POLITECNICO DI MILANO
Scuola di Ingegneria dell'Informazione

POLO TERRITORIALE DI COMO
Master of Science in Computer Engineering

Prototyping a Touch-based Communication Application for Social Support of the Elderly focusing on UI Aspects

Supervisor: Prof. Fabio Salice
Assistant Supervisor: Hassan Saidinejad
Master Graduation Thesis by: Arlinda Imeri
Student Id. Number : 779928

Anno Accademico 2013/14

POLITECNICO DI MILANO
Scuola di Ingegneria dell'Informazione

POLO TERRITORIALE DI COMO
Corso di Laurea Specialistica in Ingegneria Informatica

Prototipo di una Applicazione per la Comunicazione su Dispositivi Touch per il Supporto Sociale per gli Anziani e focalizzata sugli Aspetti di Interfaccia Utente (UI)

Relatore: Prof. Fabio Salice
Correlatore: Hassan Saidinejad
Tesi di laura di: Arlinda Imeri
Matricola: 779928

Anno Accademico 2013/14

SOMMARIO

Il numero delle persone anziane è in rapida crescita. Sulla base delle statistiche redatte da Eurostat, nei prossimi 50 anni la popolazione sarà sempre più vecchia. Per esempio, la Commissione Europea ha stimato che, tra il 1995 e il 2025 la sola Inghilterra vedrà un aumento del 44% della popolazione con età superiore ai 60 anni [2]. Sulla base di quanto riportato da WHO Active Ageing, i cinque livelli di bisogno più importanti per la popolazione anziana sono la salute, la sicurezza, l'indipendenza, la mobilità e la partecipazione. Sempre in accordo con questa ricerca, le relazioni sociali e la mobilità sono fattori che producono uno stato di benessere nella popolazione anziana. L'integrazione sociale e la partecipazione degli anziani nella società sono spesso visti come indicatori di un processo di invecchiamento sano e produttivo. Al contrario, l'isolamento sociale può abbreviare la vita delle persone anziane. Un numero crescente di anziani si ritiene sia a rischio di isolamento e solitudine. In questo contesto, il ruolo dell'ICT come strumento per migliorare la qualità della vita degli anziani è ampiamente riconosciuto sebbene rappresenti una ulteriore sfida il fatto che le persone anziane devono interagire con quella parte di tecnologia che ha lo scopo di aiutarli in qualche modo nella loro quotidianità. Si tratta di questioni legate all'accettazione della tecnologia, l'accessibilità e l'usabilità delle soluzioni tecnologiche.

In questo lavoro l'attenzione è focalizzata sul sostegno sociale rivolto alle persone anziane fornendo loro uno strumento software semplice da utilizzare sia per comunicare sia per motivare la comunicazione. La questione principale analizzata in questo lavoro è dare una risposta alla seguente domanda: Quali sono le linee guida per la progettazione di una interfaccia utente rivolta agli utenti anziani?

Viene proposto un prototipo per la comunicazione che utilizza dispositivi touch-based su piattaforma Android; questo prototipo può essere utilizzato su telefoni cellulari o dispositivi tablet ed è principalmente focalizzato sugli aspetti di interfaccia utente.

Il lavoro è così strutturato. Nella parte introduttiva viene presentata una revisione della letteratura includendo alcune teorie utilizzate per progettare una interfaccia utente per gli anziani. Basandosi sul paradigma di lavoro che sviluppa una attività a partire dai bisogni della persona, è stato progettato un questionario per la raccolta di informazioni dagli utenti con il quale si identificano le loro preferenze e suggerimenti per la nuova applicazione da sviluppare. Nel

capitolo successivo, viene presenta sia una analisi degli scenari sia una analisi dei task; questi due aspetti hanno avuto lo scopo di verificare la consistenza delle linee-guida suggerite e di ottenere una più profonda comprensione del progetto. Nel capitolo seguente viene descritto il prototipo realizzato per la piattaforma Android. Le principali funzionalità del prototipo sono: iscriversi, effettuare il login, aggiungere un contatto, effettuare una chiamata, vedere e aggiornare l'elenco delle persone che l'utente può chiamare. Alcuni volontari anziani sono stati coinvolti nel processo di valutazione della progettazione; questa fase di valutazione ha inoltre contribuito a identificare altre linee guida.

Abstract

The number of the elderly people is rapidly increasing. Based on Eurostat statistics, the population will be much older in Europe in the next 50 years. For instance, the European Commission has predicted that, between 1995 and 2025, UK alone will see 44% rise in the number of people over 60 [2]. The five higher level needs of the elderly population according to WHO Active Ageing framework are health, safety, independence, mobility, and participation. According to research, social relationships and mobility in old age are important in general for the well-being of the older adult. Social integration and participation of the older adults in society are frequently seen as indicators of productive and healthy ageing. On the contrary, social isolation may shorten the lives of the elderly people. An increasing number of older adults may be at risk of being socially isolated or lonely. The role ICT can play in improving the quality of life of the elderly is widely recognized. Yet in situations when the elderly people have to interact with the technological artifacts which are meant to somehow assist them in their everyday lives, another challenge rises. It involves issues related to technology acceptance, accessibility, and usability of the technological solutions.

In this work, social support for the elderly people is the focus: providing them with easy to use communication software as well as motivating communication. The main question discussed in this work is: What are the key design guidelines for designing a user interface for elderly users?

The work goes toward prototyping a touch-based communication application for android systems to be used on mobile phones or tablet devices with the main focus on user interface aspects. In the first stage, it represents a literature survey and theories used for designing application for user interface for elderly people. Afterward a questionnaire was designed to gather information from the elderly regarding their preferences and suggestion for the new application to be developed. Then use case scenarios were extracted and task analysis was done to verify suggested guideline and gain deeper design understanding. Afterwards a prototype was implemented using android platform. The main functionalities of the prototype are: sign up, login, add a contact, make a call, see and update the list of people who the user can call. The elderly volunteers were involved in design evaluation process. In addition guidelines were extracted from the lesson learned during this work.

Table of Contents

List of Figures

List of Charts

List of tables

Chapter 1

INTRODUCTION

This chapter is dedicated to the introduction of context in which this work has been done. It goes through the analysis of the target group, age related impairments and technology for elderly people. It starts with considering the demographic studies, needs and social involvement for elderly people. This is followed by a section regarding age related impairments, where are explained major categories of disability for elderly people. Technology for elderly people is a domain interested for this work, it talks about assistive technology and elderly people.

1.1 Aim of Research

Demographic studies show that elderly population is growing all over the world. The number of people older than 60 is expected to be 2 billion in 2050, covering 22 percent of the world population [3].

At the same time, technology is rapidly changing. Even though technology offers many advantages but is not always accessible for the elderly. In most of the cases we are testimonials of how hard is for elderly people to be adapted and use the technology products such as Internet, PC, mobile devices or smart phones. In fact, there is no evidence that elderly people have an aversion to the use of technology, it is just that the interface of the technology devices is not adaptive for them. This is because the user need have not been analyzed for different scenarios when designed the user interface. According to [10] the designers have verified that the difficulty of use is not the case, moreover they were surprised by the fact of how fast elderly people can learn a technological device, more specifically a mobile phone if it accomplishes their needs.

Thus why most IT entrepreneurs undertake strategies to find innovative solutions that can support elderly people to satisfy their needs. Consecutively, the market shape is changing and new trends and opportunities are brought. There are different application areas for technical support, like homecare, safety, security, social interaction, information, lifelong learning and more, that are under discussion or already in development or in use.

However, when is up to the decision taking about the design of the applications for independent living, specific requirements of users has to be taken into account. Since it should guarantee an accessibility and usability for older people, due to their restricted ability [16].

One of the primary needs of elderly people is communication as well as social involvement. Therefore we make a prototype of communication application accessible for elderly people by taking into consideration their impairments. We aim to have interface as simple as possible as well as easy to understand and learn

In order to understand the elderly needs and preferences a preliminary study has been conducted. An interview with a group of 21 participants from different countries, (Macedonia and Kosovo),nationalities(Albanian, Macedonian, Kosovan), genres, different age groups(from 50 to 75+ years), professions, educations as well as technological background.

As older people's visual and cognitive skills decline, during Innovative Computing Technology (INTECH,2012) researches has demonstrated that touch screens and apps can really help, as they require little muscle mass or hand-eye co-ordination and are very easy to understand. Apps, such as Skype, iFace, YouTube, Catch Up TV, games, researching interests and on-line shopping all significantly improve personal interaction and help with the quality of elderly lives, so combating loneliness [5].

Taking into consideration these results we chose to work on a tablet platform. Tablets are currently the pinnacle of mobile technology. They are compact, very lightweight and extremely easy to carry, exactly what is needed for elderly people. Moreover tablets provide touch-based interaction, an important property for elderly users, that ensures more accurate and less time required than the use of mouse. The tablet's main innovation is that it is capable of sensing more than one point of contact at a time [21].

1.2 Target group-The Elderly

Our target group is elderly people, who have more than 55 years old. The number of elderly people is increasing dramatically. The study made by Mamolo and Schrebov [12] which included 27 countries showed that in 2030 that the percentage of elderly people is expected to reach 25 (Figure 1).
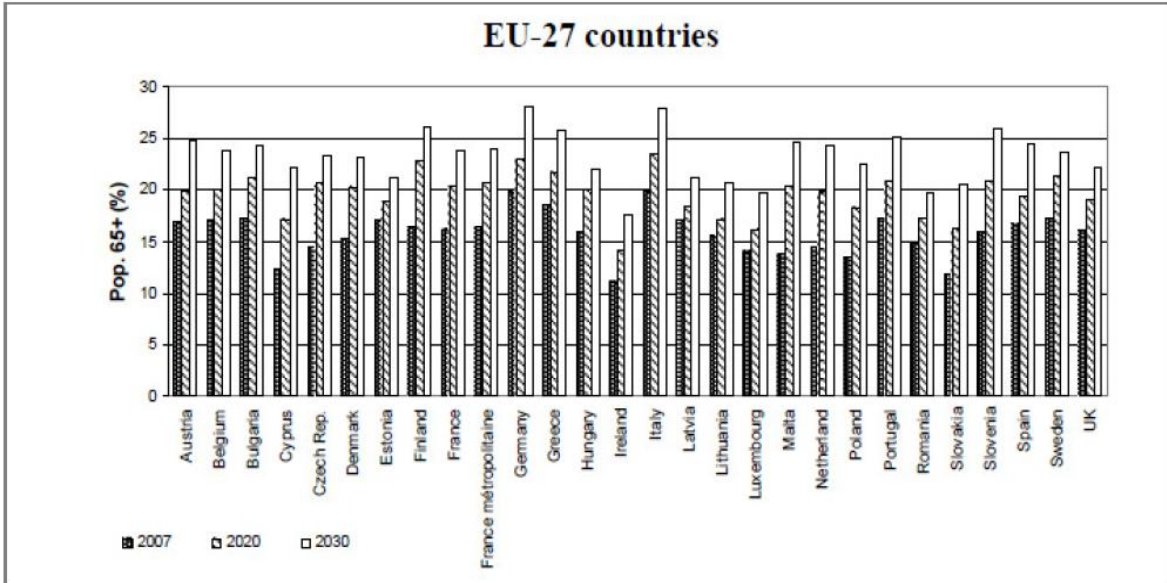
Figure 1.1 Population projections for individuals 60+ years for the years 2007, 2020 and 2030, across 27 European countries [12].

This user group which differs in capabilities and disabilities can get assistance from technological application in order to hang on to an independent and easy living, as well as reduce health care expenses which are necessary for them.

According to [8] even that elderly people do not have computer skills are interested in electronic devices, the topics they show more interest differ by gender and age(Figure 2).
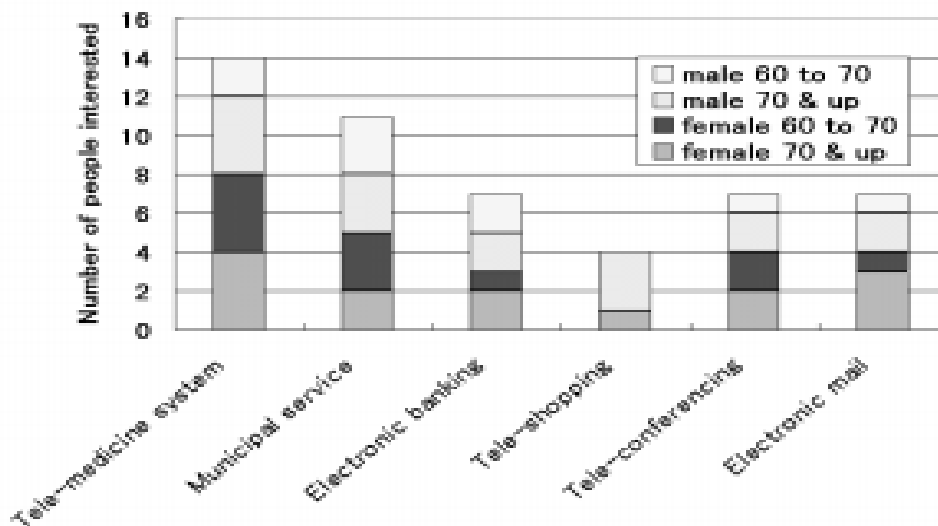
Figure 1.2.Interests in internet services among elderly people [8].

When designing adaptive application for this target group, the information provided in figure 2 have been taken into consideration, which is the interest topics of elderly people.

1.3 Age-related Impairments

Aging brings different problems regarding the individual's life and causes age specific barriers, such as limitations of mobility, visual and hearing impairments as well as motor impairment.

On average, elderly people need more support and care than young and middle age people. The support is needed in all different activities that a person does in his/her everyday life such as driving a car, going for a walk, shopping, eating, communicating and meeting with people. While, to be independent means being able to do every activity by your own without need of assistance [16].

Nowadays the main apprehension of the IT entrepreneurs as well as researchers is how to support independent living for aging people. There are two main advantages raised from this approach. First, related to social aspect, older people will be more independent and will be able to participate more in social life, spend time in their familiar surroundings, without a need for an external care thus, increasing their life quality.

What is disability?

A disability is a physical or mental problem which affects body functioning such as movements, senses and activities .People with disabilities are continuously facing problems in daily life where environmental and social barriers have an important role.

Figure 1.3. The bio-psychosocial model of disability (WHO, 2001) [1].

In figure 3, which comes from World Health Organization research we can observe the factors which affect participation or body function. They are divided into two groups' environmental and personal factors. Environmental factors describe the environment where they are living, while personal factors represent their social life in the world [1].
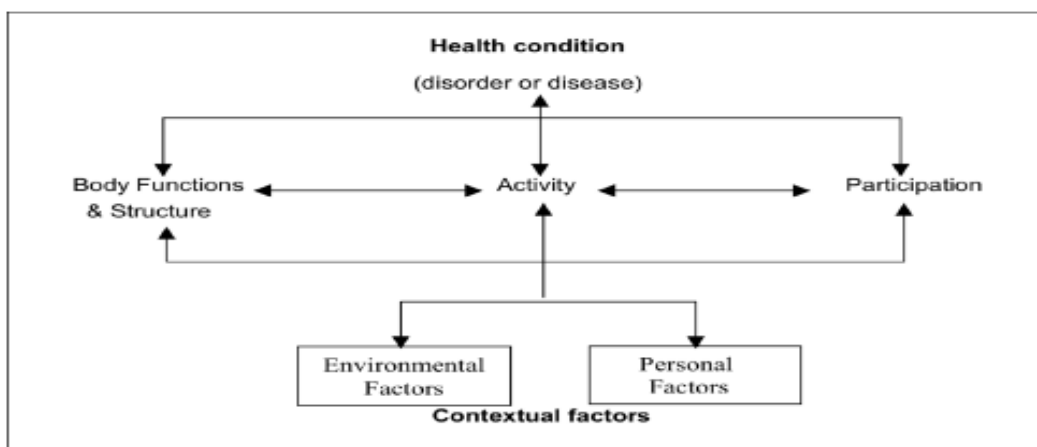
Major categories of disability are:

1. Visual disabilities
2. Auditory disabilities
3. Motor Impairment
4. Cognitive Impairment

Visual Disabilities

Visual disabilities are disorders in the structure and function of the eye, manifested by vision loss of a person in different degrees which require the use of assistive technology.

There are different types of visual disabilities regarding the degree of loss:

Blindness there are two types of blindness complete and partial. Taking into consideration that blind people cannot use a mouse and cannot click on links, as a solution for those users is screen reader, whose function is to translate the interface to audio and translate the interface to Braille characters.

However also the screen reader has its own limitations. For example, it cannot describe the images, which means that alternative text should be provided in order to read the image description. Another important limitation is that the screen reader reads in linear fashion, one word at a time, so it cannot understand the layout of the page and especially if there is a need of reading the table, task which can be quite confusing.

Low vision is a loss of eyesight or reduced vision .A person with low has difficulties to accomplish activities of daily living including,writing,reading,watching television, recognizing people etc.Thus when designing applicaition for these type of users high contrast between colors,color overriding as well as software screen magnifier is required.

Color blindness is the inability to see colors and make a distinction between them.So there is defficiency of colors.The most popluar deficiency is the red-green,people usually can not make a distinction between these colors especially if their darkness are similar they are confused

easily.In addition also orange,beige and yellow are confused with red and green.Another rare type of defficience is called achromacy which has to do with detection of black and white.So as designers should take care that the colors are not the only technique for transmiting information [28].

Visual Problems Associated With Ageing

Visual problems associated with aging include:

 - ➢ **Static visual ageing :** people that has more than 85 years old suffer more from this disorder.The low illumination condition is one of the main coutributer in this diseases.
 - ➢ **Dynamic visual ageing:** it mostly appears in the ageing people,especially when there is present moving of objects, more time is needed to be detected a object.Thus when designing an application for ageing people more time should be provided for accomplishing a task.
 - ➢ **The ability to focus clearly on objects at different distances:** it is well known problem in the ageing population which even by using glasses can not be cured since problem leftover a range in which objects are in focus.
 - ➢ **The sensivity of color vision:** whith increasing age the loss of sensitivity across spectrum and especially the loss of blue and violet is deacreasing. Researche shows that during the ages of 60-70 the accurate color discrimination reaches 76 percent,while among ages of 80-90 whis percentage goes to 56 [28].

Auditory Impairments

An auditory impariamnet concerns with the problem that prevents people to recive a sound throug the ear,called also as hearing loss.There are three types of auitory impariment:

 - ➢ **Deafness :** is totall loss of hearing,which can not be cured by technology and that is followed by not understanding a speech.
 - ➢ **Hearing impairment:** includes impairement in hearing but is not including in the definition of deafness.

> **Deaf –blindness:** is a combination between auditory and visual impariments that affect seriosly people in their communication and other educational needs.

Auditoty impairements associated with ageing people:

Hearing loss is one of most appearing problems among the elderly people.While getting older sounds of higher frequencies turn out to be more difficult to detect.Another important aspect is the background noise which make it difficult the detection of relevant noise and perception of appropriate sound such as speech [29].

Motor Impairments

Motor imparements consist of loss or limitation of function in body part,which make it difficult to move.Consist of problems with movement of hands to use a keyboard,shakiness,paralysis of some part of the body as well as limb loss.

Motor impariment associated with ageing people

Slowing of behavior is one of the most important change regarding the agieng process.While a person is getting older has difficulty in moving.Thus people belonging to this category has a difficulty in using technolgy devices because of the body restriction.Some of the innovation that has been developed for this group are:

> software such as Sticky Keys that make difficult keystrokes more accessible

> voice recognition systems

> pointers controlled by mouth or head movements

> text entry systems to help enter messages with fewer keystrokes [30].

Cognitive Impairements

Cognitive impairment is when a person has trouble remembering, learning new things, concentrating, or making decisions that affect their everyday life. People belonging in this group have a problem in thinking clearly and precisly.The sympompts are awareness, reasoning, memory, thinking, perception and judgment.

There are three categories of cognitive disorders:

- ➤ **Delerium:** is a short time problem in which people have a problem of awareness in the enviroment.
- ➤ **Dementia:** a brain problem which affects memory and shows difficulties in concentration.
- ➤ **Amnesia:** is a loss of memory,but does not affect the brain function.

Cognitive impairment associated to elderly people

Most of the people have a problem with long term memory,especialy in their elderly age.How fast they can remember or retrieve an information depends on the familiarity they have with the topic,as well as on the cultural experiences.But the processig speed decreases with age,thus why is should be taken into consideration as time critical task when presenting information [30].

