihnen weitere Funktionen des Service näher bringen.
4. Beenden Sie das Gespräch, indem sie auf das Symbol  klicken. Mit diesem Symbol legen Sie auf.

C. Adopted SUS Questionnaire

Fragebogen zur Nutzerfreundlichkeit

Bitte füllen Sie diesen Fragebogen aus, nachdem Sie „Frag nach!" getestet haben.

Zur Beantwortung der Fragen gibt es immer 5 verschiedene Möglichkeiten:

1 – Ich stimme gar nicht zu.

2 – Ich stimme eher nicht zu.

3 – Ich stimme mittelmäßig zu.

4 – Ich stimme eher zu.

5 – Ich stimme voll zu.

Entscheiden Sie bitte für jede Frage, welche Nummer am besten zur Beantwortung passt und kreisen Sie diese Nummer ein.

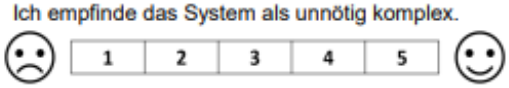
Alter: _____ männlich o

weiblich o

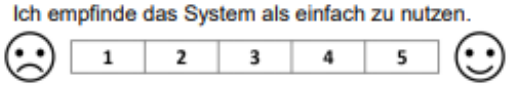
Ausbildung: _____

1. Ich kann mir sehr gut vorstellen, den Service regelmäßig zu nutzen.

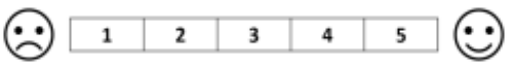
2. Ich empfinde das System als unnötig komplex.



3. Ich empfinde das System als einfach zu nutzen.

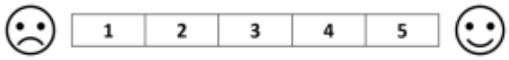


4. Ich denke, dass ich technische Unterstützung brauche, um den Service zu nutzen.

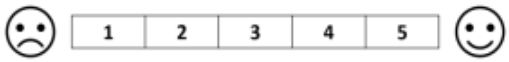


5. Ich finde, dass die verschiedenen Funktionen im Service gut integriert sind.

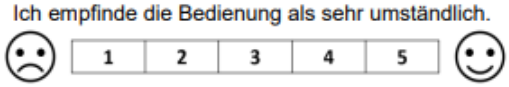
6. Ich finde, dass es im Service zu viele Inkonsistenzen gibt.



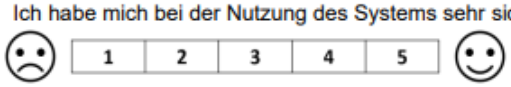
7. Ich kann mir vorstellen, dass die meisten Leute das System schnell zu beherrschen lernen



8. Ich empfinde die Bedienung als sehr umständlich.



9. Ich habe mich bei der Nutzung des Systems sehr sicher gefühlt.



10. Ich musste eine Menge Dinge lernen, bevor ich mit dem System arbeiten konnte.

Abschließend besteht für Sie noch die Möglichkeit, offen über Ihre Erfahrungen beim testen zu berichten. Möchten Sie noch etwas ergänzen? Wie hat Ihnen die Nutzung gefallen?

_____

_____

_____

_____

_____

_____