1.4 Technology for the Elderly

The products that enable independent living of the elderly are classified into different groups such as:

- ➤ Communication devices
- ➤ Medical assistive technology
- ➤ Mobility
- ➤ Tele monitoring/Tele-medicine
- ➤ Compensation of impairments
- ➤ Consumer electronics multimedia
- ➤ Smart home
- ➤ Safety and security

In figure 4 is provided the ratio of product groups among all member states of EU
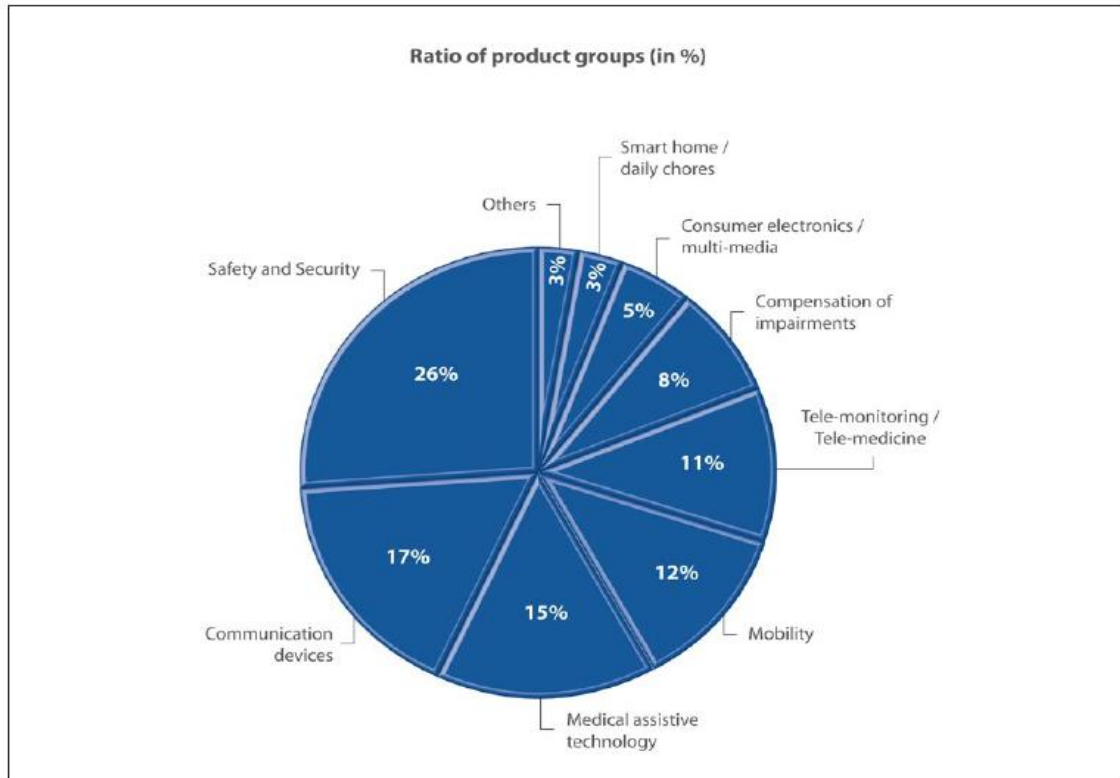
Figure 1.4. Ratio of product groups among all member states of EU-27 [16].

Communication Devices

These devices cover the need of social interaction by providing different kind of information to the users. Using this devices elderly people will be able to obtain consultancy, information as well as maintain the social contacts with other people.

In order to design and develop accessible products, providers that are producing communication devices for elderly people should consider specific problems that elderly users are facing such as hearing and visual impairments.[16]

As communication devices for this group of people would be visual telephones, specified internet and email application and computers with devices for image or symbol communication. These devices can be a touch screen devices that uses pictures or symbols of typical items and activities that make up a person's daily life. For example if the person wants to call might touch the image of the cell phone.

On the other hand, some devices employ also a text display, where the display panel typically

faces outward so that two people can exchange information while facing each other.

Speech-generating devices go one step further by translating words or pictures into speech. Some models allow users to choose from several different voices, such as male or female, child or adult.[16]

Medical assistive technology

Medical assistive technology are used by family of elderly people as well as the healthcare personal of the elderly people with the reason of supporting their daily healthcare procedures. Usually, the focus of these products are medical applications, which are able to measure e.g. the blood glucose, blood pleasure etc and give alarm for it.

Tele monitoring/Tele-medicine

Is a new technology development which allows the elderly people to be treated and monitored in their homes, by making it possible not to move to medical institutions. Such devices have the ability of transmitting the parameters to the responsible staff, who control and interfere if necessary. Taken as a whole, these products give more autonomy to elderly patients.

Smart home

Often elderly people have troubles performing their daily activities, such as cooking, making the bed, eating etc. As great help are automatic and intelligent devices.

Smart home technology provides assistance to patients with emergency assistance, reminder system, and medication administration, assistance for problems such as hearing, visual and cognitive impairments. As benefit is continuous monitoring and improved psychosocial effects.

Chapter 2

Touch Gesture Technology and the Elderly user

This chapter is dedicated to touch gesture technology and elderly people. It starts with user interface adaptation and elderly people. Available frameworks and projects related to assistive technology for elderly people such as GUIDE and OASIS are explored. It continues with research done for touch screen devices and elderly people. In the end it presents the requirements and guidelines recommended for touch user interface design.

2.1 User Interfaces and The Elderly

Mobile phones are becoming an important factor in people's life. Taking into consideration different features that mobile devices provide we may start thinking to make some application that will be used also by elderly people. As we said before elderly people have limited capability, and in order to do an application suitable for user needs, it needs to be analyzed, including both common and specific group's needs.

To analyze user needs we should take into consideration different scenarios which are mostly used by those people, such as:

- On the telephone;
- You have a message
- I need help, etc [10]

One of the challenges of adopting the technology to elderly people is the interface. Adaptivity has to be taken into account when designing the application, regarding [10] the user interface keypad should not be used because of the problems with the small keys, also the button should

not be too small, since people that have a problem with eyesight cannot read it. In addition there cannot be too many steps to be remembered.

Available Frameworks and Projects

There have been developed some projects which are based on the field of adaptivness of user interface for elderly people. Some of those projects for which we might be interested are: OASIS and GUIDE.

GUIDE

GUIDE ("Gentle user interfaces for elderly people") is a research project which provides adaptation of user interface technologies by making them accessible to the elderly people.
It supports any application based on HTML, JavaScript, CSS, and Widgets. It also, allows integrating as well as managing and adapting to different multimodal technologies used for user interface. It can be said that it serves as a bridge between application and the user interface making it easy to be understood by the non technical people.
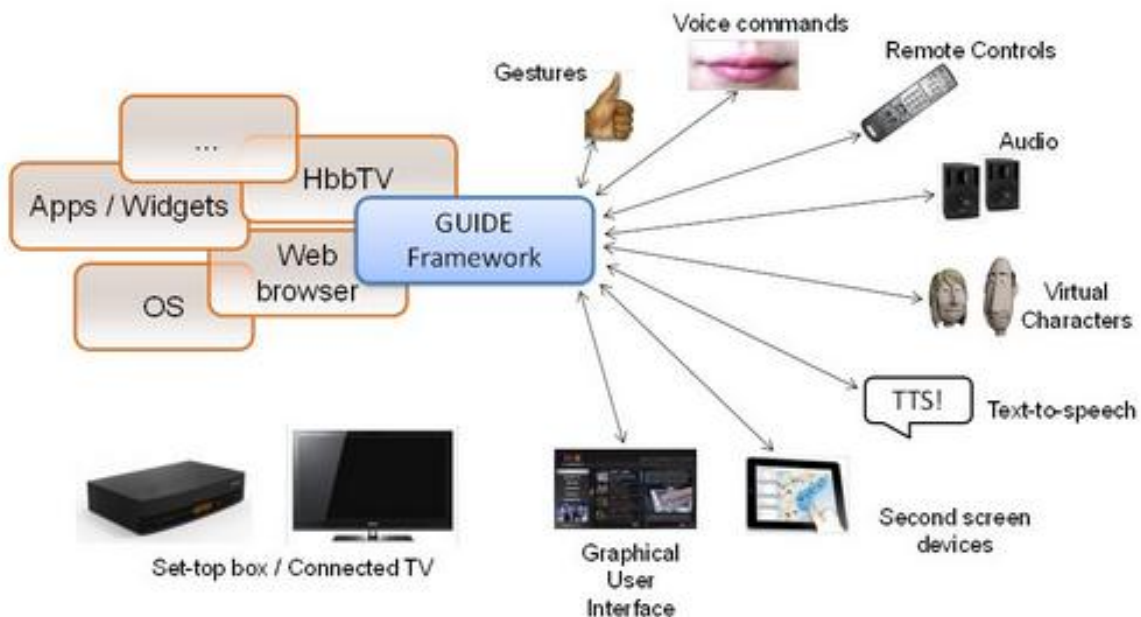

Figure 2.1 Interaction between application and UI [15]

The Benefits Of Guide For Elderly People

➢ *"GUIDE develops solutions to make TV experiences more accessible for elderly people"*

➢ *"It considers the impairments of elderly people and give to them a support using multimodal application. Also it imitates the effect of the impairments occurring to them during TV interaction."*

➢ *"GUIDE supports the development of applications that can help to improve social inclusion and independent living."*

➢ *"GUIDE results will be also relevant for general personalization, and therefore basically applicable for all users."*

The GUIDE is useful not only for elderly people but for everyone, and it is expected to support smart user interface and service personalization for other users [15].

Architecture and Concepts

In order to get in touch with the elderly people avoided the risk of the new technology acceptance by them GUIDE uses already existing interaction modalities such as speech and gesturing. Configuration of which do not require a special skills as well as are easy to use.

GUIDE process of recognizing users consist of two steps: User Initialization Application (UIA) and constant monitoring of the user interaction.UIA is the first step which is executed every time when the application recognizes new user, it starts with collecting information about the user, represent to them how they can interact with TV. It has simple UI where In order to make a measurement about the adaptation that is going to be provided it uses questioner asking about the user preferences such as button and text size and color, or the audio perception, and as the user continues to the next steps the application by itself start the adaptation process by the information already got, all along this questioner process a virtual character accompanies the user (in figure 5 can be seen the virtual character used by GUIDE.)

While the second step is constant monitoring of the user interaction, which allows the user to

make a change about specific thing that was not detected as is needed by the application, thus it allows the update of the current user specification.

Figure 2.2 Virtual character in UIA process phase [15]

The User Interface Components

The user interface components of GUIDE are:

➢ **Remote Control - Gyroscopic Remote Control**
Is used to control remote devices such TV, DVD player, stereo system and everything that can be plugged to the TV set. It uses to make easy navigation consequently improving the usability of remote control. To avoid the distance problems between the remote and the receiver communication has been used RF4CE communication.

➢ **Visual Human Sensing and Gesture Control**
This component recognize properties of the user using visual sensing, it receives images from camera and by applying the Computer Vision techniques tries to identify the user by their body features .In addition it supports also gesture control.

➢ **Spatial Audio and Speech Recognition**
It allows the application to run just by voice control, by being attached to the GUIDE it delivers only recognized commands by the user. This is done by beam forming on the microphone array.

- ➤ **Tablet and Multi-touch Interfaces**

  The tablet is able to act as audio visual I/O device, providing for instance a speech input channel for those users that own a tablet and a regular TV.

OASIS

OASIS stands for "Open architecture for Accessible Services Integration and Standardisation.

Is an Integrated Project of the 7th FP of the EC in the area of eInclusion that aims at increasing the quality of life and the autonomy of elderly people by facilitating their access to innovative web-based services. In the beginning 12 initial services have been selected for prototype development in the project's lifetime. These services are joined into three main categories:

- ➤ Independent Living Applications,
- ➤ Autonomous Mobility, and
- ➤ Smart Workplaces Applications

Taking into account that the technical system usability depends on the people that are using it and the context of use, make us understand that this request is more sensitive when is designed for elderly people since it requires more appropriate, cost effective and personalized solution to be involved .

OASIS in order to accomplish its goal which is to ensure high quality interaction for elderly people by using adaptation techniques, it addresses diversity in different dimensions such as:

- target user population and changing abilities due to aging,
- categories of delivered services and applications
- different computing platforms and devices

By taking into consideration this characteristics OASIS user interface will include adaptation based on device, user and context of use.

OASIS, User Interface Adaptation Methodology

OASIS, User Interface Adaptation Methodology is composed by stages:

- specification stage
- alternative design

Specification stage identifies the conditionally adjustable UI aspects and the dimensions correlated with the adaptation decision.

In Alternative design stage for each UI component a set of alternative designs are created, which are defined according to the requirements of each adaptation dimension. Furthermore these stages are encoded into a rule set which is loaded by inference engine, which then is evaluated and propagated to the actual presentation layer.

The OASIS Adaptation platform infrastructure is composed by DMSL (Decision Making Specification Language) and Adaptive Widget Library.

DMSL (Decision Making Specification Language) is decomposed in :

- **DMSL Engine Core** which is doing loading and evaluation of rules
- **DMSL Proxy** acts as mediator between the core and the external clients

Adaptive Widget Library is a set of buttons or dropdowns menus as well as complex UI components such as file uploaders which supports adaptation process by utilizing the DMSL Server.
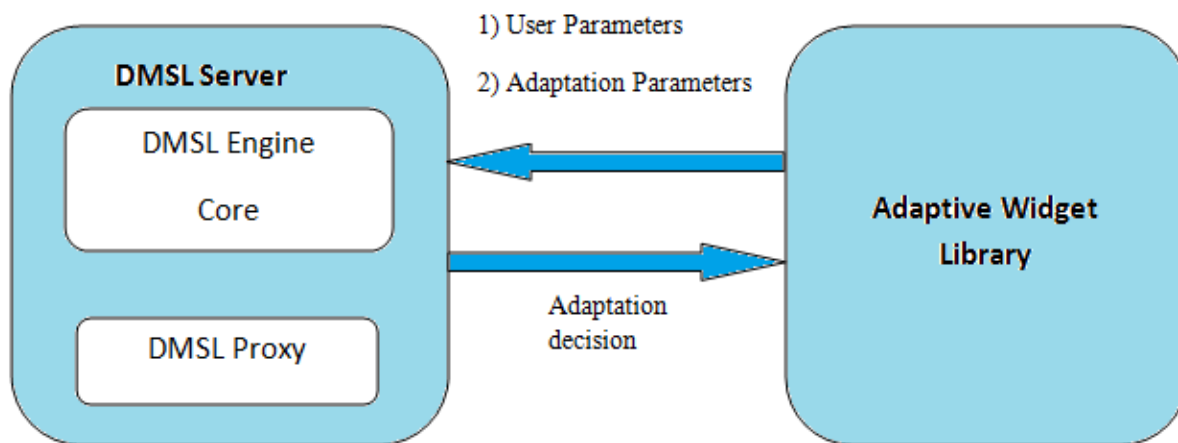

Figure 2.3 OASIS Adaptation platform infrastructure [17]

According to [17] the adaptation steps are as following:

1. At compile time, the developer defines the rule file that the DMSL Server will load for the specific User Interface decision-making process and builds the user interface using the OASIS Adaptive Widget Library

2. At runtime, the application when necessary invokes the adapt method for each contained widget.

3. Each widget asks the DMSL server to evaluate all the rules related to its subject to adaptation attributes.

4. Upon successful evaluation, it applies these decisions and updates its appearance to meet user and context needs.

OASIS widget library provides developers with fundamental support for applying adaptation in UI. But still additional features which are not included in OASIS should be explores such as the length of interactions, the number of interaction objects or options, the metaphors, wordings and operators, and the depth of menus are dialogue characteristics potentially subject to adaptation.

2.2 Touch Screen for the Elderly

The word, development of multi touch technology has been used since 1984 from W.Buxton. Touch gesture technology is considered to be as more instinctive way of use in computer devices. According to [11] a touch screen technology can be used in three ways:
  - ➢ One user interacting with a device, as an example is a cell phone
  - ➢ Multiple user interacting with a single device in the same time
  - ➢ Multiple users interacting with one device at different time.

If we take into account the disabilities,[13] suggest the following categories:

  - ➢ **Fit older people:** includes people who do not accept that there capabilities are weaker than when they were younger.
  - ➢ **Frail older people:** include people who have a reduction in the work of their functionalities are considered to have a "disability".
  - ➢ **Disabled people who grow older:** Includes the people who had become older because of the disability they posses and which also affect their function in everyday tasks.

Touch screen are used when designing interfaces of older adults since it requires direct input. Moreover also the size of the buttons in touch screen is larger, a point which contributes in the

easiness of the elderly life. An experiment with elderly people has been done, asking them to use pencil-paper and touch screen computers. After the experiment has been asked the satisfaction level for both of them. The use of touch screen showed to have higher satisfaction than paper-pencil [19]. In addition another research [20] compared adults' use of a touch screen and a mouse, and the result showed that older people performance is much better with touch screen than mouse, these come as a result of movement time to a target, which takes twice as long with a mouse as with a touch screen.[21] represent a research where an experiment about the time needed to point in a touch screen device between different group age, including younger people, middle age people and elderly people. In the figure bellow are expressed the result of the experiment.
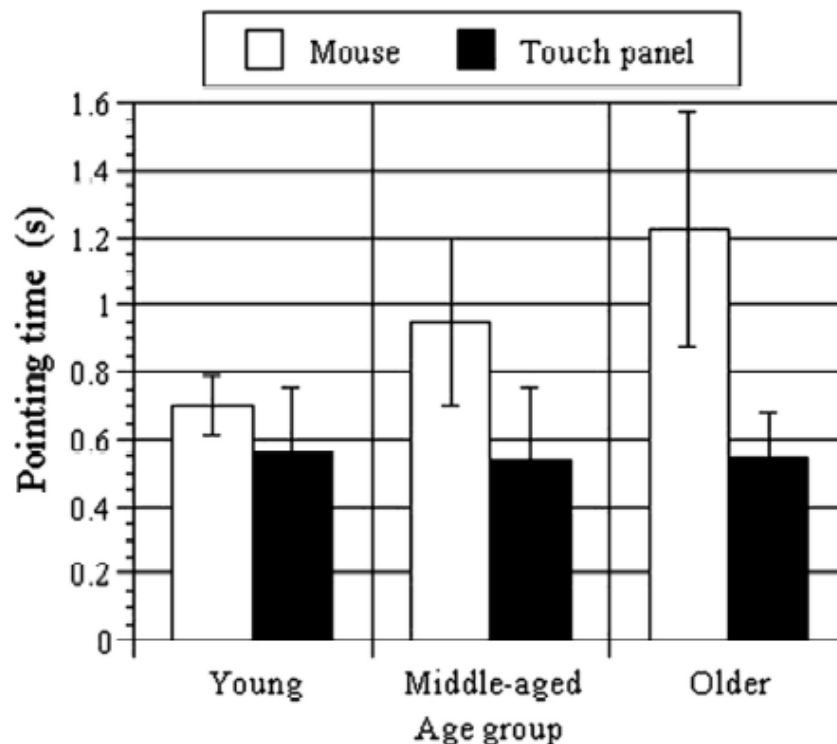

Figure 2.4 Pointing time for different age group [20]

Figure 8 illustrates that regarding the time to point a touch screen there is not a difference between young people ,middle age people and elderly people.

18

In addition according to [21] touch screen interface express that:

➢ Target size should be at least 16,5x16,5mm in all ages

➢ Distance between each touch sequence that user have to move to perform a task should be 3,3 cm regardless the age of the people.

➢ In middle-aged and elderly users, touch screen interface can reduce age related differences in pointing task .

While the use of more symbolic gesture such as characters, numbers or arrows is given by a research of Stößel in 2010 [22].

Touch Screen Use

Touch screen use is increasing everyday starting from tablets, ticket machine, displays, ATM machines and so on. Several studies have evaluated usability issues of classical computer device as mouse and keyboard for older users. Mouse manipulation is not easy to learn for older user since it demands high hand-eye coordination, more cognitive effort [25].While the touch screen devices is done by direct contact on the display screen, there is no need of intermediary devices. Older users could completely benefit of touch screen interaction advantages. They are a heterogeneous population; age-related changes in cognitive and motor skills affect each person differently [26].

2.3 Requirements for Touch-based User Interface Design

Size of the button

The size of the button for different target of people changes. For elderly people the touch panel can be different from standard size, this is due to the degradation of abilities by the influence of the age. The University of Wisconsin-Madison [23] has done a research including participants with physical disabilities were recruited from independent living centers. A group of participants had a medical condition associated with motor control impairment, a group consisted of individuals who do not have condition a motor control impairment affecting the upper limbs. There were wheelchair users in each group, some had a motor control disability that affected the upper limbs, and some did not.

This study's task was performed on a 15" resistive technology touch screen mounted to a force plate so that force data could be extracted to complement the timing data retrieved from the touch screen. The button size, which ranged from 10mm! to 30mm! in 5mm! increments, and; Gap size, either 3mm! or 5mm!.

Result showed that if touch screen is going to be used than the button size should be at least 20 mm. If is used any button with smaller size automatically it affects the performance. And if is used larger buttons it does not give much better performance that can rationalize the use of extra space. Thus, cooperation should be made between available screen space and button size.

Space size

An important factor of accuracy of touch panel is the space between two o more sensitive areas. There are different consideration about spacing size, such as a inactive space of 5 to 6 mm around sensitive areas. While for numerical input a 2 mm or less space is accepted and 0 mm space in very limited screen space.

Button size approach regarding different size for different target group is valid also for spacing. According to [23] each area should have a space among 3.17mm to 12.7 mm, where the elderly people 6, 35 mm. And if there is a limited screen and the time is not an issue, 0 mm space can be used, but it increases the error rate and the satisfaction of the user is lower.

Text Size or Icon

It seems that elderly people prefer text more than icon. This result is given by Bladder in 2008.The preferred used fonts for these people are Sant Serif and Arial. In addition according to any research simple text is the most preferred one of the elderly people. Bigger font may gain more readability, but too big font may require more screen space or even multiple screens, this may require more short term memory in order to combine and interpret many chunks of information.

Chapter 3

Questionnaire

This chapter is dedicated to questionnaires. Questionnaires are used as a method to investigate user needs, expectations, priorities and preferences. The questionnaires were aimed to elderly people. Majority of the questionnaires were done face to face, and some of questionnaires for the people living outside of Macedonia are distributed via email.

3.1 Questionnaires and results

After taking into consideration the researches that has been done in order to make adaptable user interface that will be used by all people including also elderly people, we start with the designing of user interface. As first step, a questionnaire was designed to understand the elderly needs and preferences in order to make an adaptive user interface, what they like and what they do not like, what they understand easily and the difficulties encountering in understanding.

The questionnaires are realized mostly in Macedonia and Kosovo. The nationality of the interviewees are Albanian, Macedonian, which means the answers are in Albanian language, Macedonian language, and English.

The questioner contains 19 questions, with each question are obtained information about how the application we are planning to develop is going to be more adaptable for target people.

It is important to mention that not all the people accepted to do the interview. Mostly people older than 64 year refused to do the interview by saying that have more important issues to carry about than answering a questionnaire about technology; as well they are not interested about technology.

In the following graph we can see the percentage of elderly people that were interviewed:

> ➢ 71 percent of the interviewees were between 51 to 64 years old
> ➢ 19 percent were people with more than 64 years old and
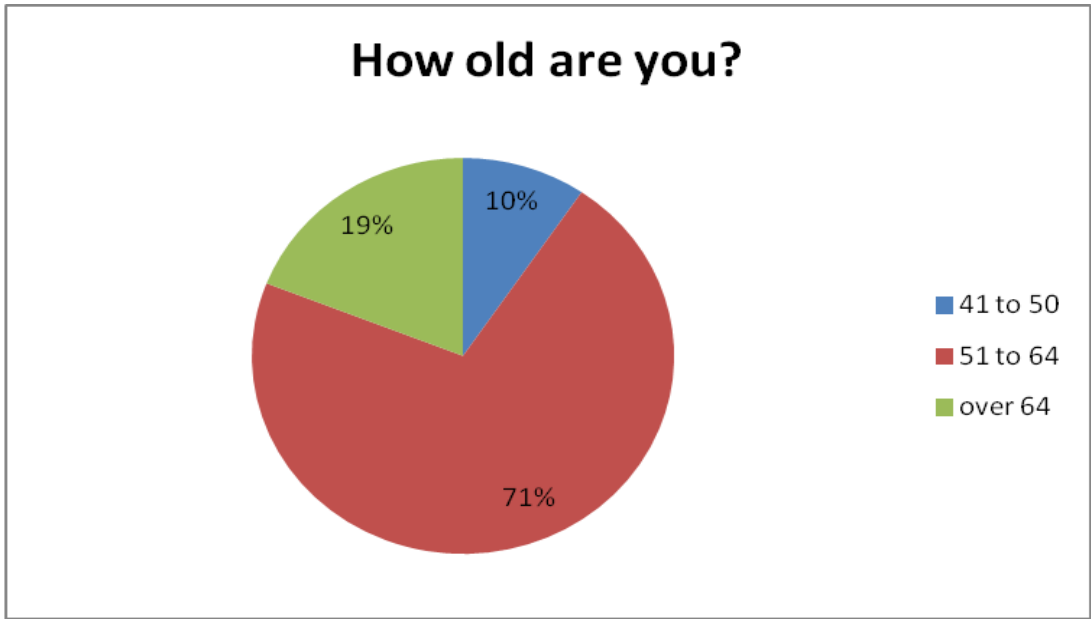> ➢ 10 percent are people between 41 to 50 years old.

Chart 3.1 Age of interviewees

Important information to be known is the educational level of the interviewees. People with different education level has been found in order to see if the impact of the educational level in the use of the technology devices. In the chart below we can see most accurate percentage of it.
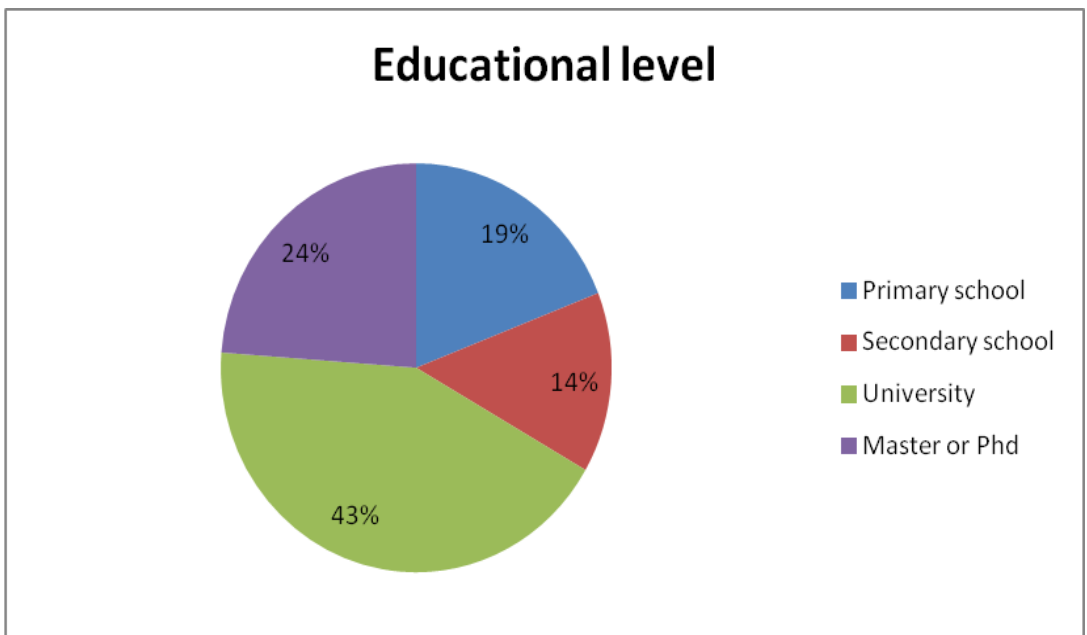

Chart 3.2 Educational level

An impressive information is that all the interviewees (100 percent) do use mobile communication regardless the age, the educational level, nationality etc.
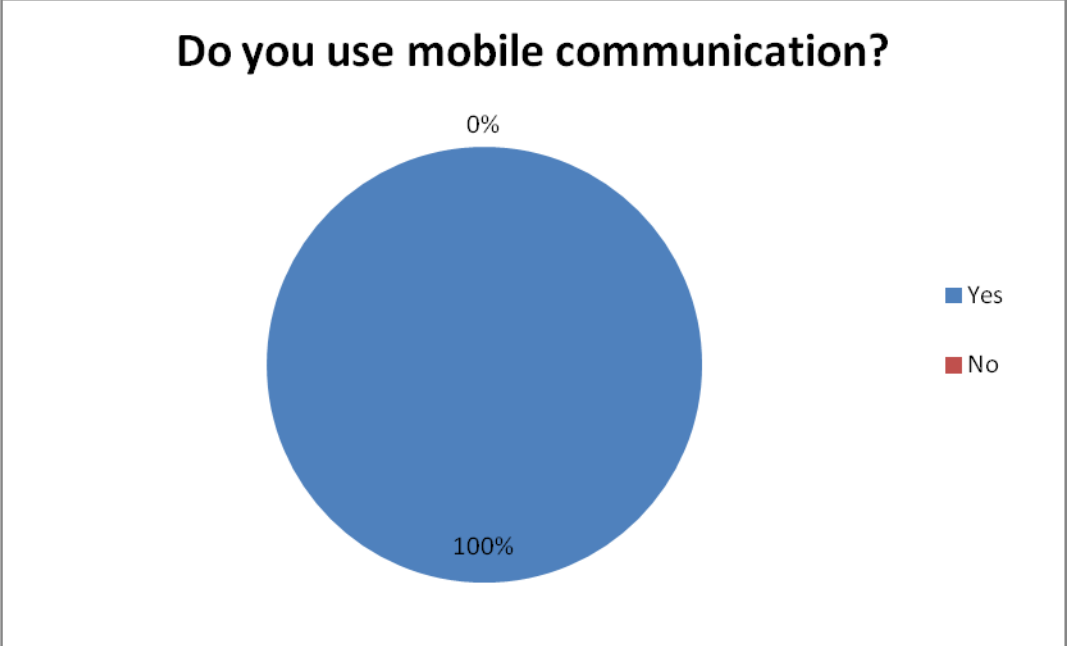

Chart 3.3 Use of mobile communication

The result gained by the questionnaire is supported by the research done by International Telecommunication Union (2012), who says mobile phone subscriptions in Europe are around 119.5 per 100 people, meaning that there are more mobile phone subscriptions than individual person and, on a larger scale,86.7% of the world's population is estimated to own a subscription.

In order to know how much the application should be complicate, interest about the experience of the interviewees in applications has been conducted. As expected, elderly users are not advanced user, 28 percent declared that more or less know how to use mobile applications and only 24 percent accepted that they are advanced users. It is observed that the people that declared that have university or master/PhD education also declared that are advanced users of mobile applications, which is assumed as true information since these people use the technology in their professional life.
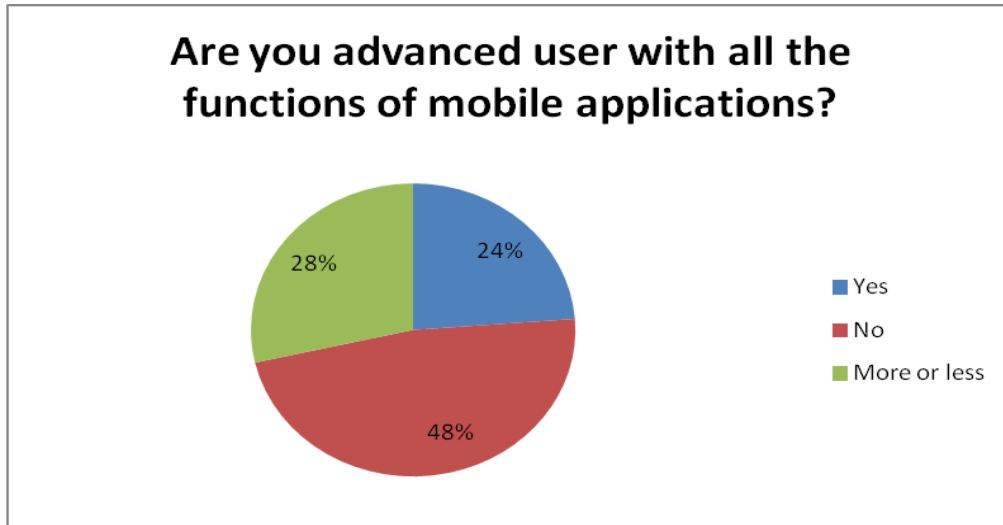
Chart 3.4 Advancement level of users with mobile application

This result makes us understand that the design of the application should not be advanced, since elderly people do not prefer complicated applications.

Another useful information to know is if the elderly people are interested in new device or application. From the chart we can observe that not all the elderly people are pro technology, 29 percent of the interviewees do not want new application or device.
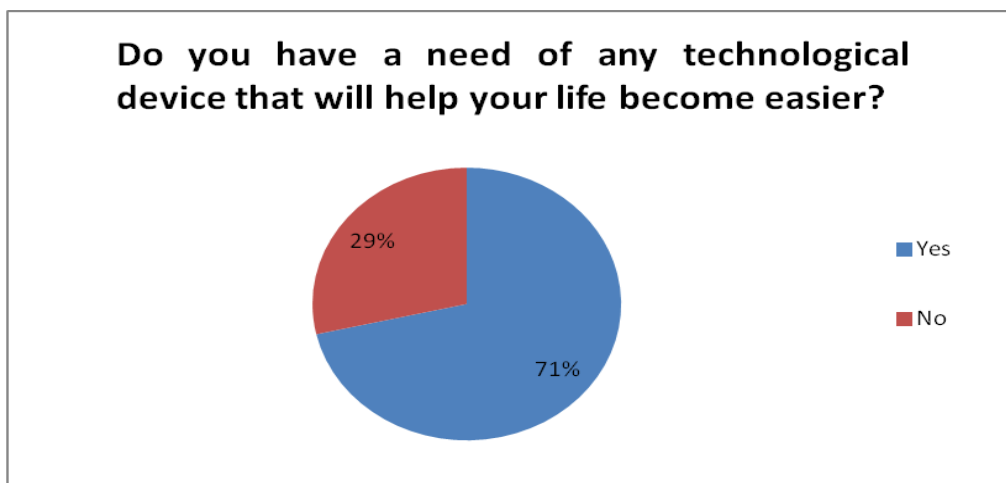

Chart 3.5 Need of any technological device that will help your life become easier

The participants were asked about the applications in which they are mostly interested, the answers were different including that the device should be laptop, mobile, tablet and even some declared that it may be any type of devices. An important point to mention is that 22 percent of interviewees declared that they do not need it.
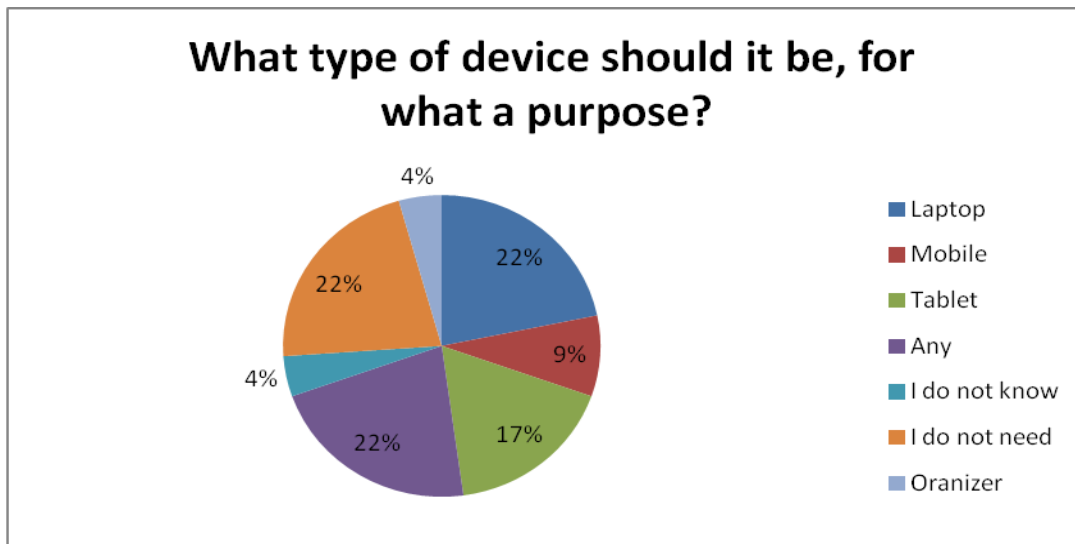
Chart 3.6 Device type and purpose of the application

In order to get information if the application should be a reminder of medicines, the interviewees were asked if they take medicines and if they have difficulties for it. The higher percentage(48 %) declared that they take medicines but they do not have difficulties with reminding to take them.33 percentage of them declared that they do not take medicines and only 19 percent of them declared that they take medicines and they have difficulties in remind the exact time to take them.
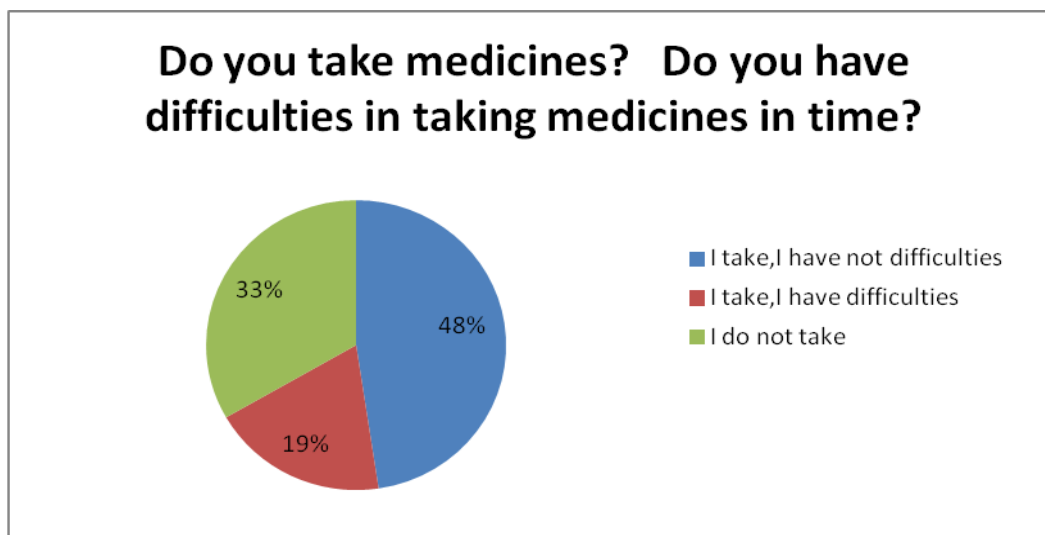

Chart 3.7 Consuming of medicines and the difficulties of taking them in time

In the interest of understanding if elderly people are assisted by family member or are living alone which means are in need of special people who will take care of them, they are asked about it. But, as expected (from my side) in these places people are living with their family.
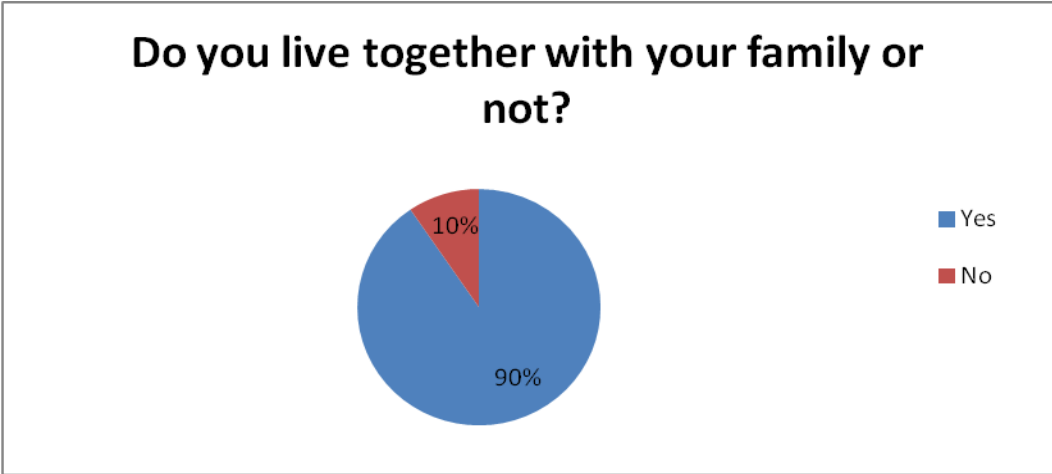

Chart 3.8 Living with family

Another idea for the application is to make a communication application which will help elderly people to stay in touch with their relatives. In order to know if this is one of their need I thought to ask about if their family members are outside of home.

The result showed that even 62 percent of the interviewees have some person of the family outside of house/country including daughter, son, brother, sister etc. This means making an application for communication issues is really good idea.
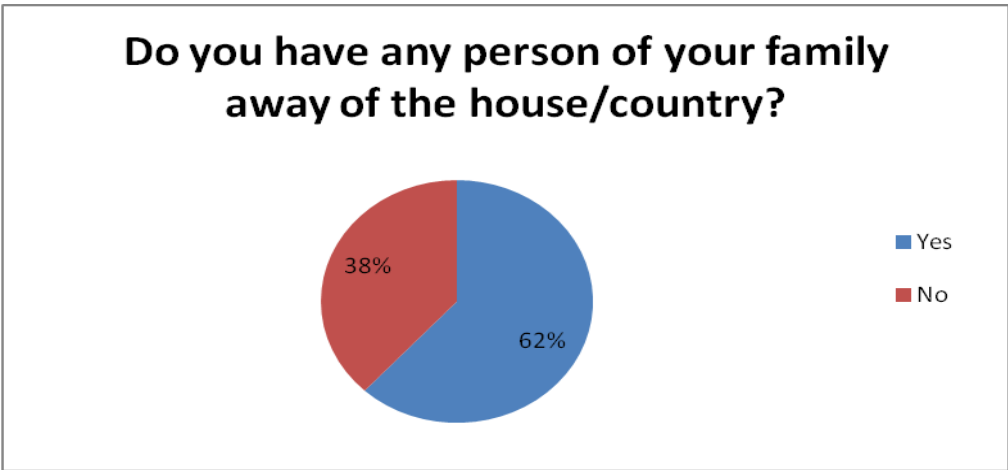

Chart 3.9 Person of your family away of the house

Interesting result is that 67 percent of the interviewees answered that they can function independently without help of any other person. And only 24 percent declared that they need help and 9 percent declared that sometimes they need help.
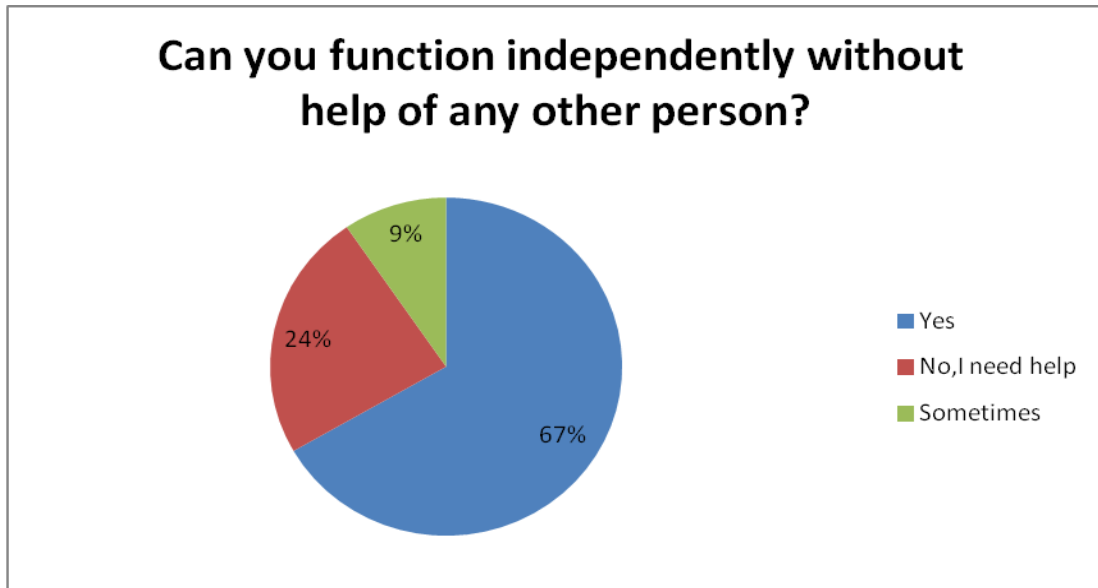
Can you function independently without help of any other person?

- Yes
- No,I need help
- Sometimes

9%
24%
67%

Chart 3.10 Independent living and need of help

We have more or less equal results for the next question about difficulty of remembering all the steps in an application. In the chart below we can see more accurate percentage.
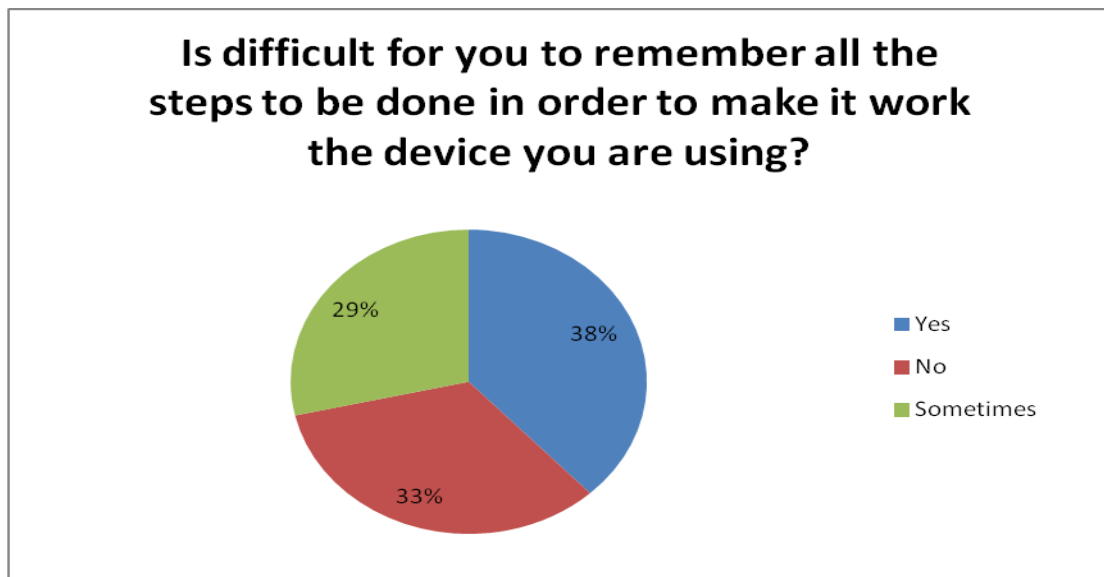
Is difficult for you to remember all the steps to be done in order to make it work the device you are using?

- Yes
- No
- Sometimes

29%
38%
33%

Chart 3.11 Remembering of the steps

In addition the majority said that they can remember from 1 to 5 steps without problems, more than 5 they found difficulties. But,another observation made is that people that were working with calculation including math professors,programers,economists declared that they can remember even more than 10 steps without any problem.
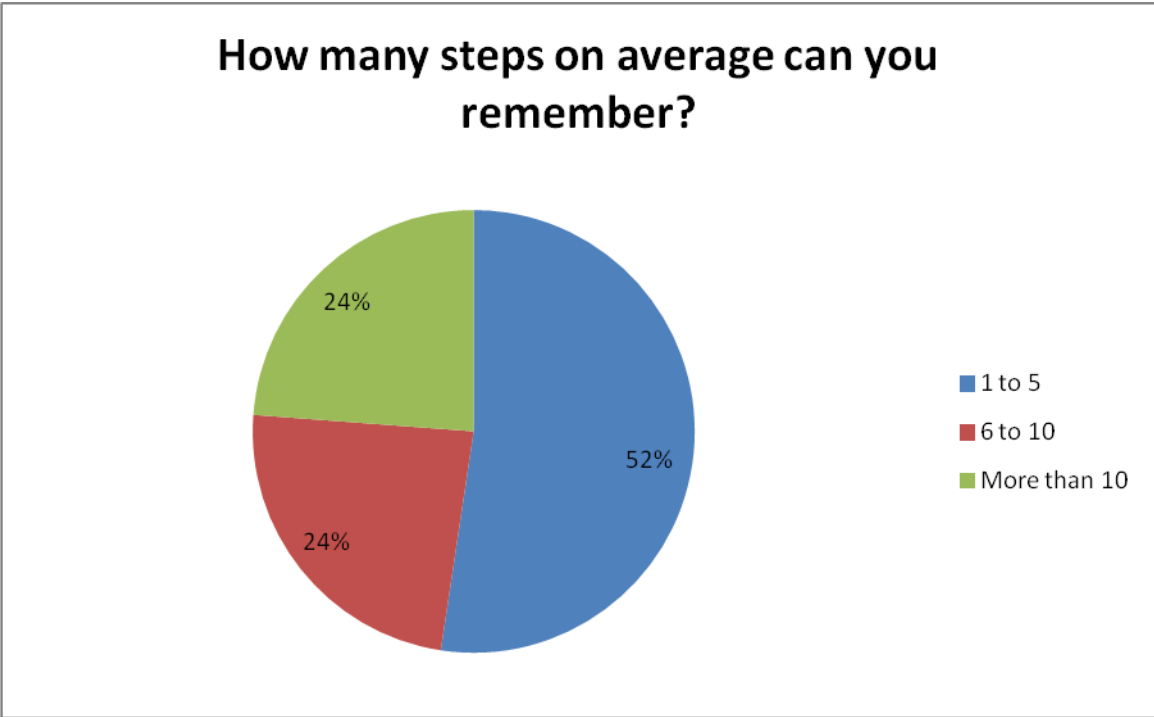

Chart 3.12 Average of the steps remembered

The result of this question supports the theorem of Miller in 1956.Miller was studying the limitations of short term memory. He concluded that there is a limit to the amount of items the immediate memory can be retained and that is 7 ± 2 rule. This means that people can remember from 5 to 9 steps in an application.

It is important to know if the elderly people prefer mostly icons/pictures on the application or text. Observing the results I concluded that it may be good solution if text and icon are present, in this way all the users will be satisfied.
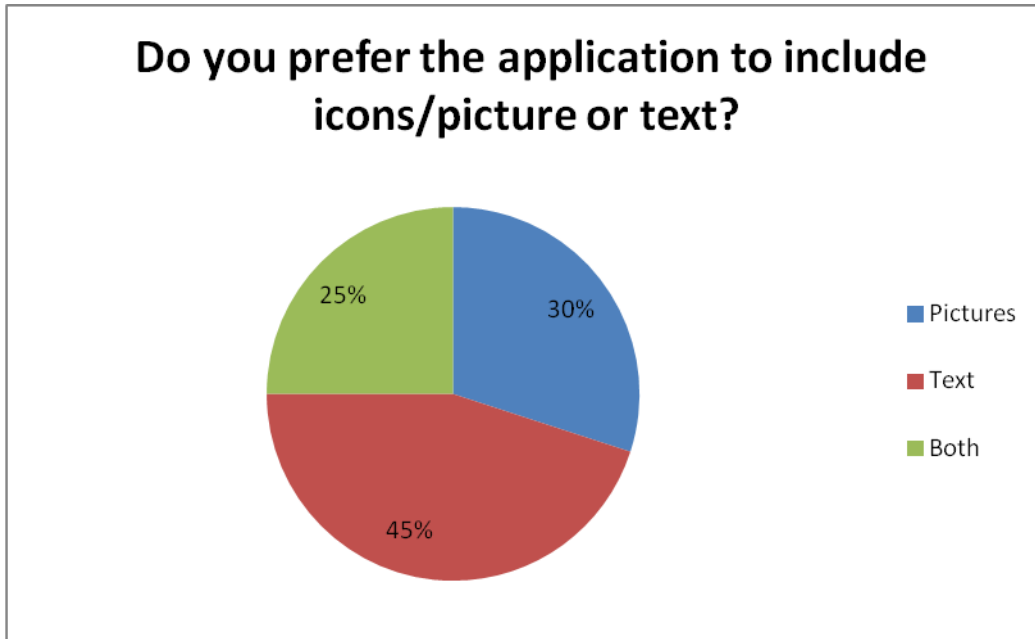
Chart 3.13 Icon/picture or text

Different answers were gained for the size of text that may be more suitable for the elderly people, the largest percentage has gotten the "size 18" and "size 20".
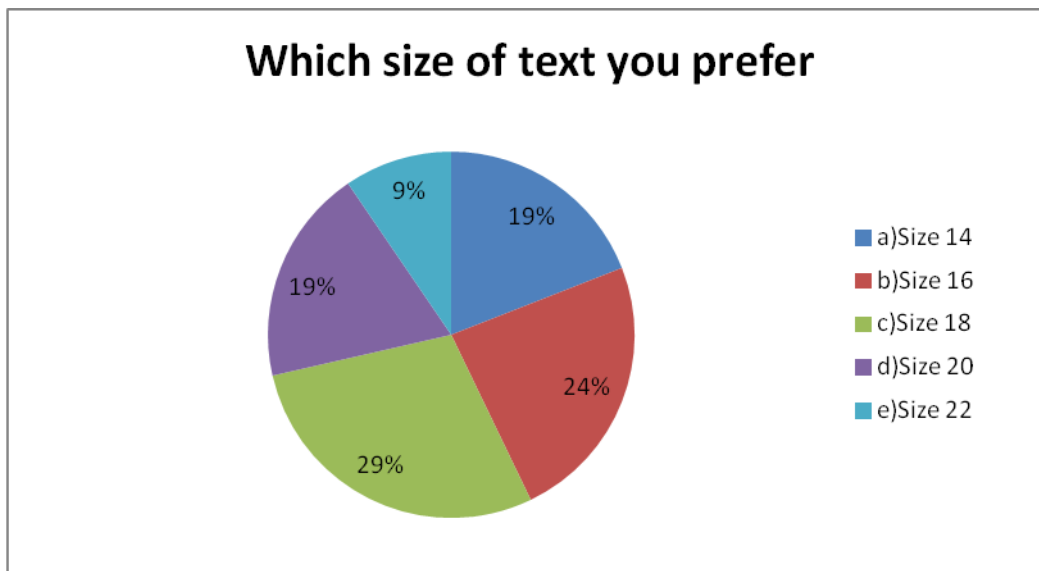

Chart 3.14 Suitable size

It seems that the icon or picture in an application is more understandable if the picture is similar to the action it represents. Also, some answers showed that is important that the picture is clear and not with so many mixed color.
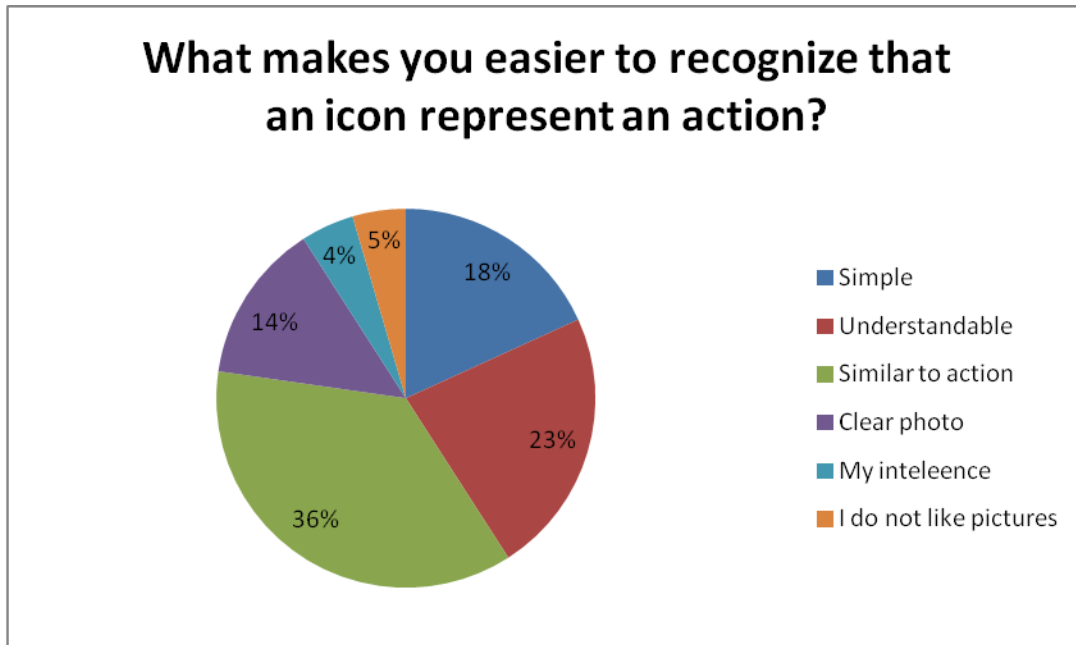
Chart 3.15 What makes you easier to recognize that an icon represent an action

So , the future applications should take into consideration this information by trying to find icons which are similar to the action, understandable, simple as well as clear photos without problems with colors.

In order to understand better which icons or pictures should be used some common pictures were inserted that are used in the different communication application, and asked from them to say to me what they understand from this picture.

Below are presented the icon and pictures used and the result for it

ICON/PICTURE	RESULT
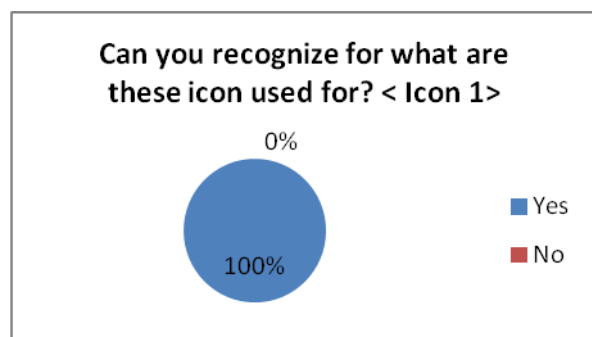
Chart 3.16 Recognition of icon 1
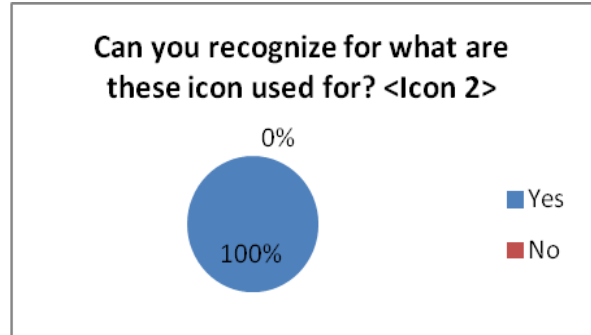
Chart 3.17 Recognition of icon 2
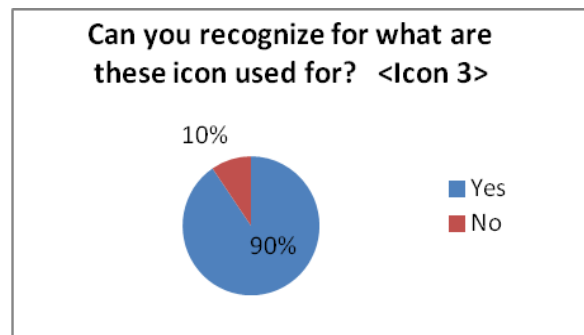
Chart 3.18 Recognition of icon 3
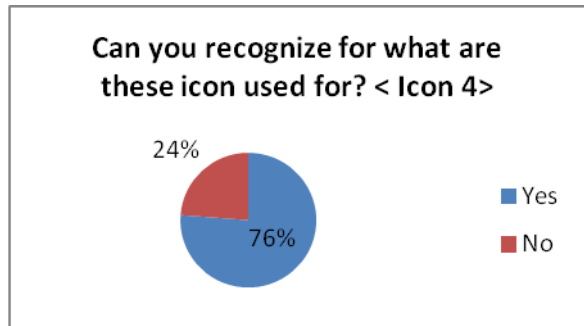
Chart 3.19 Recognition of icon 4

From the result, is observed that the first three pictures are perfectly understood by the interviewees, while the forth one is kind of problematic. This means either the icon is not good or either the people are not familiar with this function.

We continue with the next question with the intention to know which communication device is most used one. Greater percentage of people have answered that they use mobile, Skype.
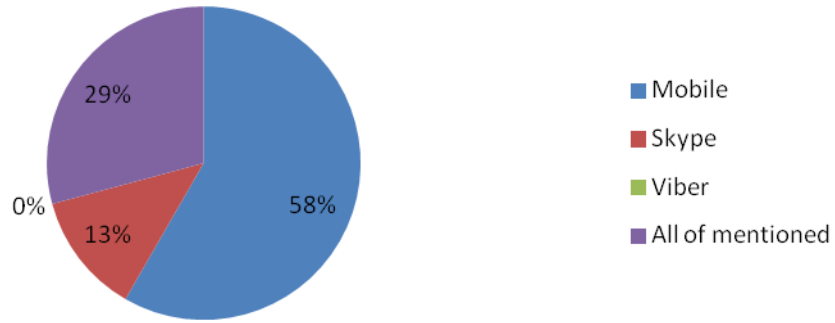
Chart 3.20 Usual device used for communication

As useful information to know is how much elderly people call other people and how many calls it receives back.
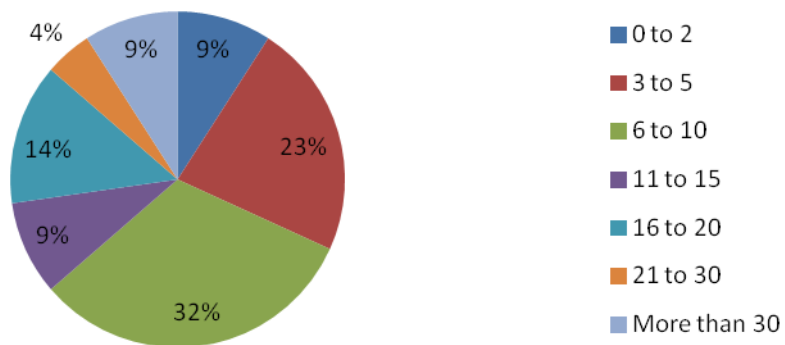
Chart 3.21 How many times elderly people call
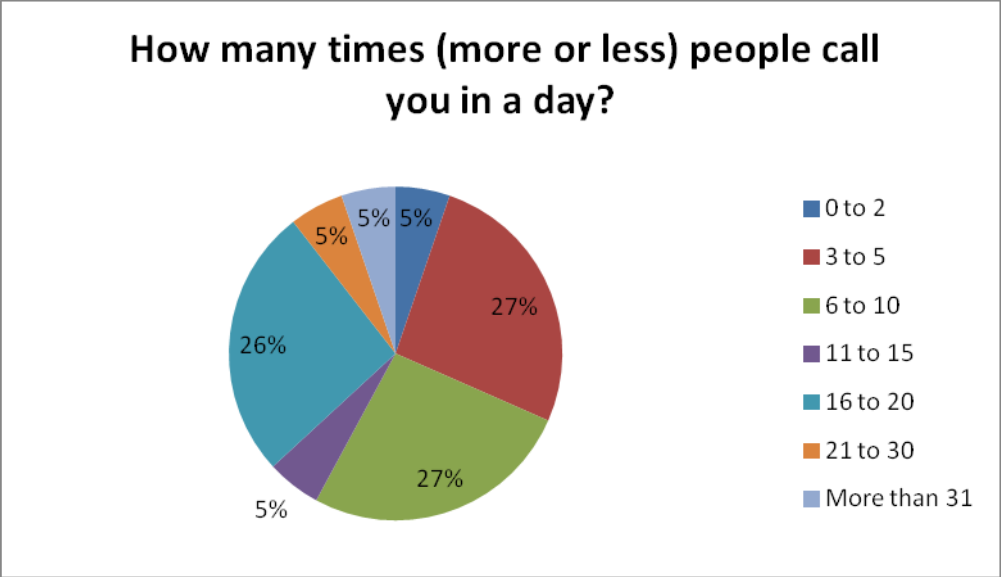
Chart 3.22 How many times elderly people are called

From the result is observed that elderly people are mostly called that they call others.
The last question is about which type of communication they prefer voice, video or what?
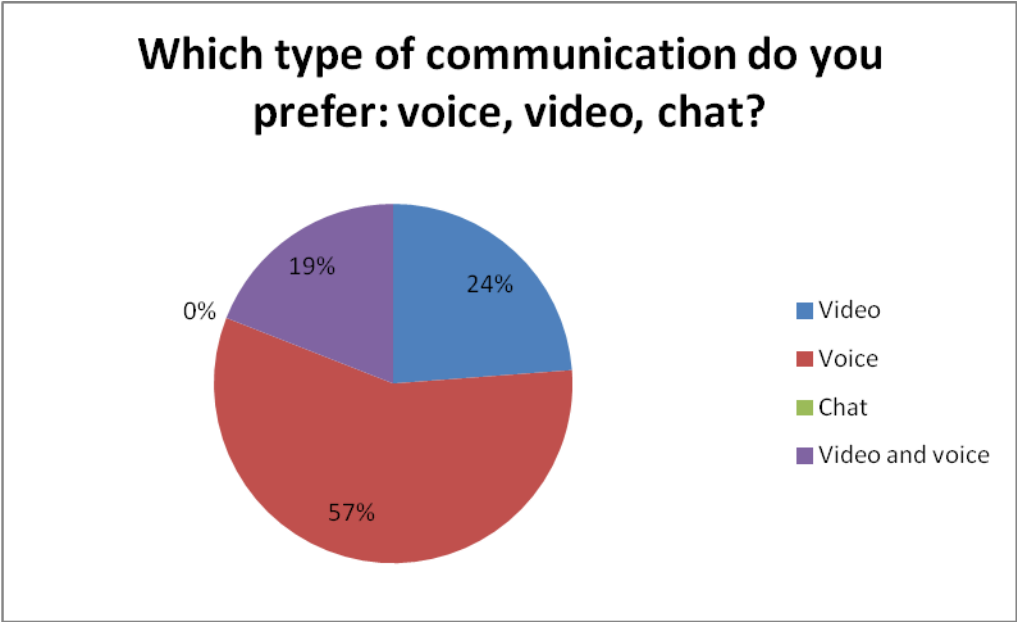
Chart 3.23 Voice, video or chat

The result shows that they prefer voice communication mostly. Also, we can observe that chat conversation is 0 percent voted, which answers the question 15,chart 19 why 24 percent of interviewees did not know for what this icon was used for.

3.2 Observations

➢ Educational level of elderly people had a great impact on their choices for technology since, mostly people who declared that had a university degree or master/PhD degree had more knowledge about technology and could answer the question without difficulties and b giving more examples.

➢ People older than 65 declared that do not have a need of technological device

➢ Only a small percentage of people said that they have a need of special people caring about them, this is due since 90 percent of the interviewees declared that the live with their family and most of their needs of them are accomplished by their family member.

➢ In average people can remember 5 steps. The result of this question proves the theorem of Miller in 1956.Miller was studying the limitations of short term memory. He concluded that there is a limit to the amount of items the immediate memory can be retained and that is 7± 2 rule.

➢ People that were working with calculation including math professors, programers, economists declared that they can remember even more than 10 steps without any problem,while people older than 65 can remember 3 to 5 steps.

➢ In the icon recogniton part,the first two icons were 100 percent recognized by the users,while the third picture was 90 percent recognized accuratly.But if we just consider the question that 100 percent of the interviwees used communication devices i.e mobiles and not all the interviwees have their relatives away of home make us realize that not all the people use video communication in their lives,and that the icon can be cosidered as successfully recognized.

➢ The fourth picture is not recognized by 24 percent of the interviwees,which means either the icon is not good either the interviwees are not familiar with the icon.

➢ The result show that the average size of the text that can be reconized by elderly people is between 18 and 20.

➢ Almost half of the interviwees choosed text reather than the icon for representing an action in an aplication by expaling that they may be confused if they have just the icon which may lead to missunderstanding of the action.

- There is a slight differences between the amount of times the people are called and they call.People decleared that they are called more than they call.
- Taking into consideration that 0 percent of the interviewees said that they prefer to include chat in their applications, gives answer why in the previous question about the icon recognition 24 percent of the interviewees did not know for what this icon is used for.

As limitation may be taken that I grow up in Macedonia,a place where the culture is much more different from Italy and other European countries.The result of the questionarries may not reflect correctly to the reality in the other part of the world.Since in the countries where the questionarries are done Macedonia and Kosova,people live mostly with their family starting from grandmother, grandfather till the grandchild while this is not the case in Italy, where are rare cases to find a family living together from grandparents to grandchild.

Chapter 4

Preliminary study
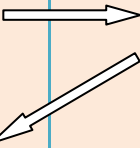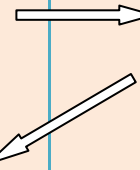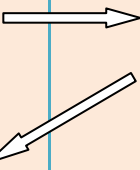
This chapter is dedicated to preliminary study including use case scenarios and task analysis for the application to be developed. A use case is a written description of how users will perform tasks on application. It outlines, from a user's point of view, a system's behavior as it responds to a request. The use case is made up of a set of possible sequences of interactions between systems and users in a particular environment and related to a particular goal [31]. Different scenarios, covering different functionality has been taken into consideration with aim to understand better the user needs for the application.

According to [27] task analysis can be defined as guide to any process that identifies and examines the study of what a user is required to do, in terms of actions and/or cognitive processes, to achieve a task objective. The idea is that task analysis provides some structure for the description of tasks or activities, which then makes it easier to describe how activities fit together, and to explore what the implications of this may be for the design of products. This can be particularly useful when considering the design of interfaces to products, and how users interact with them. Task analysis for five main functions has been realized, including: signup, login to the application, add contact, make a call, add to schedule.
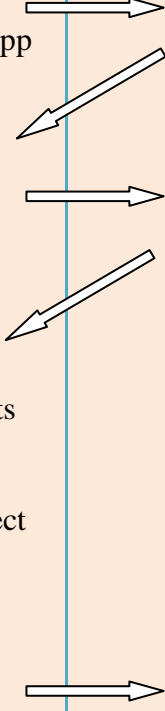
4.1 Use Case Scenarios

In this section of the work are designed five use case scenarios. Different user with different age, educational level, capabilities and experience in the technology has been considered.

4.1.1 Use case scenario 1: Register for access to the system

Use Case Name: Register for access to the application.	ID Number: 1 Importance Level: High
Primary Actor: User **Short Description:** Ana is 60 years old and she is a teacher. She got interested for the new application. She wants to register in order to use the system.	
Trigger: Ana turns on its tablet and enters to the communication application	

Major Steps Performed
 	
  1. Ana turns on its tablet   ⟹   The applications installed in the user tablet are displayed
 	
  2. Ana selects the icon of the application   ⟹   Login page of the application
 	
  3. Ana clicks the sign up button   ⟹   System displays the sign up page
 	
  4. Ana fills the required information i.e name ,email, cell phone number and address
 	
  5. Ana clicks "Register button" ⟹ System displays a message "Congratulation, the registration is done successfully "	

4.1.2 Use case 2: Log in to system

Use Case Name: Log in to application	ID Number: 2 Importance Level: High
Primary Actor: User **Short Description:** Francesco is 65 years old, he is a civil engineer. His son studies in France. He heard about the communication app and got interested to use it in order to communicate easily with his son. He registered and now he wants to do the login.	
Trigger: Francesco turn on its tablet and enters to the communication application	
Major Steps Performed	**Information for Steps**
1. Francesco turns on its tablet and selects the app	Application displays login page
2. Francesco enters his email and password	System verifies the credentials
3. System allows or rejects the user -If credentials are correct	
4. The home page of the communication app is displayed	Welcome message is displayed

4.1.3 Use case 3: Add a contact

Use Case Name: Add a contact	ID Number: 3	Importance Level: High
Primary Actor: User **Short Description:** Luigi is 63 years old, he is a mechanic. Part of his family lives abroad of the country. He started using the application, sign up, login and now is looking to add a contact		
Trigger: Luigi tries to login the communication application		
Major Steps Performed		**Information for Steps**
1. User login in the system		System displays the home page of the application
2. Luigi clicks to the "Create contact" tab		
3. Luigi insert the contact name, phone, email and address of the contact		
4. Luigi clicks to "Add to contact" Button		A message "The contact is added to your contact list" is displayed
5. Luigi clicks to contact list tab to verify if its contact has been added		

4.1.4 Use case 4: User makes a call

Use Case Name: User makes a call	ID Number: 4	Importance Level: High
Primary Actor: User		
Short Description: Arta is 70 years old, she is a retired medical and lives alone. She has difficulties in moving and sometimes needs assistive help. She wants to use the application with the function of making a call to its contact, when she needs help.		
Trigger: Arta makes a call.		

Major Steps Performed	Information for Steps
1. Arta login in the system ⟹	System displays the home page of the application
2. Arta sees its contact list	
3. Arta searches and selects the contact that she wants ⟹	A window with the information of the chosen contact is displayed
4. Arta chose to make a audio or video call.	
5. Arta presses the button for making a call ⟹	A call is made

4.1.5 Use case 5: User schedule a contact

Use Case Name: User schedule a contact	ID Number: 5	Importance Level: High

Primary Actor: User
Short Description: Elona is 62 years old, she is a retired economist. She has a memory loss and most of the time has difficulties in remembering when their children and nephews are available to communicate with her. She wants to use the application with the function of scheduling a contact, by specifying the date and time when their children and nephews are available.

Trigger: Elona schedules a contact.

Major Steps Performed	Information for Steps
1. Elona login in the system	System displays the home page of the application
2. Elona select the schedule tab	Systems displays the page of schedule tab
3. Elona clicks "add to schedule" button	Systems displays the contact list of the user
4. Elona chooses a contact to schedule	Date picker dialog is displayed
5. Elona choose the date when its contact is available	Time picker dialog is displayed
6. Elona chooses the time	The selected information are listed in the scheduled contact list.

4.2 Task Analysis
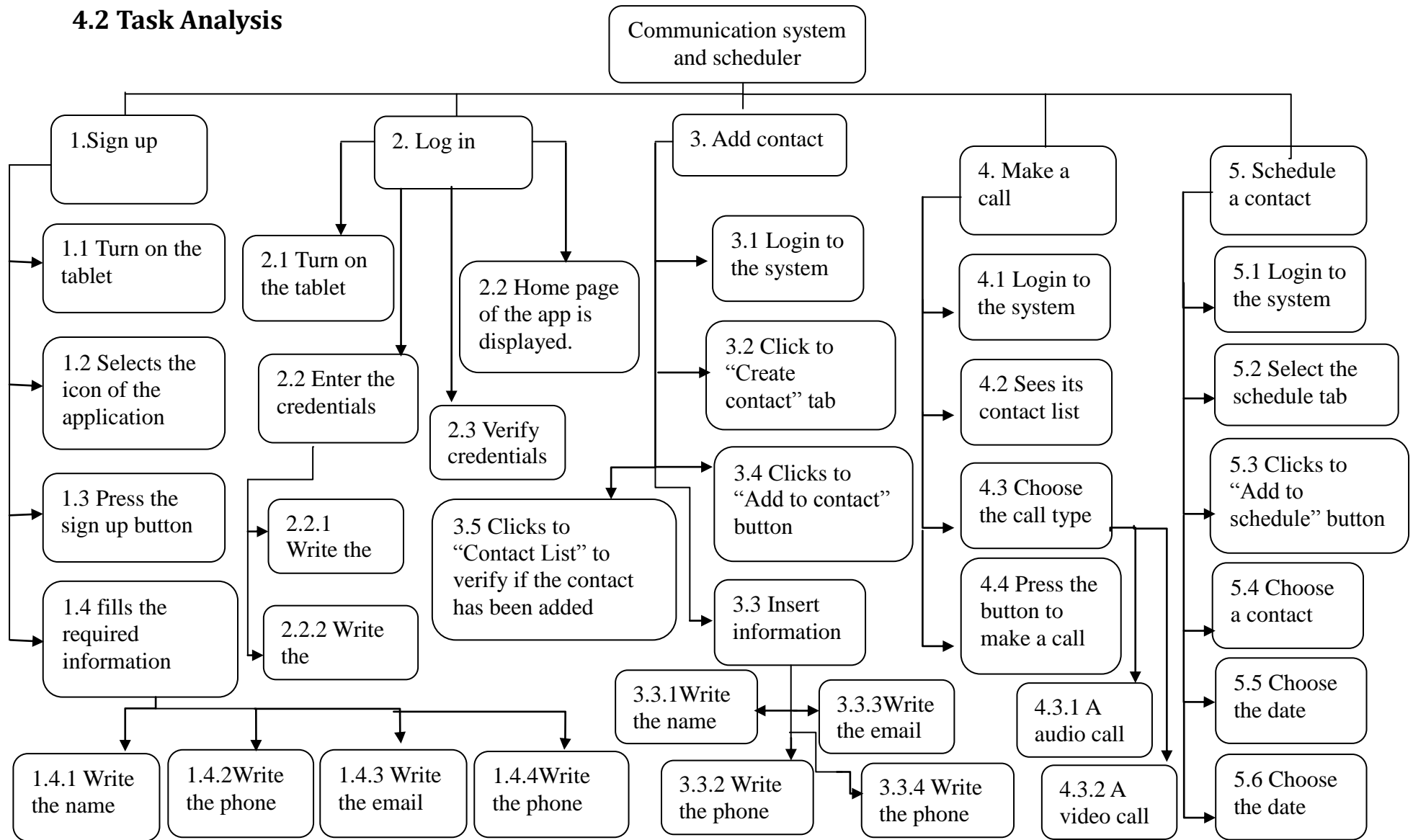
Chapter 5

User interface design

This chapter is dedicated to the main body of work done which has been prototyping a touch-based communication application for social support of the elderly focusing on UI aspects In the previous chapters we discussed about many obstacles between elderly users and usage of technology.

5.1 Prototype Design

In this part are represented and suggested some features that an application should consider in order to improve the performance of the application when used by the elderly users. User interface design for elderly people it is different than user interface for other users, because of impairments they might have including physical abilities such as cognitive, eye vision, motor impairments and mental declines such as the use of new product and technology.

A considerable number of researches have recommended design guidelines for elderly users. These recommendations as well as the result gained from the questionnaires regarding the preferences of the elderly users for a communication application are taken into consideration while designed the prototype proposed by this work.

The prototype has been realized on android platform. Eclipse was used as development environment. The text size, color as well as icon are chosen according to results gained from the questionnaire. "Keep it as simple as possible " is the motto that is followed in this prototype, since simpler is more useable for elderly users.

Screen shot of the prototyped user interface for elderly people is represented in the following pages.

In the menu screen the prototype appears with a name Contact maker, as well as an icon to identifying the application (Figure 9).
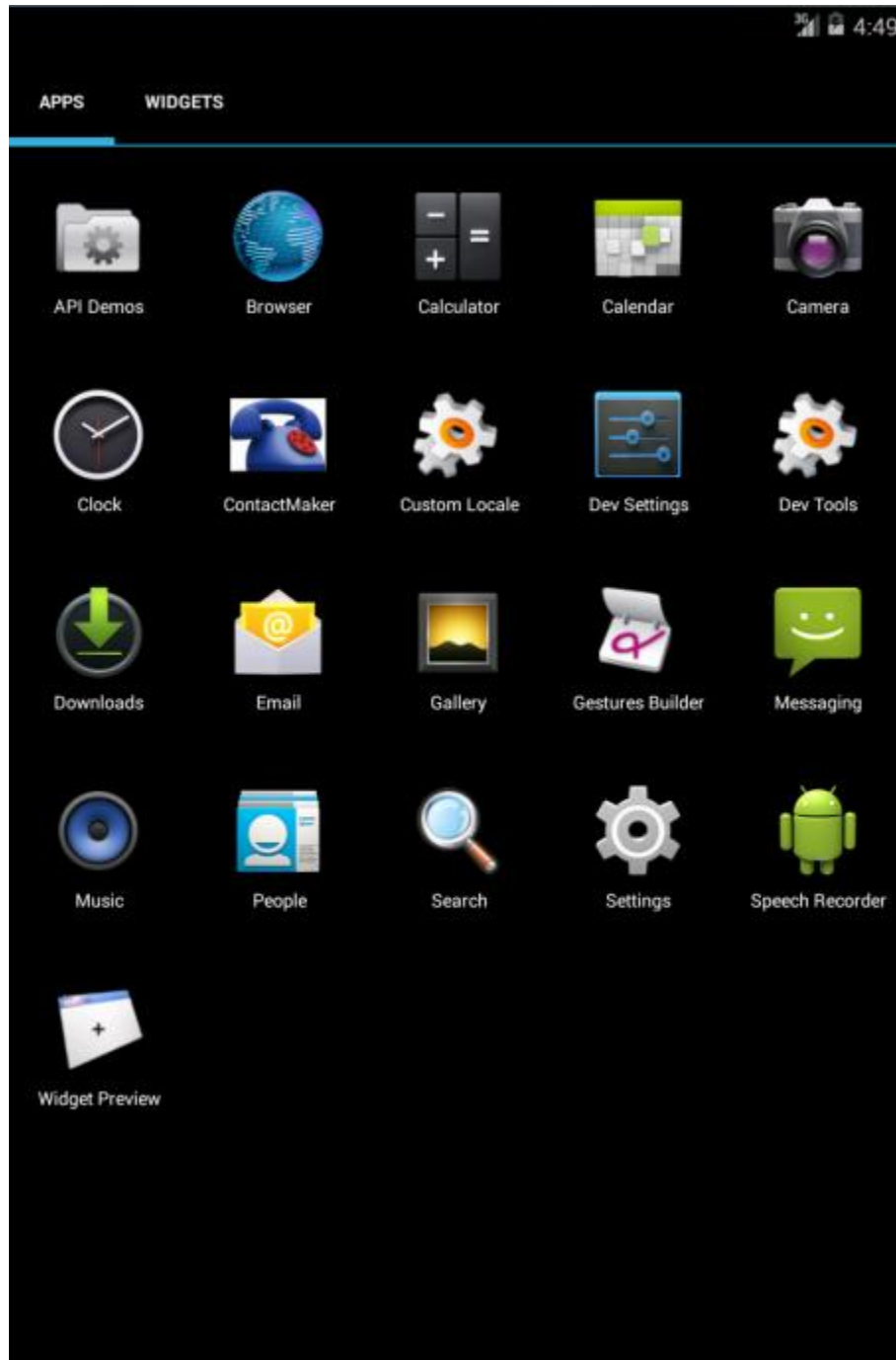
Figure 5.1 Home screen of android device

After selecting the application, the user is directed to the following page (Figure 10), that offers the possibility for sign up ad login. The text size chosen is 20 dp as was required by user from the questionnaire results. The colors of 2 buttons are different, in this way the user understands that two buttons represents two different functions.
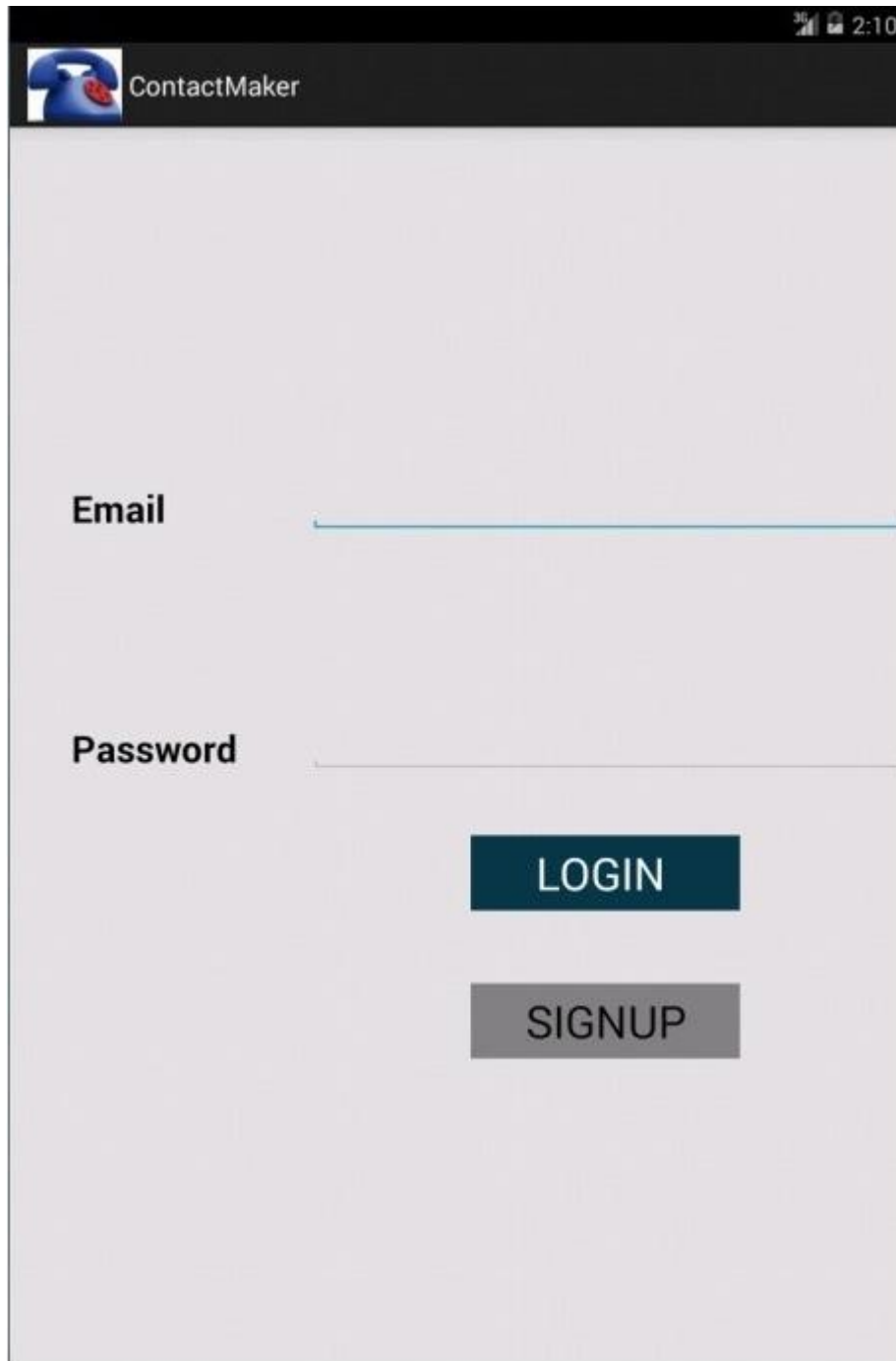
Figure 5.2 Login page of the prototype

By pressing the sign up button, user is directed to the following window (Figure 11). The password field intentionally is made to be seen by the user with aim of avoiding errors such as unintentionally selecting another key, caps lock on etc.

Figure 5.3 Sign up page of the prototype

Once signed up the user goes back to the previous page to make the login (Figure 12)
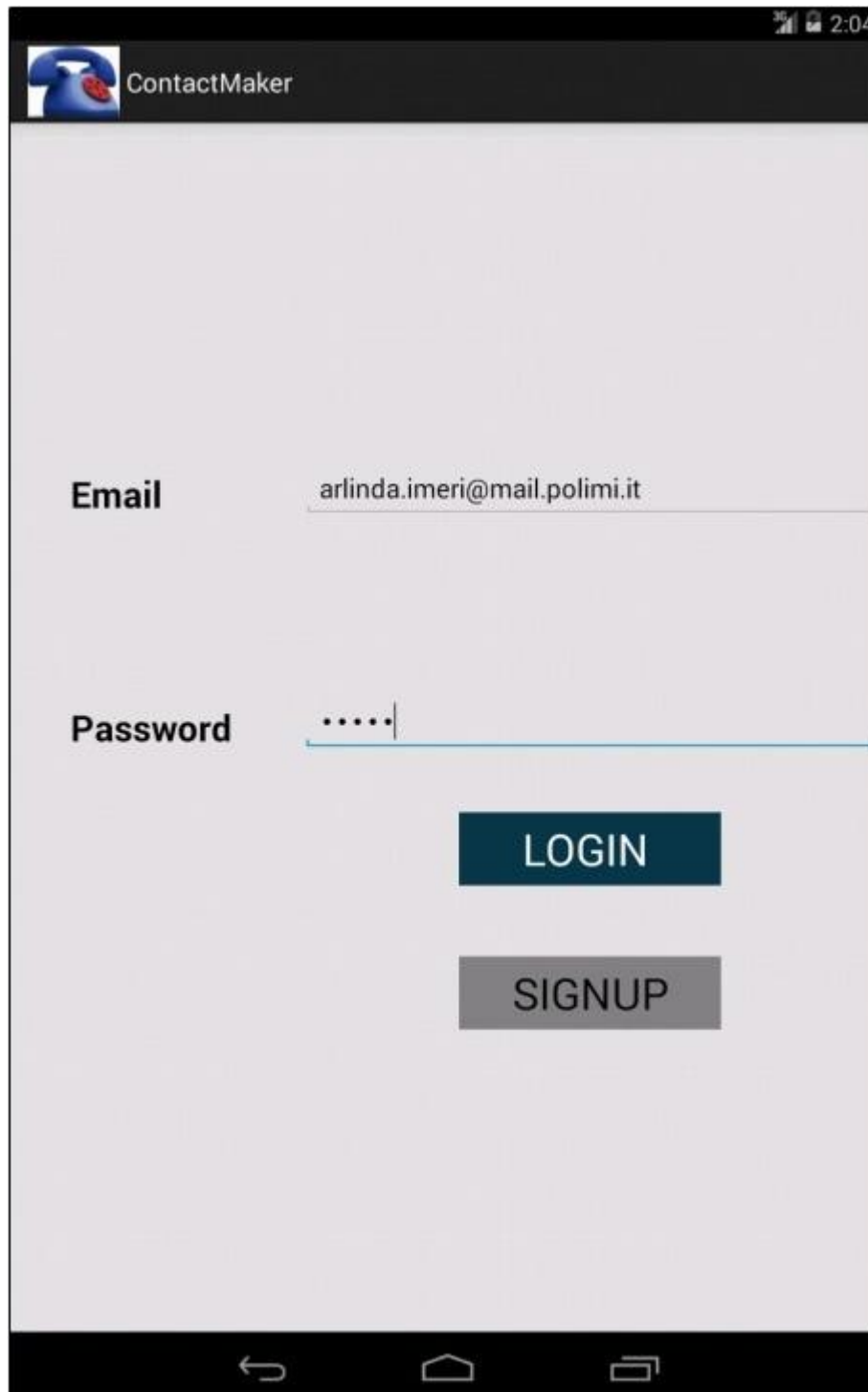
Figure 5.4 Login page of the prototype after sign up

After the validation process of the email and password, if the user has provided correct credentials, the following page it appears (Figure 13).
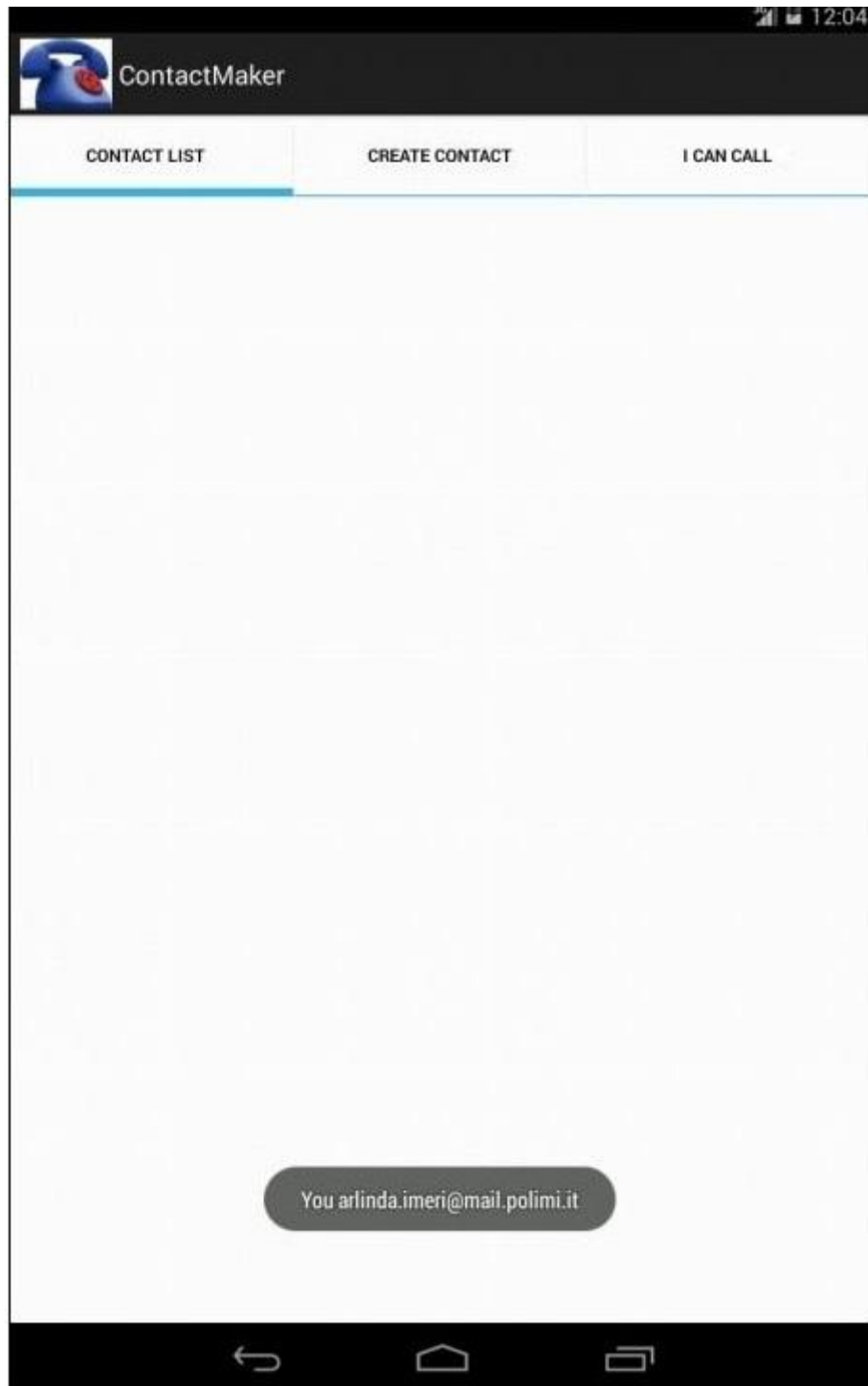
Figure 5.5 Home page of the prototype

It contains three tabs, which cover the three main functionality of this prototype:

- ➢ Contact List,
- ➢ Create Contact,
- ➢ I Can Call.

Contact List tab is the default page. In this page (Figure 15) are listed all the contact the user has added. For each contact are displayed Contact name, phone, email and address. In addition from this page the user can realize the function of Make a Call.

Create Contact tab allows the user to add its contacts (Figure 14). In this page the user is asked to fill the information of the person he wants to have as a contact. After filling all the information a button "Add to contact" need to be pressed, in order the contact to is listed to the Contact List tab. A message "A contact has been added" is displayed in the end, endeavor the user about the action he/she has done.

I Can Call tab allows user to see the list of contacts he has scheduled regarding their availability (Figure 18). Moreover in this page a button "Add contact" is presented, giving a possibility to add a contact to the list "I Can Call". When pressed the button "Add contact" dialog box of contact list of the user is appearing, allowing the user to select the contact that wants to schedule, once selected another dialog box "Select the date" appears, allowing the user to select the date that wants to schedule the contact, is followed by a dialog box "Select Time". After the time is selected and the information are listed in the list "I Can Call"

The decision of having tabs in the top of the windows has been made with aim of making it possible to the user to jump from one functionality to the other, providing easy navigation through interface without getting confused the user.

In the bottom part of the page, an message "You + email of the user "appears, reminding them the account they used for login.

.

In the figure bellow is presented Create Contact tab, allowing the user to add contact to its Contact List.
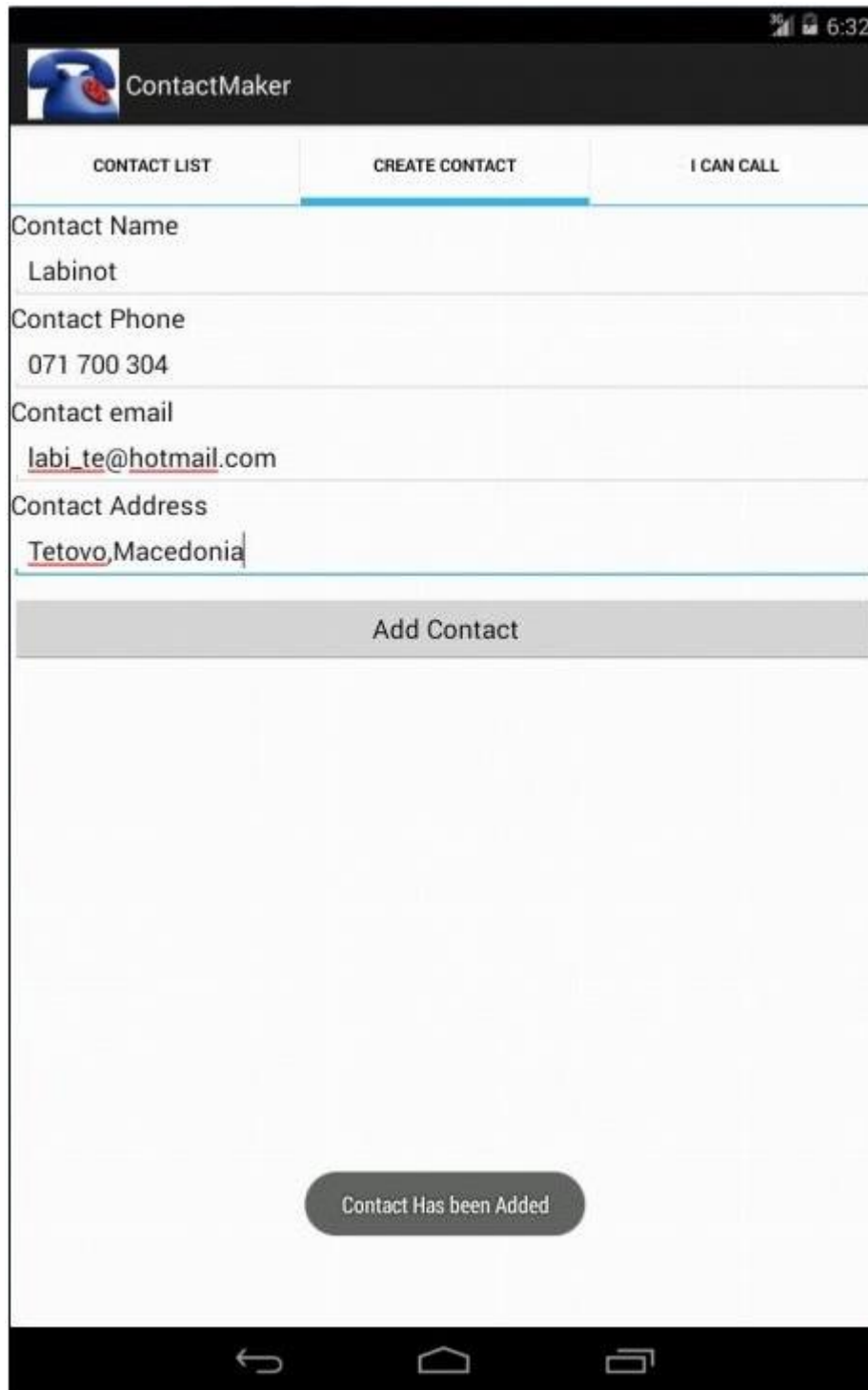
Figure 5.6 Create Contact tab

After a contact has been added from Create Contact tab, the contact appears in the contact list tab (Figure 15).

Figure 5.7 Contact List tab

After adding couple of contacts, the contact list looks like
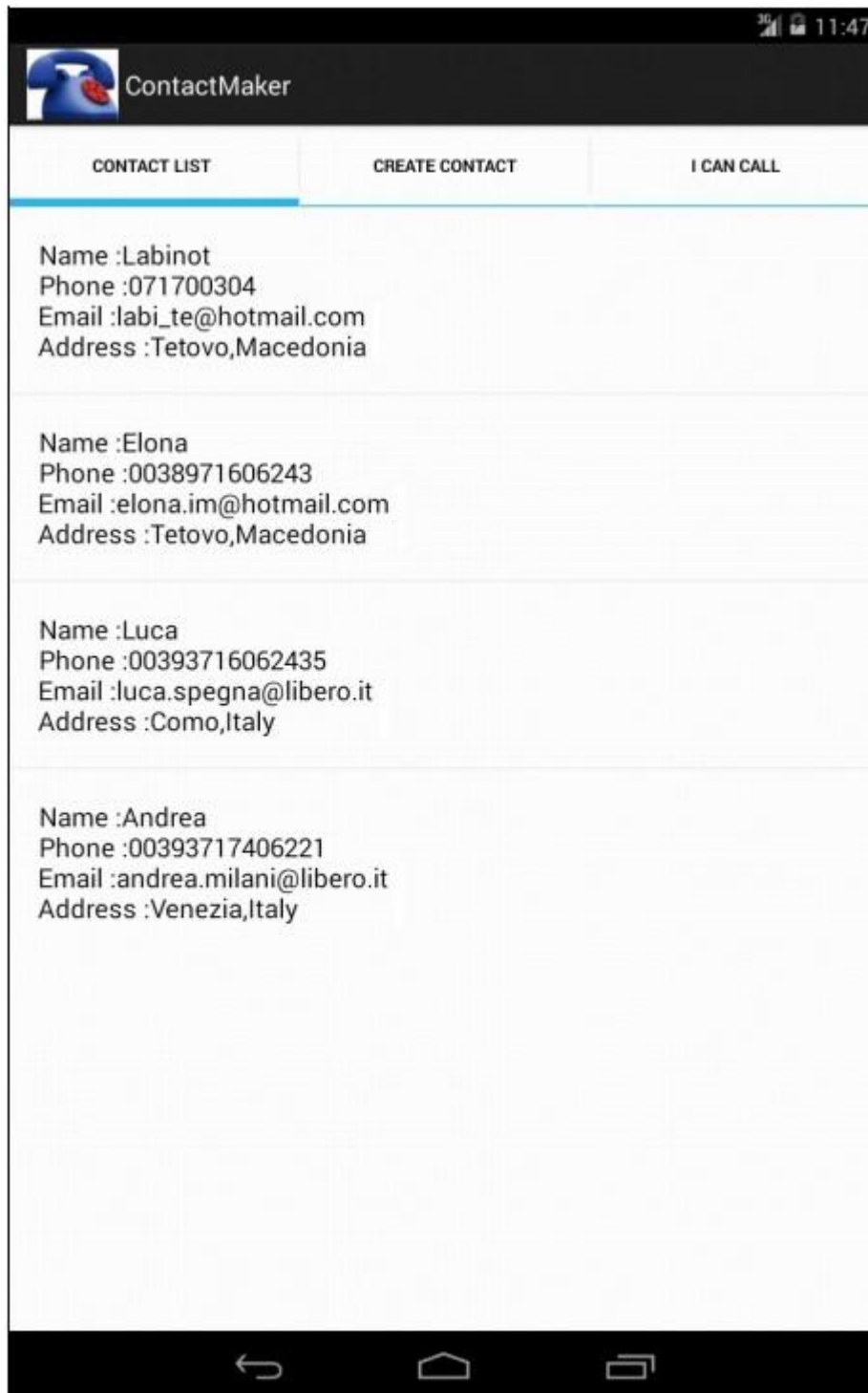
Figure 5.8 Contact List tab after adding couple of contacts

By pressing one of the contacts that appear in the list, the user is directed to the call section, where user can select the call it wants: audio call or video call.
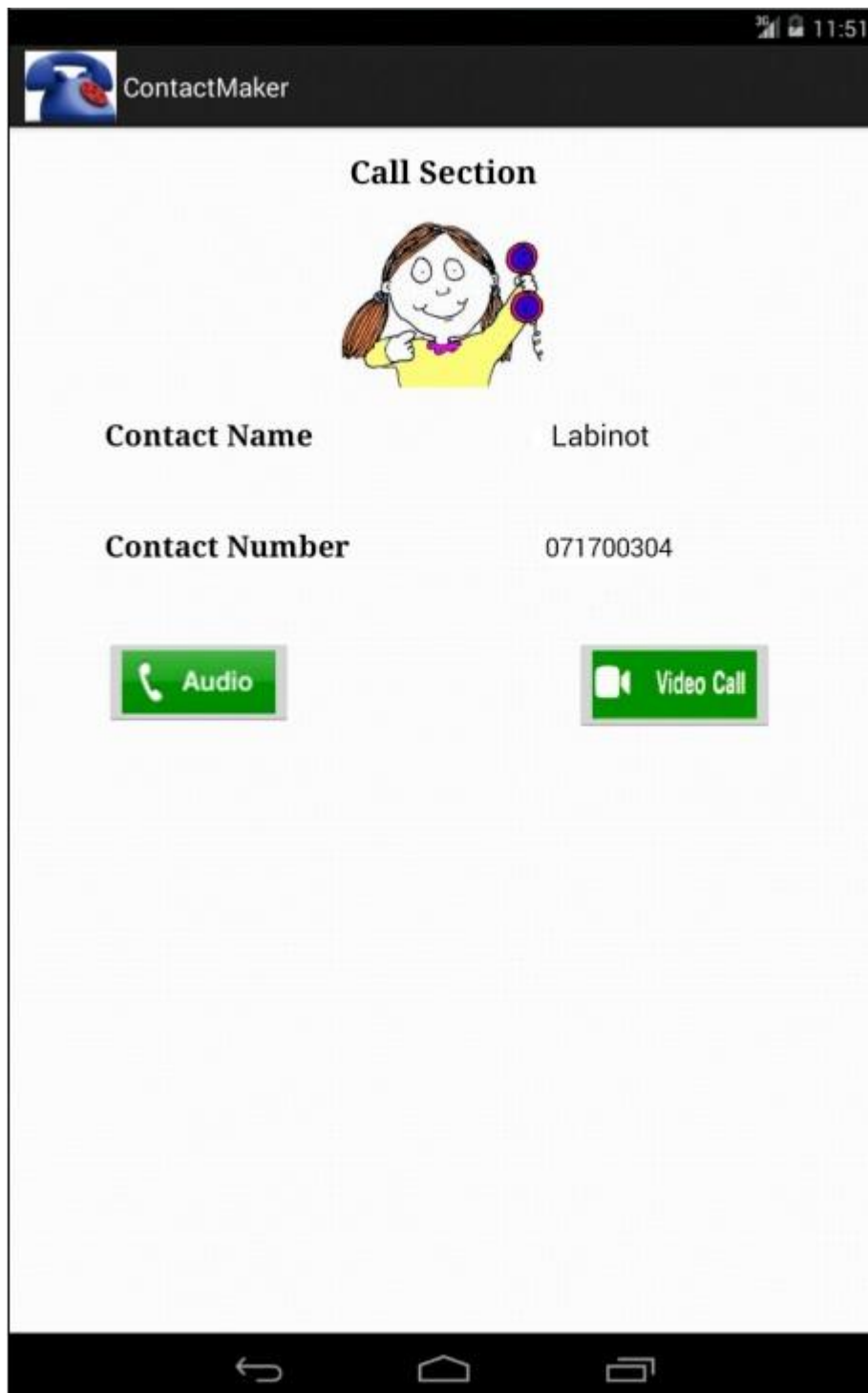
Figure 5.9 Make a call

The other functionality is realized using the tab "I Can Call" (Figure 18). It gives the possibility to schedule a user contact regarding their availability.

Figure 5.10 I can Call tab

By pressing "Schedule" button the user is directed to the following page (Figure 19).
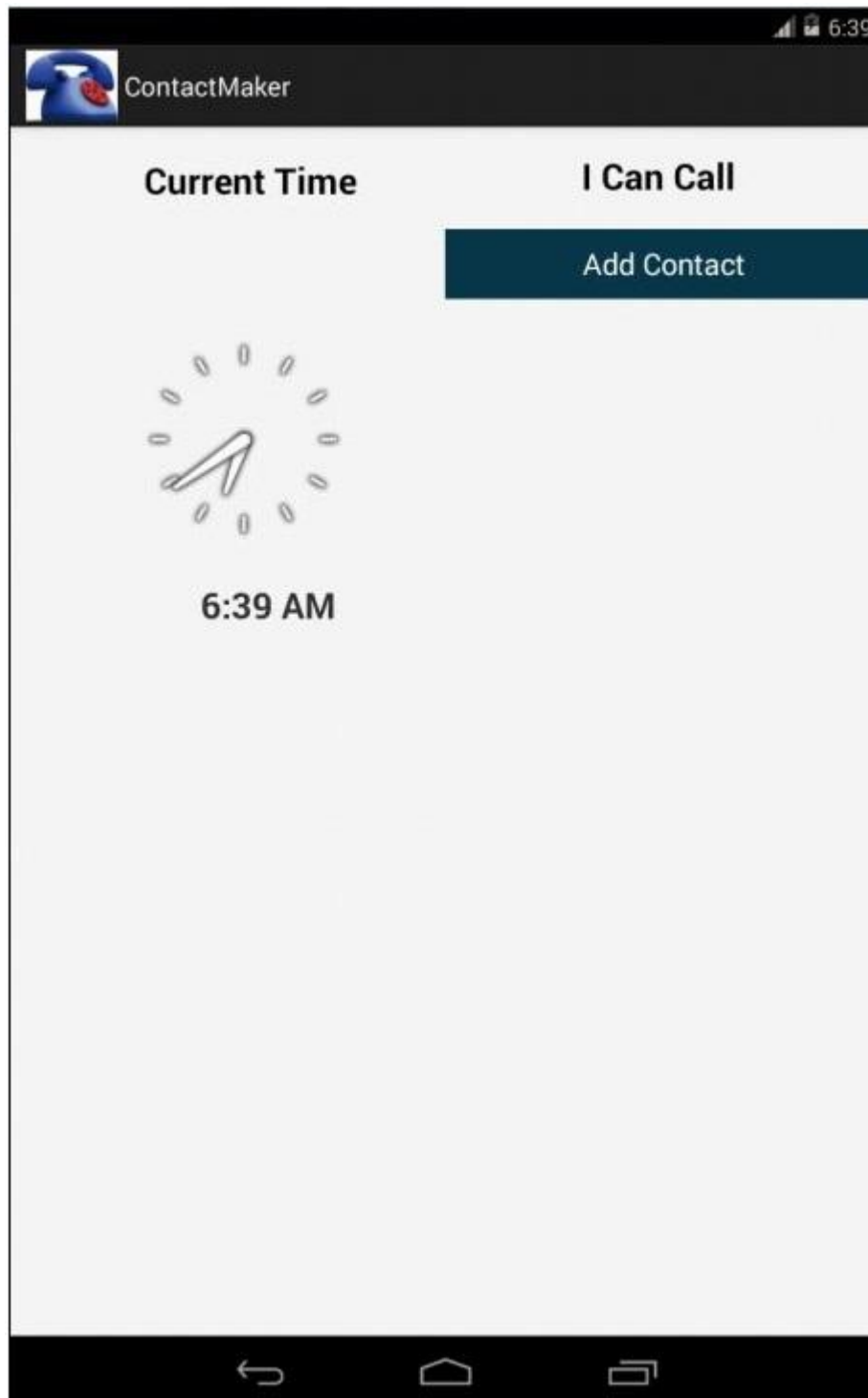
Figure 5.11 Schedule a contact to "I can call" list

Once pressed "Add to schedule" button, a dialog box with the contact list of the user appears. The user need to select the contact he wants to schedule
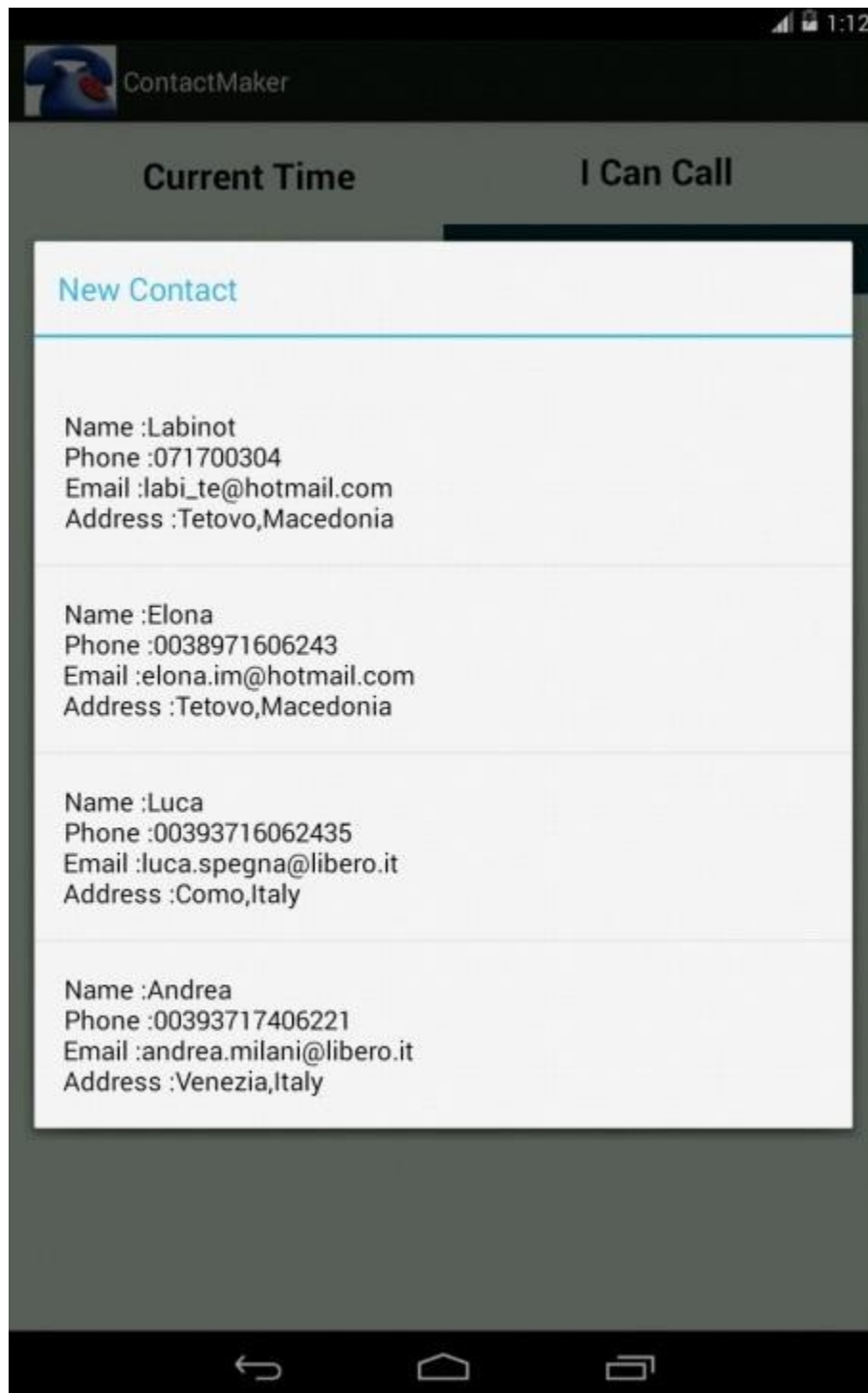
Figure 5.12 Choose a contact to add to your "I can Call" list

After selecting the contact that user wants to schedule, a dialog box of "Select Date" appears. The user is required to select the date he want to schedule.
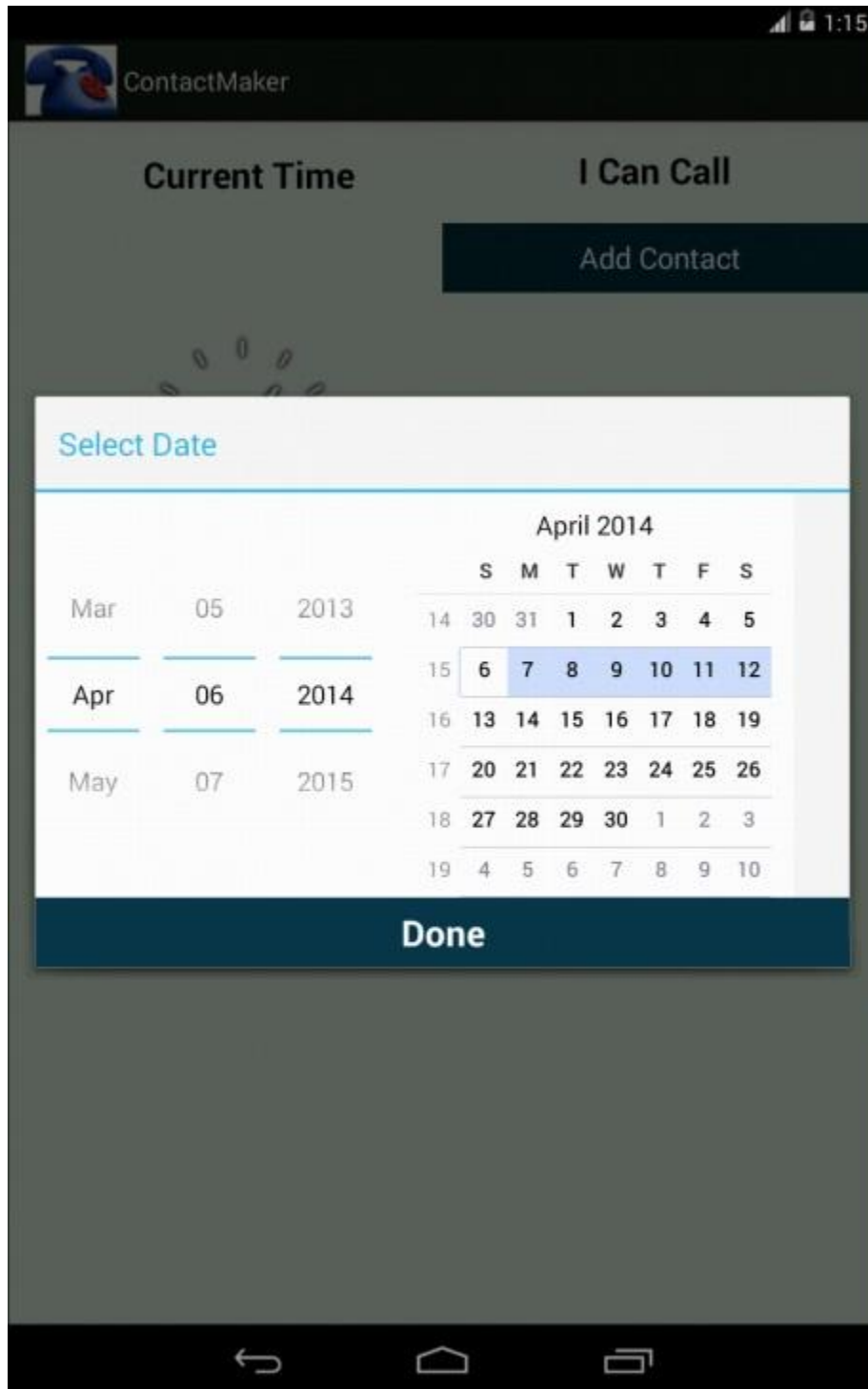
Figure 5.13 Select the date

After selecting the date when the contact is free, a dialog box of "Select Time" appears. The user is required to select the time he want to schedule.
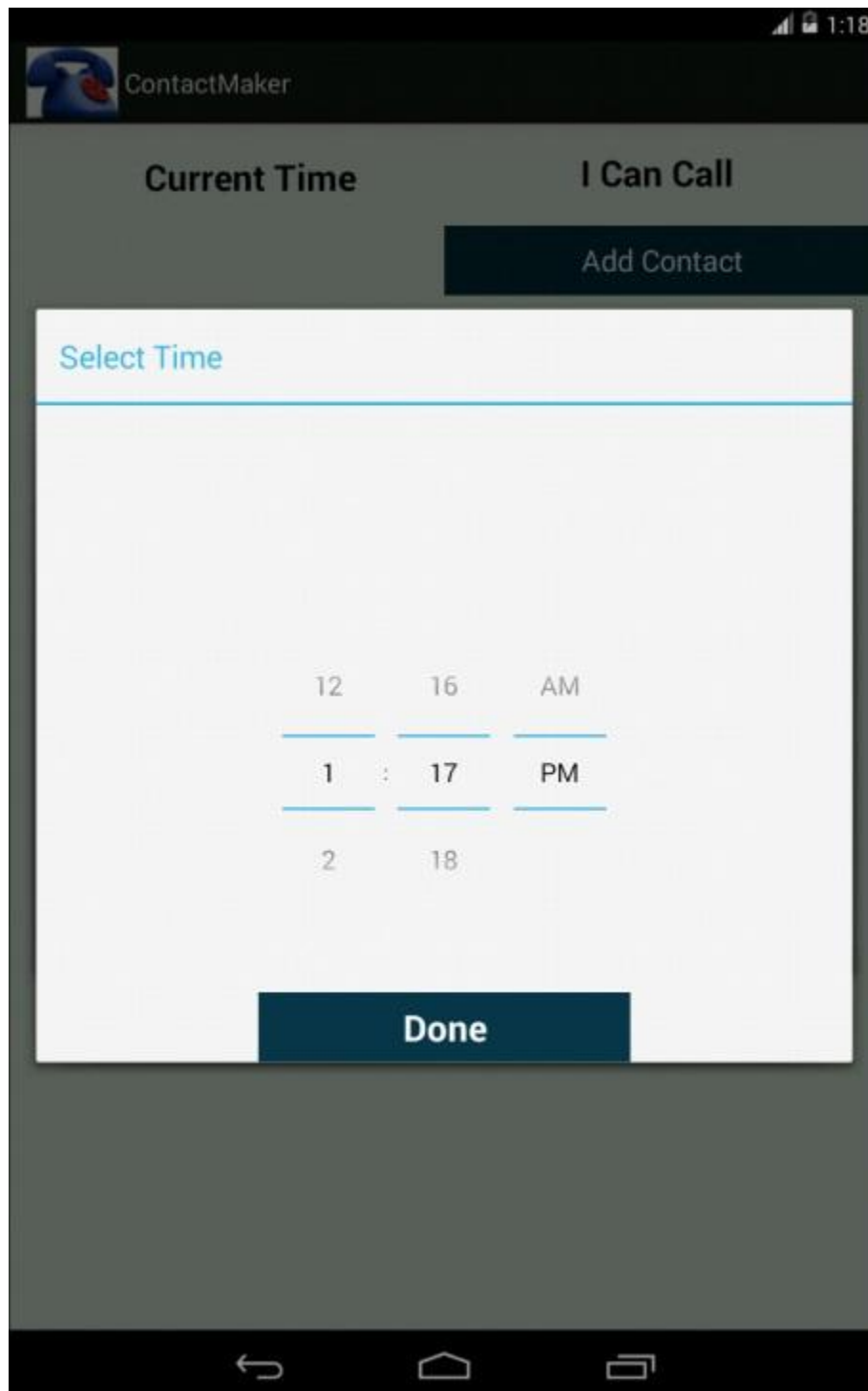
Figure 5.14 Select the time

The selected information contact name, date, time appear in the "I Can Call"list.
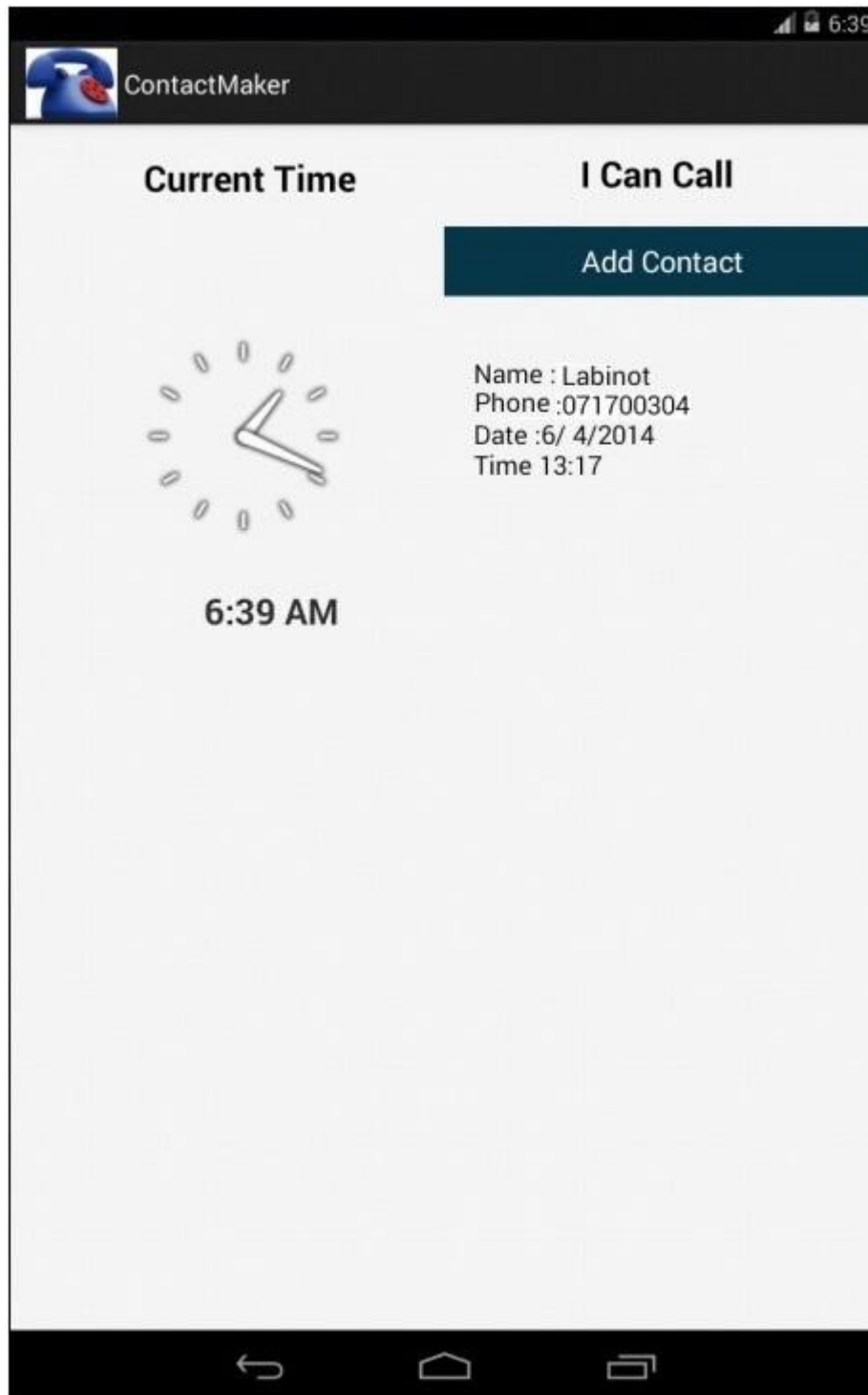
Figure 5.15 Check your "I can call list"

Chapter 6

Evaluation

This chapter is dedicated to the evaluation of the application. After finishing the prototype with the required functionality a usability test for elderly people was performed. Different tasks have been asked to be done. The study took place in a participant home, park and a restaurant considering as more comfortable places for them. Results and tasks of the test are provided in this chapter.

6.1 Use Case Evaluation

After the completion of the prototype application, evaluation testing is performed. The test was performed individually to each user. The home of participant, a park and restaurant were chosen as places to be evaluated, since it is considered as more preferable place for elderly people. The device used for testing was a Tablet "Arnova 10G2." Participants were users with different with different, age, educational level, capabilities, experience in the technology has been considered.

In the beginning, to the users was explained that the intention of this test is not about measuring their capabilities but evaluating the application, which they may consider as an option of assistive tool that they can use in the future. In addition an introduction for the application and its function was provided to each participant in their own language. It started with explaining the aim of application, continued with its function and showing to them how they can perform the specific action.

After the explanation, the user was asked to perform one of the functions that the application provides such as: sign up, login, add contact, make a call, and add to schedule. During the time the user was exploring the application, the user was observed about its action, if they do it correct or not, if they made mistakes or not, how much time they needed to accomplish a task as well if they succeeded to do it.

To evaluate if the test was successful, success criteria, level of difficulty of the task and the maximum time required for a task to be declared as successful.

In the table below are provided the information needed for this evaluation test.

	Task 1	Task 2	Task 3	Task 4	Task 5
Goal	Sign up	Login	Add contact	Make a call	Add to schedule
Departure Page	Tablet Home screen	Tablet Home screen	Tablet Home screen	Tablet Home screen	Tablet Home screen
Arrival Page	Sign up page	Login Page	Add contact page	Call a contact page	Schedule page
Path	Tablet Home page>Application sign up page	Tablet Home page>Application login page	Tablet Home page>Application login page-> Add contact	Tablet Home page>Application login page> Add contact-> Contact List-> Make a call	Tablet Home page>Application login page> Add contact> Schedule page
Level of difficulty	Easy	Easy	Medium	Difficult	Difficult
Maximum Time Required	5 min	3 min	7 min	8 min	10 min
Successes Criteria	The user must find the sign up page, and then sign up to the application	The user must be able to login.	The user must be able to add a contact to its contact list.	The user must be able to make a call	The user must know how to schedule a contact

Table 6.1 Information need for evaluation test

6.1.1 Evaluation for Use Case 1

Be able to sign up

	User 1(motor disability)	User 2 (normal, healthy User)	User 3 (low educational level, but with experience)	User 4 (medium educational level, without experience on application)	User 5 (high educational level and experienced user)
Task execution	The user finds it easy to use the application, and reaches the application	Without problems, easy	Does not encounter difficulties for performing the task.	Completed in time but needed more explanation.	No problems at all
Outcomes	Positive	Positive	Positive	Positive	Positive
Level of success	Medium	High	High	Medium	High
Time spent	4 min	3 min	3 min	4 min	1 min
Comments or Suggestion	Easy to carry device, touch screen better than the mouse	Understandable	Easy to use	Impressed by the technology	
Errors done	-------	-------	-------	1 error	-------

Table 6.2 Evaluation test for Use Case 1

6.1.2 Evaluation for Use Case 2

Be able to login

	User 1(motor disability)	User 2 (normal, healthy User)	User 3 (low educational level, but with experience)	User 4 (medium educational level, without experience on application)	User 5 (high educational level and experienced user)
Task execution	Without any problem	Without any problem	Without any problem	Without any problem	Without any problem
Outcomes	Positive	Positive	Positive	Positive	Positive
Level of success	High	High	High	High	High
Time spent	2 min	1 min	1 min	2 min	1 min
Comments or Suggestion	Not complicated application	-------	I appreciate that as login credentials is required email, so that I do not have to remember the user names for this application	I did it.	Nice
Errors done	-------	-------	-------	-------	-------

Table 6.3 Evaluation test for Use Case 2

6.1.3 Evaluation for Use Case 3

Be able to add contact

	User 1(motor disability)	User 2 (normal, healthy User)	User 3 (low educational level, but with experience)	User 4 (medium educational level, without experience on application)	User 5 (high educational level and experienced user)
Task execution	Task completed	Task completed without any problem	Without any problem	Task completed	Without any problem
Outcomes	Positive	Positive	Positive	Positive	Positive
Level of success	Medium	High	High	Medium	High
Time spent	6 min	4 min	3 min	5 min	2 min
Comments or Suggestion	Not complicated application, but I need to look to some notes, such as email of the other user to add it.	I appreciate that it reminds me to write correct email, not to make a mistake in it.	Is not asking too much information, and once saved, I will have there all the time	I like the fact that when I add second contact I can see the previous contact I added not to add again the same. We are old and sometimes we forget what we did.	A simplified application, with not so many information required.
Errors done	-------	1 error writing the correct address of a contact	-------	-------	-------

Table 6.4 Evaluation test for Use Case 3

6.1.4 Evaluation for Use Case 4

Make a call

	User 1(motor disability)	User 2 (normal, healthy User)	User 3 (low educational level, but with experience)	User 4 (medium educational level, without experience on application)	User 5 (high educational level and experienced user)
Task execution	Task completed	Task completed without any problem	Without any problem	Task completed	Without any problem
Outcomes	Positive	Positive	Positive	Positive	Positive
Level of success	High	High	High	High	High
Time spent	7 min	4 min	4 min	5 min	3 min
Comments or Suggestion	I just have to click on the contact, and then I can make the type of the call I want. Is simple to understand.	So easy to make a call. I do not have to spent money anymore to speak with my son in Germany.	In other application sometimes I get confused how to make a call, so many buttons are present, and sometimes I have difficulties reading the text is written. Here I can read without any problem	Is interesting that I just touch in the screen and something happens	I can read the text list without problem, and it gives me opportunity to make meetings online easy.
Errors done	1 error	-------	-------	-------	-------

Table 6.5 Evaluation test for Use Case 4

6.1.5 Evaluation for Use Case 5

Add to schedule

	User 1(motor disability)	User 2 (normal, healthy User)	User 3 (low educational level, but with experience)	User 4 (medium educational level, without experience on application)	User 5 (high educational level and experienced user)
Task execution	Task completed	Task completed	Without any problem	Task completed	Task completed
Outcomes	Positive	Positive	Positive	Positive	Positive
Level of success	High	High	High	High	High
Time spent	8 min	6 min	5 min	8 min	5 min
Comments or Suggestion	I like the fact that in the same page I see the scheduled contacts when they are free, and the contact list. In this way I do not have to go back to my contact list.	It is perfect that I can schedule a contact when it is free, in that way I do not forget to call them.	It is a good organized application. It helps remind things.	I like the scheduling part mostly. My son is living in Austria, I want to speak with him ,but I always forget in which day and what time is he free to talk	It is easy to manage, and do not require to many steps to remember to do it. Really appreciated.
Errors done	-------	-------	1 error	-------	-------

Table 6.6 Evaluation test for Use Case 5

6.2 Results and Discussion

Due to limited time, a small evaluation test has been realized. A total of 5 elderly people participated and completed the test. Four men and two women with age between 60 to 72.They come from different background some of them had experience with the technology and applications some did not. The evaluation test took place in different places, it was asked from the user the place that they feel more comfortable. Three users decided for their home, one for a park area and the other a restaurant while drinking coffee.

The results overall were quite positive. It was observed that the talk before taking the test, explaining them that this test is not for them, but for the application, to help improve and make easier their life was so important. They got interested in the application and wanted to try it. Some of them said that they do not want training, they want to try it by itself since they have experience with technology, while others were listening carefully the introduction for the application, and showed interest while demonstrating to them the application and what they can do with it.

The participant that had no previous experience in applications and technology in the beginning had difficulties, it seemed a bit difficult to get used to it and was taking much more time than other, while after some minutes and tries he got used to it and wanted to try it constantly. By time and practice, its performance improved.

For the participants that were familiar with applications in general, there was not any difficulty of use, they appreciated the use of common icons for representing an action such as make a call. Also, they specified as an advantage the simple user interface. Another attribute they liked was the use of email instead of a username, since in this way they do not have to remember information more. The fact that is not needed to do too many steps to accomplish a task was valued. In addition, saving the information of previous user added to the contact list was useful for the participant, since it reminded them not to add anymore the same contact.

In the end they said that they prefer to use tablet more than a computer.

After the testing the user were asked to give their impression for the application, what they liked the most as well as their suggestions.

Some of comments were:

"The application is easy to navigate, I do not have to look or use the back button to find the button which will send me to another part of application, I have it in the upper part of the page I'm currently."

"Mostly I liked the scheduler part, I'm old person I do not remember all the things. And sometime I forgot that my son told to me we can talk at x time, and if I use this application, I can write there immediately while I'm speaking with him, at what date and time we can communicate again."

"The application is simple. The text size is for appreciated. I tried to use the application but I have problem with reading what is said. I suggest to continue working, it will be great if the video is working also."

"I'm surprised that with this "thing" I can call my son and speak with him. I thought that these computers are just for playing games, for losing time and did not want to use it before. Also I thought they are difficult to be understood especially in my age."

6.3 Guidelines

Many researches declare that adding too many functions into application is not an attribute that increases the usability of the applications, regardless if they are young or older users. By adding more functions the application it becomes more complex, and this is not preferable if we are talking about elderly users, taking into consideration the cognitive impairments a user may have. To get the adequate design of user interface need to be taken into consideration the differences between young and old people. In addition also the environment of the elderly people is different from country to country, they may differ in perception, behavior, self-confidence and traditions. Hence "Keep it as simple as possible" is the most powerful guideline when it is up to design.

Bellow are presented some guidelines suggested when designed for elderly.

1. Home screen should be designed carefully to represent main functions but not to look overloaded and complicated to be understood, able to be understood by short term memory

2. Use navigation bar

3. The functions that are not used often it is better to be removed

4. Use the Miller Rule, by reducing steps per functions to 7 +/- 2 items

5. After an action done, inform the user about it, by displaying a message, vibration, sound etc. In that way user knows that he did something.

6. One button should perform one action

7. If they are two buttons in the same page but with two different functionalities, make a distinction on them by using different color or graphic.

8. Make clear the separation between functions in the application; it avoids complex thinking on the elderly.

9. Do not make use of too many colors, elderly users face vision impairments

10. Use of appropriate size interface components: text, size of button, spacing size between

Chapter 7

Conclusion and Future Work

This work concerned the design and implementation of a prototype of a touch-based communication application for social support of the elderly focusing on user interface aspects. The first two chapters served as introductory chapters defining the context of the work. Concepts of the target group, age related impairments and the technology for the elderly were introduced in the first chapter. Chapter 2 was dedicated to an introduction of User Interfaces and Elderly by indicating existing frameworks, continues with Touch screen for the elderly and finishes by defining requirements/guidelines for touch user interface design. Chapter 3 introduced the preliminary work done with aim of understanding the requirements for the new application, it included five use case scenarios: Sign up, Login, Add a contact, Make a call, Add to schedule. In addition was presented task analysis for all five use cases. Chapter 4 is dedicated to the questionnaires and interviews with elderly people, results of the questionnaires and observations are presented. Chapter 5 stepped into the design and implementation part of the prototype. It started by explaining the language used for implementing the prototype, followed by description of the device used. Print screen of the user interface windows are listed. Chapter 6 was dedicated to the evaluation and testing of the prototype. Tables 1, 2, 3, 4 and 5 summarize the results, comments and suggestions for the application. Our results show that the prototype that was developed, is flexible, simple and understandable enough to some of limitations elderly people face.

As future work is planned development of other functionalities, such as implementation of video call. Elderly users will be able to use a communication application that satisfies their needs, without having difficulties in reading the text, remembering too many steps to do. In a fast way they can call their families as well add to schedule contacts that they have a need of. Another feature of the application as a future work is having a history of how many times a person is called, how many minutes the person has talked with another one in a specific period, in this way we will be able to measure quantitatively analyze the social communication of the elder person as well as the pattern of communicating with others.

References

[1] World Health Organization, World Bank , "World Report on Disability 2011"
ISBN 978 92 4 068521 5 (PDF)

[2] Kurniawan, S.: Age Related Differences in the Interface Design Process. In: Stephanidis, C. (ed.) The Universal Access Handbook. Taylor & Francis, Abington (in press, 2009)

[3] UN: Department of economic and social a_airs (desa) world population ageing 2009. New York: DESA, United Nations (2009)

[4] Kurniawan, S.: Age Related Differences in the Interface Design Process. In: Stephanidis,

[5]. Njelesani, Janet, et al. "Using a Human Rights-Based Approach to Disability in Disaster Management Initiatives." *Natural Disasters. InTech. http://www. intechopen. com/books/natural-disasters/using-a-human-rights-based-approach-to-disability-in-disaster-management-initiatives* (2012).

[6] Segal, Daniel L. "Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR)." *Corsini Encyclopedia of Psychology* (2010).

[7] Stein, John, and Vincent Walsh. "To see but not to read; the magnocellular theory of dyslexia." *Trends in neurosciences* 20.4 (1997): 147-152.

[8] Iida, Akemi, Nick Campbell, and M. Yasumura. "Emotional speech as an effective interface for people with special needs." *Computer Human Interaction, 1998. Proceedings. 3rd Asia Pacific*. IEEE, 1998.

[9] Stein, John. "The magnocellular theory of developmental dyslexia." *Dyslexia* 7.1 (2001): 12-36.

[10] Abascal, Julio, and Antón Civit. "Universal access to mobile telephony as a way to enhance the autonomy of elderly people." *Proceedings of the 2001 EC/NSF workshop on Universal accessibility of ubiquitous computing: providing for the elderly*. ACM, 2001.

[11] Caprani, Niamh and O'Connor, Noel E. and Gurrin, Cathal (2012) *Touch screens for the older user.* In: Auat Cheein, Fernando, (ed.) Assistive Technologies. InTech, pp. 95-118. ISBN 978-953-51-0348-6

[12] Mamolo, Marija, and Sergei Scherbov. *Population projections for forty-four European countries: The ongoing population ageing*. Vienna Inst. of Demography, 2009.

[13] Newell, Alan F. "Accessible Computing--Past Trends and Future Suggestions: Commentary on "Computers and People with Disabilities"." *ACM Transactions on Accessible Computing (TACCESS)* 1.2 (2008): 9.

[14] Sears, Andrew, et al. "Investigating touchscreen typing: the effect of keyboard size on typing speed." Behaviour & Information Technology 12.1 (1993): 17-22.

[15] Jung, Christoph, and Volker Hahn. "GUIDE–Adaptive user interfaces for accessible hybrid TV applications." *Second W3C Workshop Web & TV*. 2011.

[16] Gaßner, Katrin, and Michael Conrad. "ICT enabled independent living for elderly." A status-quo analysis on products and the research landscape in the field of Ambient Assisted Living (AAL) in EU-27 (October 2010) (2010).

[17] Leuteritz, Jan-Paul, et al. "Development of open platform based adaptive HCI concepts for elderly users." *Universal Access in Human-Computer Interaction. Intelligent and Ubiquitous Interaction Environments*. Springer Berlin Heidelberg, 2009. 684-693.

[18] Stephanidis, Constantine, et al. "Adaptable and adaptive user interfaces for disabled users in the AVANTI project." *Intelligence in Services and Networks: Technology for Ubiquitous Telecom Services*. Springer Berlin Heidelberg, 1998. 153-166.

[19] Yarnold PR, Stewart MJ, Stille FC, Martin GJ (1996). "Assessing functional status of elderly adults via microcomputer". *Percept.Mot.Skills* **82** (2): 689–690. PMID 8724947

[20] Charness, N., Bosman, E. A., & Elliott, R. G. (1995). Senior-friendly input devices: Is the pen mightier than the mouse? Paper presented at the 103rd Annual Convention of the American Psychological Association Meeting, August 1995, New York

[21] Lee, S. K., William Buxton, and K. C. Smith. "A multi-touch three dimensional touch-sensitive tablet." *ACM SIGCHI Bulletin*. Vol. 16. No. 4. ACM, 1985.

[22] Stößel, Christian, and Lucienne Blessing. "Mobile device interaction gestures for older users." *Proceedings of the 6th Nordic Conference on Human-Computer Interaction: Extending Boundaries*. ACM, 2010.

[23] Sesto, Mary E., et al. "Effect of touch screen button size and spacing on touch characteristics of users with and without disabilities." *Human Factors: The Journal of the Human Factors and Ergonomics Society* 54.3 (2012): 425-436.

[24] Jin, Zhao Xia, Tom Plocher, and Liana Kiff. "Touch screen user interfaces for older adults: button size and spacing." *Universal Acess in Human Computer Interaction. Coping with Diversity*. Springer Berlin Heidelberg, 2007. 933-941.

[25] Vigouroux N., Rumeau P., Vella F., Vellas B.Studying Point-Select-Drag Interaction Techniques for Older People with Cognitive Impairment. C.Stephanidis (Ed.): *Universal Access in HCI,* Part I, HCII 2009, LNCS 5614 (2009), 422–428.

[26] Motti, Lilian Genaro, Nadine Vigouroux, and Philippe Gorce. "Interaction techniques for older adults using touchscreen devices: a literature review."*25ème conférence francophone sur l'Interaction Homme-Machine, IHM'13*. 2013.

[27] Kirwan, Barry, and Les K. Ainsworth, eds. *A guide to task analysis: the task analysis working group*. CRC press, 2003.

[28] Eye Diseases Prevalence Research Group. "Causes and prevalence of visual impairment among adults in the United States." *Archives of ophthalmology*122.4 (2004): 477.

[29] Victoria, Melbourne. "Use of hearing aids by older people: influence of non-auditory factors (vision, manual dexterity)." *International Journal of Audiology* 42 (2003): 2S21-2S25.

[30] Kluger, Alan, et al. "Patterns of Motor Impairment in Normal Aging, Mild Cognitive Decline, and Early Alzheimer'Disease." *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 52.1 (1997): P28-P39.

[31] Trauth, Eileen Moore, ed. *Encyclopedia of gender and information technology*. IGI Global, 2006.